

ABSTRACT BOOK

APSA ANNUAL MEETING MAY 7-10, 2025

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APSA2025
ANNUAL MEETING



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MAY 7 - 10, 2025 • MONTRÉAL, CANADA

Wednesday, May 7, 2025

Plenary 1 - Basic Science/Translational

8:30 AM – 10:00 AM

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MESENCHYMAL STEM CELL THERAPY MODULATES INTESTINAL INJURY SEEN IN NECROTIZING ENTEROCOLITIS: A PREMATURE PIGLET STUDY

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Abstract: Necrotizing enterocolitis is a devastating gastrointestinal disease commonly affecting premature infants. It is characterized by intestinal inflammation and necrosis, leading to significant morbidity and mortality. Current treatment options are limited, highlighting the need for innovative therapeutic strategies. Mesenchymal stem cell therapy has emerged as a promising approach due to its potential to modulate inflammation and promote tissue repair. In this study, we utilized a premature piglet model to investigate the efficacy of stem cell therapy in mitigating the intestinal injury associated with NEC. We hypothesize that the administration of stem cells will significantly reduce intestinal injury in a porcine model of NEC.

Premature piglets were delivered via cesarean section at 103/115 days gestation. Control piglets were sacrificed on post-natal day 1. NEC was induced in the remaining piglets with TPN starting on day 1 and hypertonic oral feeding via orogastric tube on day 3. MSCs were prepared at three doses (LD=500,000 cells/kg, MD=1,000,000 cells/kg, HD=10,000,000 cells/kg) in 1.2mL of PBS and injected intraperitoneally on day 3. Untreated piglets (NEC group) were injected with PBS alone. Piglets (n=6-8 per group) were monitored hourly for clinical deterioration and euthanized early if criteria were met. The study concluded after 5 days. Each piglet received a clinical score prior to euthanasia, and total weight gain or loss was documented. During necropsy, an intestinal injury score was blindly assigned to each piglet based on the gross findings of the bowel. A one-way ANOVA and post-hoc multiple comparisons test was utilized to analyze the scores between the control, NEC, and MSC-treated piglet groups, $p < 0.05$ was considered significant.

Macroscopic injury scores in the MD group were significantly reduced from the NEC group ($p=0.009$). All the MSC groups showed significant reduction in clinical score from the NEC group (LD: $p=0.049$, MD: $p=0.035$, and HD: $p=0.047$).

This study is the first to demonstrate the therapeutic benefit of stem cells in a premature piglet model of necrotizing enterocolitis. Additionally, we have demonstrated the clinical presentation and

gross intestinal injury associated with different doses of stem cells, aiming to identify the optimal dosage for therapeutic effectiveness.

Abbreviations: NEC= Necrotizing enterocolitis

MSC= mesenchymal stem cells

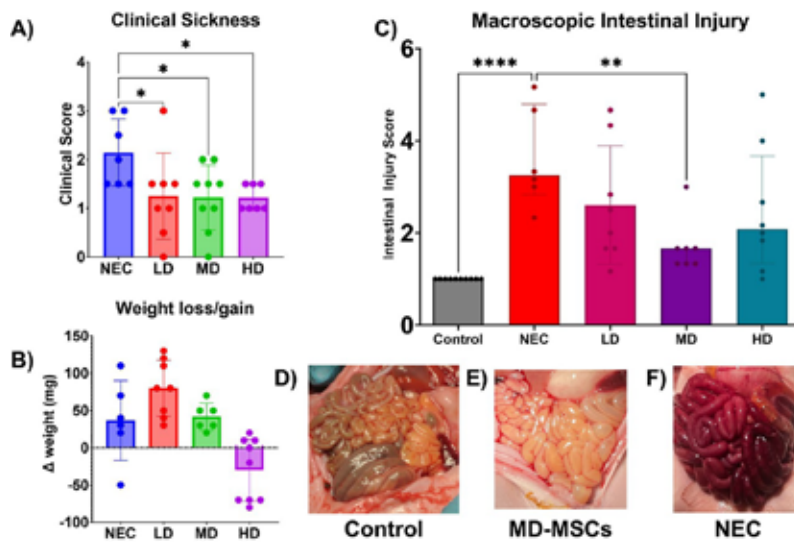
TPN= total parenteral nutrition

LD= Low dose

MD= medium dose

HD= high dose

PBS= Phosphate buffered saline



A) Clinical scores on day 5. Score ranges from 0-4 per pig; 0-2 pts are given for abdominal distension, 0-1 points are given for diarrhea, 0-1 points are given for hematochezia. **B)** Change in weight from birth to euthanasia for each pig. **C)** Scores for proximal intestine, terminal ileum, and colon were averaged for each pig. Score ranges from 1-6. **D)** Gross image of control pigs at euthanasia on day 1. **E)** Gross image of MD-MSC pigs on day 5. **F)** Gross image of NEC pigs on day 5.

CAN INTESTINAL FATTY ACID BINDING PROTEIN (I-FABP) DISTINGUISH BETWEEN NECROTIZING ENTEROCOLITIS (NEC) AND OTHER ABDOMINAL CONDITIONS IN PRE-TERM INFANTS?

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Abstract: Purpose: We have previously shown that intestinal fatty acid binding protein (I-FABP) is elevated in necrotizing enterocolitis (NEC). We hypothesized that plasma I-FABP is a specific biomarker for NEC that can differentiate NEC from other common abdominal complaints in preterm neonates.

Methods:

With IRB approval, preterm neonates born at < 34 weeks gestation who were admitted to the NICU were enrolled for prospective blood collection. Residual plasma samples were scavenged from blood obtained for routine clinical tests and stored. No additional blood was obtained for this study. Medical records were reviewed retrospectively to identify patients diagnosed with NEC and other abdominal pathologies including sepsis, feeding intolerance (FI), and spontaneous intestinal perforation (SIP). For the patients who developed NEC or had other abdominal complaints, residual samples retrieved within 1 week prior to and one week after diagnosis were utilized for I-FABP quantification by ELISA. Healthy patients matched according to corrected gestational age were selected as controls. Data were analyzed by ANOVA with mixed effects analysis.

Results:

Between July 2022 to May 2023, 69 patients were enrolled, and their residual blood samples prospectively collected. Of these, 7 patients were diagnosed with NEC, 9 were diagnosed with other abdominal pathologies as detailed above, and 8 were selected as age-matched, healthy controls.

Overall, I-FABP values were low in healthy controls (mean = 0.3 ng/ml, SEM = 0.04) and those with other pathologies (mean = 0.4 ng/ml, SEM = 0.06) compared to those who developed NEC (mean = 8.5 ng/ml, SEM = 2.4). I-FABP was significantly higher in the NEC cohort prior to, at diagnosis, and after diagnosis ($p < 0.0001$) (Figure 1). ROC curve analysis identified an I-FABP cutoff of 5.1 ng/ml as predictive of NEC compared to other pathologies with sensitivity and specificity of 100% (AUC 1.0, $p=0.001$).

Conclusion:

In patients who develop NEC, I-FABP is significantly elevated prior to, at, and after diagnosis as compared to those with other abdominal pathologies and healthy controls. The results of this prospective study endorse the utility of plasma I-FABP as both a sensitive and specific biomarker for distinguishing NEC from other diagnoses with similar presentations at symptom onset.

Abbreviations: I-FABP: intestinal fatty acid binding protein

NEC: necrotizing enterocolitis

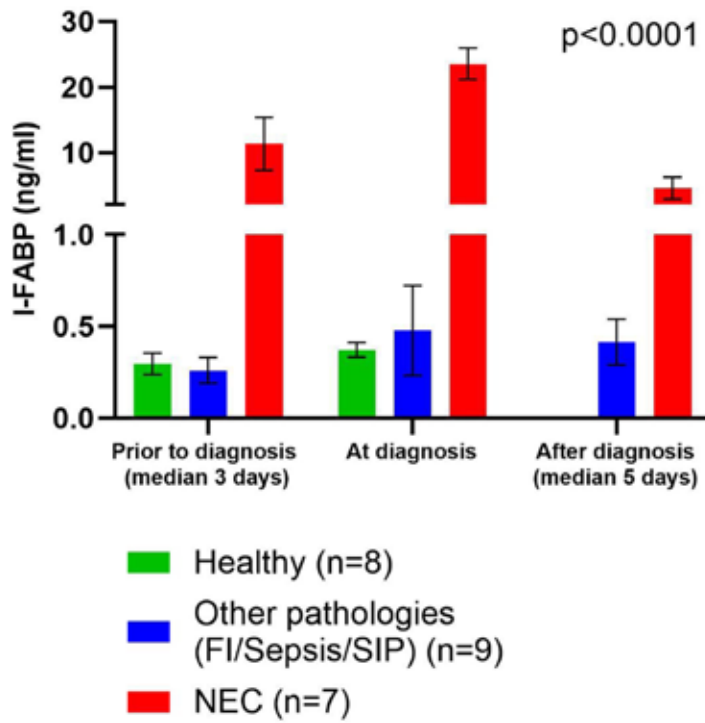
FI: feeding intolerance

SIP: spontaneous intestinal perforation

ELISA: enzyme linked immunosorbent assay

SEM: standard error of the mean

Fig. 1) Plasma I-FABP relative to time of diagnosis



CIRCULATING MATERNAL PLASMA MICRO-RNAS AS BIOMARKERS FOR DIAGNOSIS AND RISK-STRATIFICATION IN PRENATALLY DIAGNOSED CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose

Congenital diaphragmatic hernia (CDH) is characterized by a wide range of postnatal severity. Although imaging studies are used for CDH risk stratification and prenatal therapy, these modalities remain limited in their prenatal prediction. miRNA has been previously shown to be differentially expressed in amniotic fluid and plasma of fetuses and infants with severe CDH. Whether differentially expressed miRNA can be detected prenatally through noninvasive methods such as maternal blood sampling is unknown. In this study, we hypothesized that patients carrying fetuses with CDH will display a unique miRNA profile detectable within maternal plasma in comparison to healthy pregnancies.

Methods

Patients carrying fetuses with CDH (n = 25) and healthy singleton pregnancies (n = 12) were consented for peripheral blood collection after IRB approval at an urban fetal center. miRNA was sequenced at the institutional sequencing core via miRNA-seq. Low quality reads and duplicate miRNAs from different genomic locations were excluded. Subgroup analysis was also completed based on neonatal outcomes. miRNA expression between groups was compared with student's t-test (p-value < 0.05).

Results

Of the 770 miRNAs examined, 26 were significantly differentially expressed when comparing patients carrying fetuses with CDH when compared to controls. Several of the miRNA have previously been reported in CDH tracheal aspirates or amniotic fluid: miR-210-3p (p-value = 0.002398) and miR-889-3p (p-value = 0.04004). When comparing patients carrying fetuses with CDH whom either died or required ECMO in the neonatal period (n = 5) versus those who had ECMO-free survival (n = 20), there were 32 differentially expressed miRNAs including let-7c-5p (p-value = 0.03299), a miRNA previously shown to be significant in CDH non-survivors, and miR-30d-3p (p-value = 0.02944), a miRNA associated with pulmonary hypertension.

Conclusion

These results are the first to find that maternal plasma miRNA can differentiate pregnancies with CDH from those carrying healthy fetuses. Furthermore, our findings indicate that maternal plasma miRNA can potentially predict severity of disease (Death or ECMO) prenatally. This suggests that maternal plasma miRNA during pregnancy may be used to diagnose, and risk stratify CDH fetuses.

Abbreviations: CDH = Congenital Diaphragmatic Hernia

miRNA = micro-RNA

IRB = Institutional Review Board

ECMO = Extracorporeal Membrane Oxygenation

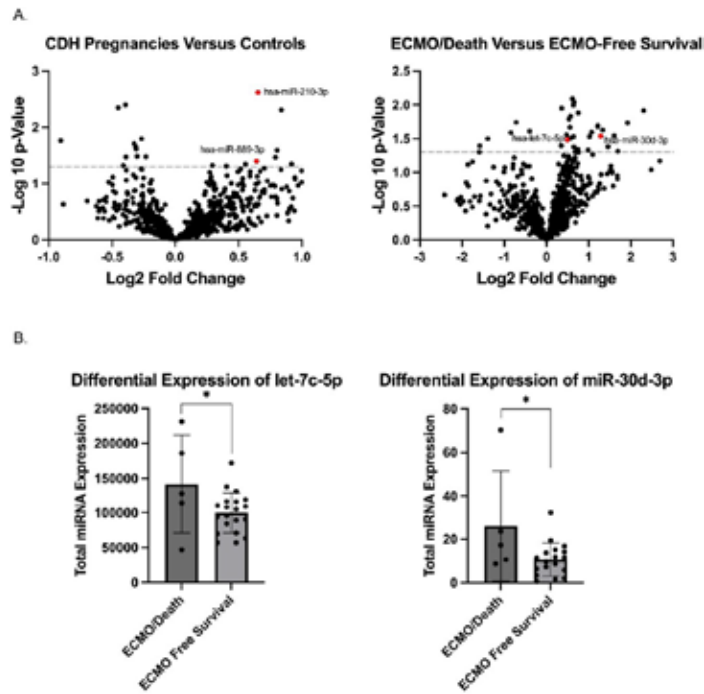


Figure 1. Differential miRNA Expression in maternal plasma of pregnant patients carrying a CDH fetus. A. Volcano plots illustrate differential miRNA expression between CDH-pregnancies and controls as well as between infants who required ECMO or died and infants with ECMO-free survival. B. Differential expression of relevant miRNAs between fetuses with favorable or unfavorable outcomes.

SECOND TRIMESTER MATERNAL SERUM MICRORNAS AS BIOMARKERS FOR CONGENITAL DIAPHRAGMATIC HERNIA SEVERITY

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Abstract: Purpose: Congenital diaphragmatic hernia (CDH) is frequently identified during the routine 20-week prenatal ultrasound. Current in utero imaging relies on lung volume measurements to predict disease severity. While fetoscopic endotracheal occlusion (FETO) has been proposed as an adjunct to standard therapy, its benefits appear limited to severe cases of CDH. Despite the established role of fetal imaging in this population, it often falls short in accurately assessing disease severity, highlighting the need for reliable prognostic biomarkers. microRNAs (miRNAs), small non-coding RNAs that circulate freely in serum, regulate key molecular pathways involved in physiological processes. Considering the limitations of fetal imaging, we aimed to identify miRNA signatures in second-trimester maternal serum (2TMS) that distinguish survivors from non-survivors in CDH cases, with potential implications for guiding FETO therapy.

Methods: After IRB approval (21-2481), 2TMS samples from pregnancies complicated by CDH were sequenced for miRNAs. Machine learning Random Forest analyses were employed to identify biomarkers distinguishing survivors from non-survivors.

Results: miRNA sequencing and Random Forest analysis demonstrated miR-376c-3p, miR-18a-3p, and miR-194-3p as the top three miRNAs distinguishing CDH survivors (n=7) from non-survivors (n=4, Figure 1A). Receiver operating characteristic curves exhibited an area under the curve of 1.0, indicating high specificity and sensitivity (Figure 1B). miR-376c-3p was significantly downregulated, while miR-18a-3p, and miR-194-3p were significantly upregulated in survivors compared to non-survivors (Figure 1C).

Conclusion: We identified miR-376c-3p, miR-18a-3p, and miR-194-3p as promising prognostic biomarkers in 2TMS, with significant differential expression between CDH survivors and non-survivors. Future directions include validation across institutions and with qRT-PCR prior to utilization of miRNA biomarkers for clinical decision-making in recommendations of FETO therapy.

Abbreviations: Congenital diaphragmatic hernia (CDH)
microRNAs (miRNAs)
Fetoscopic endotracheal occlusion therapy (FETO)
Second-trimester maternal serum (2TMS)

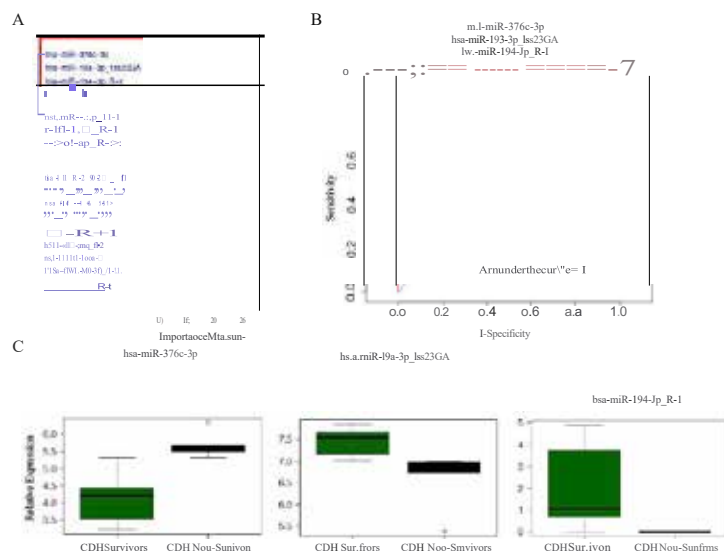


Figure 1. Random Forest analysis of 2T.MS miRNA sequencing. (A) Mean decrease accuracy plot showing the top 20 miRNAs, with the top 3 miRNAs (miR-376c-3p, miR-18a-3p, miR-194-3p) boxed in red. A miRNA further to the right on the plot indicates its increased importance in predicting CDH survival from non-survival. (B). ROC curve of the top 3 miRNAs shows an AUC = 1, demonstrating the high sensitivity and low false positive rate (1-specificity) to differentiate CDH survivors from non-survivors. (C) Box and whisker plots of the top 3 miRNAs expression fold change comparing survivors vs non-survivors.

ANTENATAL ADMINISTRATION OF AMNIOTIC FLUID STEM CELL EXTRACELLULAR VESICLES RESCUES FETAL LUNG VASCULAR DEVELOPMENT BY MODULATING YAP EXPRESSION VIA DELIVERY OF LNCRNA TUG1

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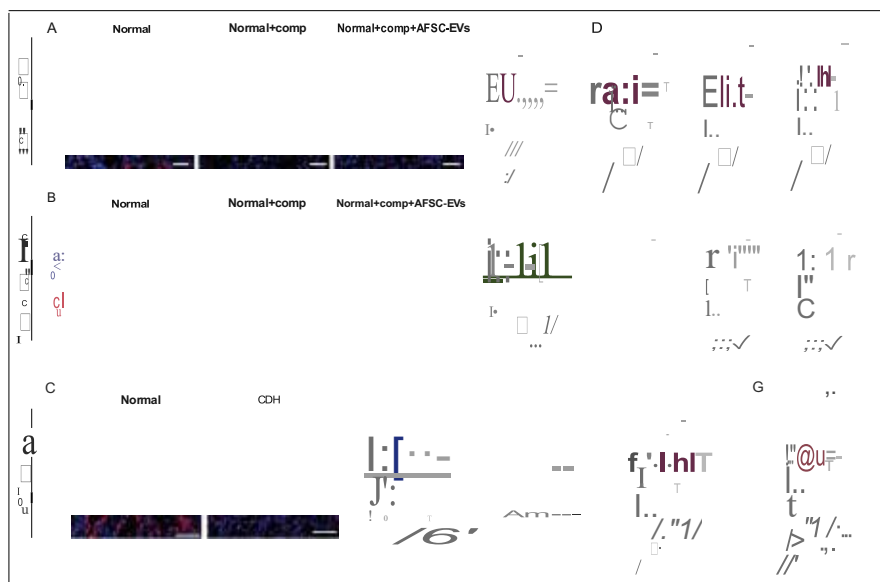
Abstract: Purpose: Impaired fetal lung vascular development secondary to congenital diaphragmatic hernia (CDH) leads to postnatal pulmonary hypertension, a primary determinant of poor outcomes. The pathophysiology of CDH-induced lung vascular remodeling and the role of mechanical compression on fetal lung vasculature remain incompletely understood. Antenatal administration of amniotic fluid stem cell extracellular vesicles (AFSC-EVs) has been reported to rescue fetal lung vascular development in experimental models of CDH. Herein, we investigated the effects of mechanical compression on lung vascular development and explored the AFSC-EV mechanism of action on the lung vasculature.

Methods: EVs were isolated from rat and human AFSC conditioned medium by ultracentrifugation and characterized for size, morphology, and EV markers. Fetal lungs from rat (IACUC#652100) and human (IRB#10-0128-E) models of CDH were assessed for vascular density, medial wall thickness (MWT) of pulmonary arteries, and the expression of markers of angiogenesis as well as Hippo signaling, a mechanosensory pathway activated by mechanical compression. CDH lung autopsy samples were used for validation. To explore AFSC-EV mechanism, we conducted inhibition studies for long non-coding RNAs (lncRNAs) contained in the AFSC-EV cargo using RNA interference (RNAi)-mediated knockdown.

Results: Mechanically compressed rat (n=6 per group) and human (n=6 per group) fetal lungs exhibited decreased vascular density, increased media wall thickness (MWT), and reduced expression of markers related to angiogenic and Hippo pathways, including YAP (main pathway effector). These features in our experimental models were similar to fetal lung specimens from CDH autopsy studies (n=4). Treatment with AFSC-EVs restored normal lung vasculature and expression of angiogenic and Hippo pathway markers (Fig1A-E). Inhibition studies revealed that AFSC-EV cargo restored YAP expression by delivering lncRNA TUG1 (Fig.1F-G). Statistical analysis: One-way ANOVA and Kruskal-Wallis. $P < 0.05$ was considered significant.

Conclusion: This study shows that mechanical compression impairs fetal lung vascular development with disruption of the Hippo pathway. Antenatal administration of AFSC-EVs rescues vascular development by modulating YAP expression via delivery of lncRNATUG1. This study adds to our understanding of the pathophysiology of CDH-induced vascular remodeling and reveals a promising new cell-free strategy to restore fetal lung vascular development.

Abbreviations: YAP (Yes-associated protein-1)



RETAINED TRANSITION ZONE OR RECTAL REMODELING? REDO PULL-THROUGH IMPROVES OUTCOMES IN HIRSCHSPRUNG DISEASE REGARDLESS OF ETIOLOGY

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Abstract: Purpose

Surgical management of Hirschsprung disease (HSCR) involves pull-through (PT) of ganglionic bowel with coloanal anastomosis. Postoperative obstructive symptoms and difficulty stooling may persist into childhood, resulting from PT of an incompletely ganglionic segment, known as transition zone PT (TZPT), or from postoperative remodeling. We aimed to determine the incidence of TZPT and compare those with TZPT to those with remodeling.

Methods

We performed a retrospective review of children with HSCR who underwent PT followed by full-thickness biopsy for obstructive symptoms from 2012 - 2023. Pathology from initial PT was re-reviewed by a blinded team of pathologists and classified as TZPT based on established criteria including residual aganglionosis, hypoganglionosis, or >2 hypertrophic nerves; if none of these pathological findings were present, but the subsequent rectal biopsy was abnormal, the patient was classified as remodeling. Preoperative and postoperative symptoms were compared between groups. A p-value < 0.05 was considered significant.

Results

There were 232 patients that met inclusion criteria; about half (n=122, 52.6%) had abnormal biopsies. Eight (6.6%) underwent redo PT for a mechanical reason alone, but most (n=77, 63.1%) underwent redo PT due to repeat biopsy concerning for TZPT. A representative sample of 34 patients (44.2%) was available for review, of which most (n=21, 61.8%) had pathological changes consistent with rectal remodeling as opposed to TZPT. There were no differences in demographics and clinical characteristics between the two groups. Postoperatively, only three patients (9.7%) remained irrigation dependent, and three patients (9.7%) continued to have obstructive symptoms, with no difference in rates between TZPT and remodeling groups.

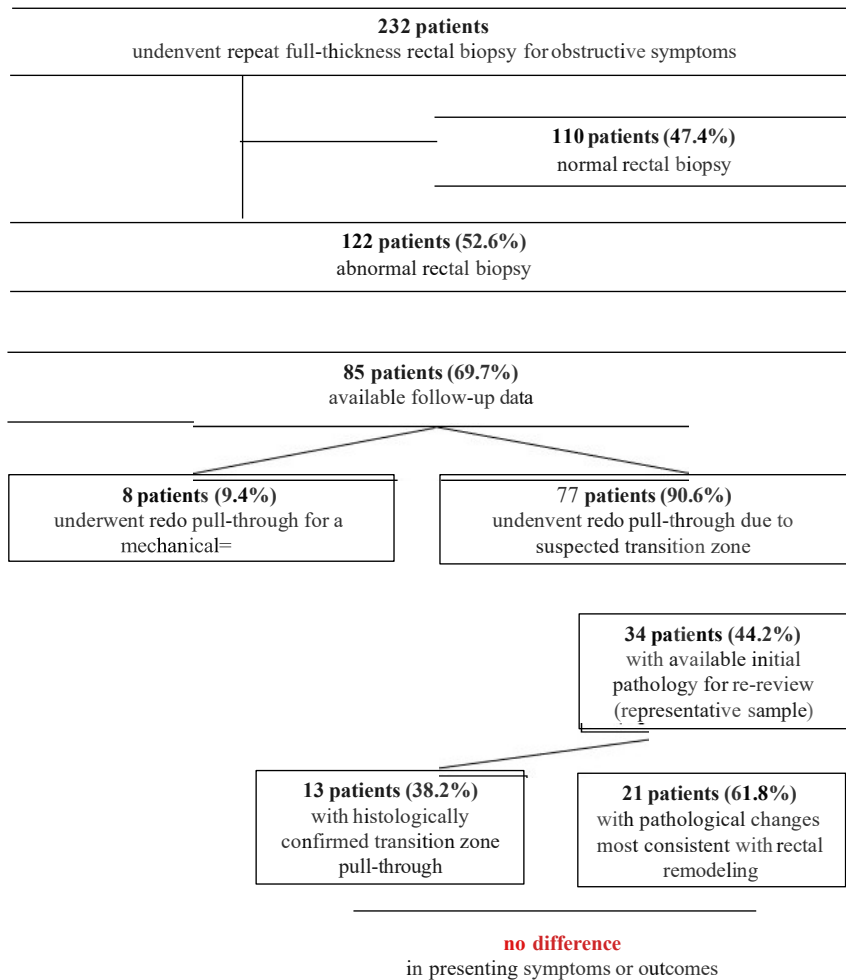
Conclusions

Clinical suspicion is high for transition zone pull-through (TZPT) in symptomatic patients with Hirschsprung disease (HSCR) with abnormal rectal biopsy after initial pull-through (PT). However, in a large cohort, incidence of pathologic TZPT was found to be lower than incidence of rectal remodeling. Regardless of pathologic findings, presentation and postoperative outcomes after redo PT were not different in TZPT compared to remodeling, and redo PT resulted in excellent functional outcomes. In symptomatic patients with HSCR with any postoperative pathologic changes on rectal biopsy, redo PT can be considered.

Abbreviations: HSCR: Hirschsprung disease

PT: pull-through

TZPT: transition zone pull-through



FETAL LUNG MACROPHAGES CONTRIBUTE TO THE SEVERITY OF PULMONARY HYPOPLASIA SECONDARY TO CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose: Pulmonary hypoplasia secondary to congenital diaphragmatic hernia (CDH) is characterized by impaired fetal lung growth and branching morphogenesis, arrested cell differentiation, and impaired vascular development. Moreover, we and others have reported that fetal hypoplastic lungs have a multilineage inflammatory profile with macrophage enrichment. However, the role of macrophages in fetal pulmonary hypoplasia remains elusive. Herein, we employed a knock-out mouse model of CDH to investigate whether macrophages contribute to arrested fetal lung development.

Methods: Animals: B6.Cg-Csf1^{rtm1.1Jwp/J} dams (AUP#64247) were either fed with nitrofen+bisdiamine to induce CDH or olive oil only (control) at embryonic day (E) 8.5. Only homozygous pups were included in this study, as they have a deletion of the Csf1r gene that is essential for macrophage survival. At E18.5, pups were harvested and their lungs analyzed. (Fig. 1A)

Outcome measures: Knock-out of macrophages was validated using genotyping, immunofluorescence (CD68) and RT-qPCR for Cd206. Pulmonary hypoplasia was assessed via mean linear intercept (MLI;H&E). Gene expression changes for lung branching morphogenesis (Fgf10), epithelial and mesenchymal maturation (Pdpn, Ager, Eln), and fetal lung vascularization (Cd31) markers were assessed via RT-qPCR.

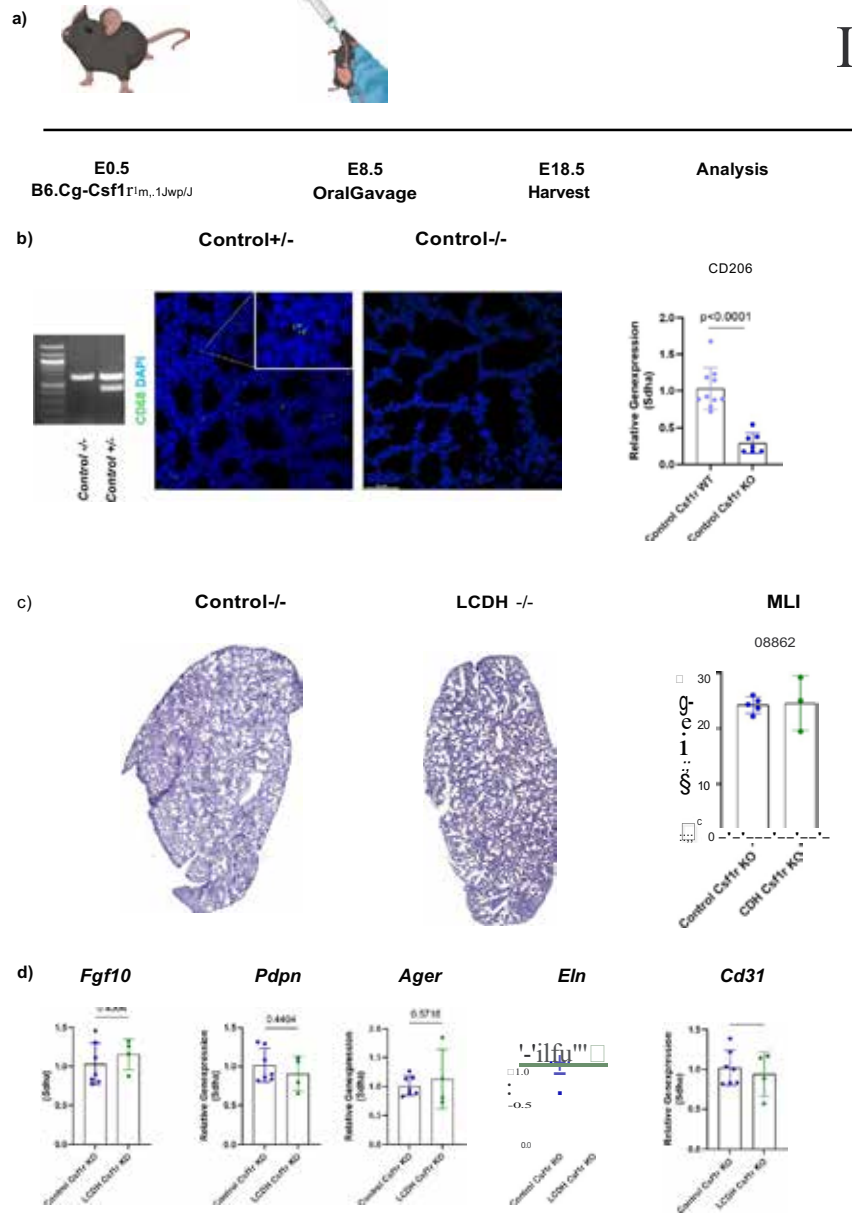
Statistics: According to data normality (Shapiro-Wilk, D'Agostino-Pearson), unpaired t- or Mann Whitney-U test were used to determine statistical significance ($p < 0.05$).

Results: Genotyping, immunofluorescence staining for CD68, and gene expression analysis for Cd206 between control heterozygous/wild-type and control homozygous pups revealed successful macrophage knock-out. (Fig. 1B) Macrophage deficient CDH fetal lungs were not hypoplastic in comparison to macrophage deficient control lungs (Fig.1C). Further, macrophage-deficient fetal CDH mouse lungs did not show alterations of genes indicative for lung branching morphogenesis (Fgf10) epithelial and mesenchymal maturation (Pdpn, Ager, Eln), and fetal lung vascularization (Cd31) when compared to macrophage-deficient control lungs (Fig.1D).

Conclusion: This study is the first to show that macrophage deficiency prevents fetal mouse with CDH from developing pulmonary hypoplasia. This opens avenues for the use of macrophage immunomodulators as a novel therapeutic strategy to preserve normal fetal lung development. Moreover, macrophages might be used as specific biomarkers to assess the severity of pulmonary hypoplasia in CDH. Additional studies are underway to further elucidate how macrophages contribute to lung inflammation in CDH.

Abbreviations:

Figure 1



FLUORESCENCE GUIDED SURGERY WITH DINUTUXIMAB-DTPA-IR800 IN A RAT MODEL OF NEUROBLASTOMA

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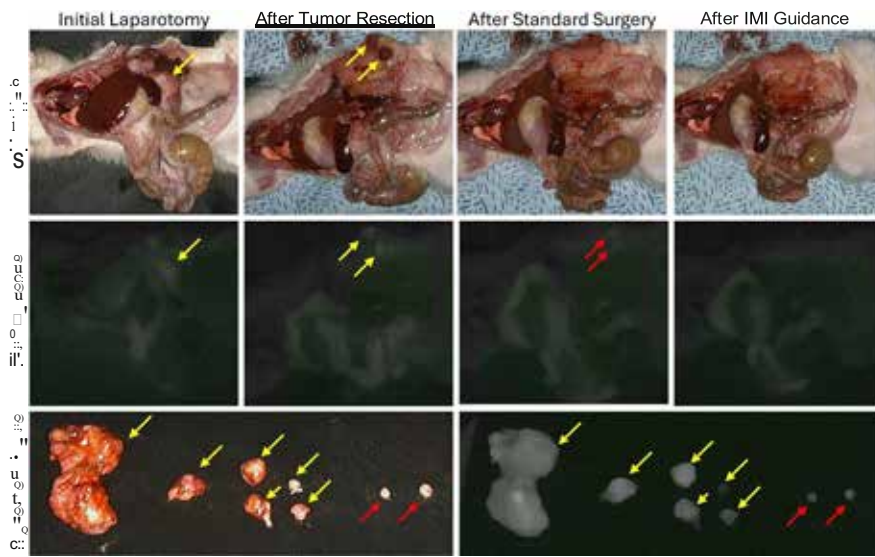
Abstract: Purpose: Complete resection is a critical component of treatment for high-risk neuroblastoma, though 5-year-survival remains near 50%. Identifying and resecting the cancer remains challenging due to hidden tumor deposits, encasement of neurovascular structures, and indistinct tumor borders. Fluorescent or radioactive tracers can be targeted to cancer to improve visualization and detection, in techniques known as fluorescence or radio-guided surgery, respectively, or more generally as intraoperative molecular imaging (IMI). Dinutuximab-DTPA-IR800 is an IMI tracer that targets GD2, a disialoganglioside that is highly overexpressed in neuroblastoma, with a near-infrared fluorophore and a chelator for In-111. Here, we present an animal experiment which simulates an established clinical trial design for fluorescence guided surgery (FGS).

Methods: SK-N-BE(2) cells were injected into the left adrenal of RNU rats (N=5 male, 6 female) to generate orthotopic xenograft neuroblastomas 5 weeks later. Four days after dinutuximab-DTPA-IR800 was injected into the tail vein, complete resection of tumor and nodules (yellow arrows in figure) was attempted with standard-of-care white light (non-IMI) surgery. The SPY-PHI near-infrared camera was then used to assess the fluorescence of previously resected tumor and to identify and resect residual fluorescent tissue (red arrows in figure). Presence of neuroblastoma was then assessed pathologically for all resected tissue as well as tumor bed. Sensitivity, specificity, PPV, and NPV were calculated from all resected tissue.

Results: Eleven primary tumors and 5 nodules were resected with white-light surgery, all of which were confirmed neuroblastoma by pathology, and 13 of which were fluorescent. An additional 20 nodules that were only identified by FGS were resected from 7 of the rats using FGS, of which 14 were confirmed neuroblastoma by pathology. Two tumor beds had small remaining disease deposits after FGS while 9 had no evidence of neuroblastoma on pathology. Collectively, FGS had a sensitivity of 84%, specificity of 60%, PPV of 81%, and NPV of 64%.

Conclusions: We conclude that FGS with dinutuximab-DTPA-IR800 in a rat model of neuroblastoma enables a more complete oncologic resection, supporting further development and clinical testing of the tracer.

Abbreviations: IMI: Intraoperative Molecular Imaging
FGS: Fluorescence-Guided Surgery



ANTICOAGULATION OF THE ECMO CIRCUIT WITH BIVALIRUDIN IN INFANTS WITH SEVERE CONGENITAL DIAPHRAGMATIC HERNIA: THE PATH TO BETTER OUTCOMES?

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Abstract: Purpose: Bivalirudin, a direct thrombin inhibitor, has been increasingly used as the anticoagulant of choice in the management of infants with congenital diaphragmatic hernia (CDH) on extracorporeal membrane oxygenation (ECMO) support. However, the utility of bivalirudin for CDH patients has largely been confined to single-center studies and efficacy remains to be determined. The purpose of this study was to analyze the impact of bivalirudin use on hospital outcomes in CDH patients on ECMO.

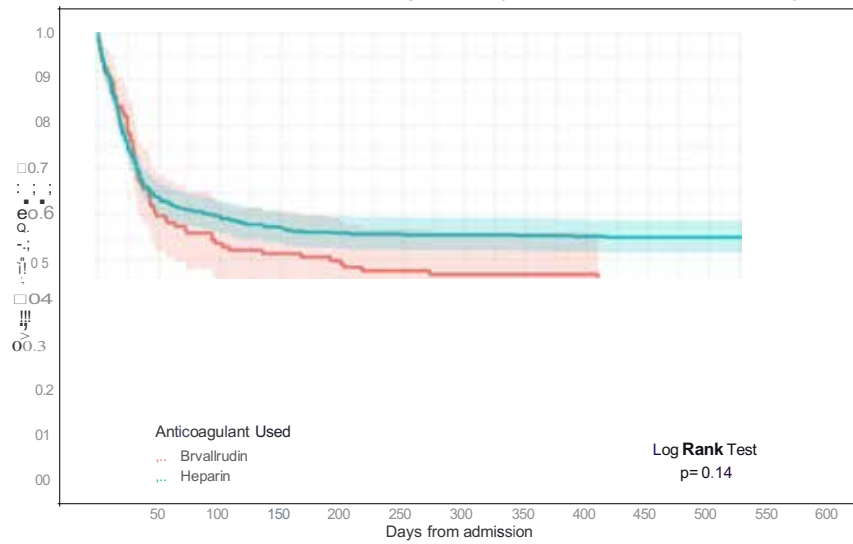
Methods: The Pediatric Health Information System database was queried for infants with CDH requiring ECMO cannulation at major children's hospitals (n=48) between 2016 and 2023. In order to minimize volume/outcome bias in the results, significant outlier institutions cannulating < 8 or >100 patients over the study period were excluded from further analysis (n=13). Patients managed with bivalirudin were compared with patients managed with heparin alone. Outcomes of interest included inpatient mortality, bleeding, thrombosis, neurologic complications, and cost.

Results: Of 3,401 CDH patients, 864(25.5%) were supported on ECMO across 35 centers. The median number of patients per center was 20(IQR, 10-30), with 131(15.2%) infants managed with bivalirudin, and 733(84.8%) infants receiving heparin alone. During the study period, institutions using bivalirudin increased from 6.7% to 53.6% (p< 0.0001), correlating with increased patient exposure over time (2.0% to 40.5%, p< 0.001). In patients receiving bivalirudin, there was no significant difference in mortality (54.2% vs. 45.3%, p=0.07; Figure), duration of mechanical ventilation (38[23-95] vs. 34[18-73.5] days, p=0.09), and neurologic complications (28.2% vs. 25.6%, p=0.61). Those receiving bivalirudin had longer duration on ECMO (16[9-29] vs. 12[7-19] days, p=0.0008), with no difference in bleeding (31.3% vs. 26.1% p=0.25) and thrombotic events (29.8% vs. 22.2%, p=0.08). Among patients surviving to discharge, length of stay was longer (120[90-186.5] vs. 101[69-154] days, p=0.006), and overall hospital charges were higher in association with bivalirudin use (\$877,821 vs. \$607,748, p< 0.0001).

Conclusion: The use of bivalirudin in CDH patients on ECMO has increased over the past decade with early experience showing similar rates of mortality, bleeding, thrombosis, and neurologic complications. Given the higher resource utilization, the utility of bivalirudin in the CDH ECMO population warrants further scrutiny in prospective studies.

Abbreviations: CDH = congenital diaphragmatic hernia
ECMO = Extracorporeal membrane oxygenation

Figure: Kaplan-Meier survival curve of CDH infants cannulated for ECMO, based on anticoagulant (bivalirudin or heparin)



DEVELOPMENT OF A NOVEL TUBULAR SCAFFOLD FOR TISSUE-ENGINEERED SMALL INTESTINE

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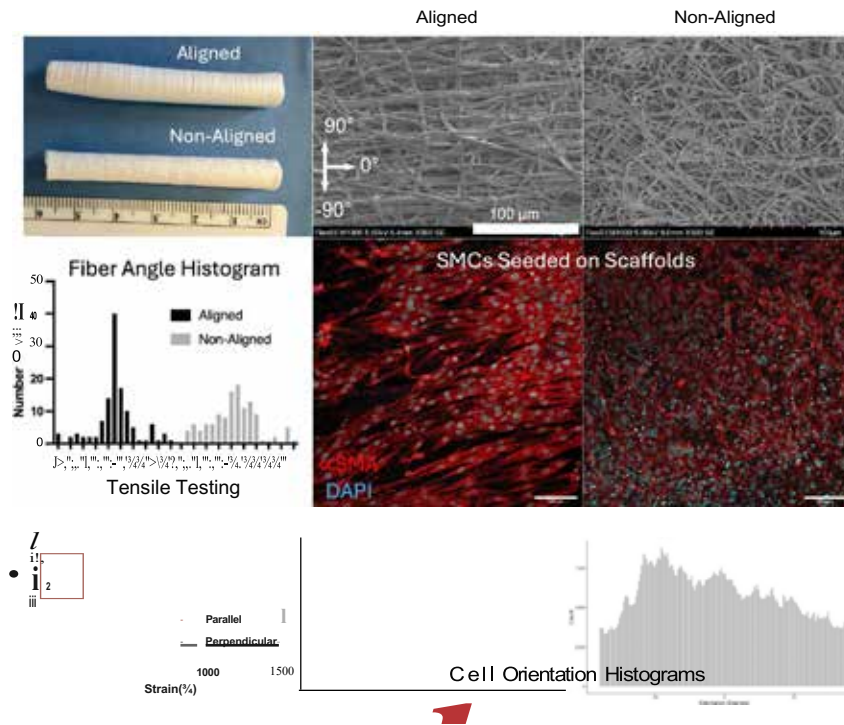
Abstract: Purpose: Infants with short bowel syndrome (SBS) have a significant morbidity and mortality rate, especially if they depend on parenteral nutrition. Tissue-engineered small intestine (TESI) has emerged as a potential therapeutic option for SBS in these infants. The purpose of this study was to develop a novel tubular scaffold that would promote smooth muscle cell (SMC) alignment and ultimately promote peristalsis (not previously accomplished) of TESI constructs.

Methods: Tubular scaffolds with aligned fibers were fabricated by electrospinning a 1:1 blend of polycaprolactone/type I collagen onto a 6 mm mandrel rotating at 9,000-11,000 rpms. The fiber diameter, alignment, mechanical properties, and in vitro degradation rate were characterized. Primary human intestinal SMCs were seeded on aligned scaffolds and non-aligned scaffolds at ~3 million cells/cm², cultured for 1 week, and then analyzed with confocal microscopy to assess SMC alignment with α -smooth muscle actin (α -SMA) staining. Non-aligned scaffolds were fabricated with the exact parameters of aligned scaffolds except the mandrel speed was 1,000 rpms.

Results: Scaffolds spun at 9-11,000 rpms (aligned) had circumferentially aligned fibers grossly and by SEM, compared to those spun at 1,000 rpms (non-aligned). The fiber diameter of aligned vs. non-aligned scaffolds was $2.97 \mu\text{m} \pm 0.37$ vs. $2.59 \mu\text{m} \pm 0.14$. The aligned scaffolds demonstrated anisotropic mechanical properties with higher stiffness and strength when tensile tested in the direction of the fibers compared to perpendicular to the fibers (stiffness 1.69 ± 0.51 MPa vs. 0.60 ± 0.21 MPa, strength 2.29 ± 1.43 MPa vs. 0.64 ± 0.25 MPa). During 6-month in vitro degradation studies, the scaffolds became stiffer and weaker until at 6 months they were fragile. Despite this, $73.39\% \pm 9.99$ of the original mass remained and they maintained their shape and lumen. Confocal imaging of cell seeding experiments demonstrated good SMC alignment on aligned scaffolds compared to non-aligned scaffolds which demonstrated more random cell orientation.

Conclusions: We have developed electrospun tubular scaffolds with circumferentially aligned fibers that promote subsequent SMC growth and alignment. These scaffolds have good mechanical strength and degradation profile that is suitable for the ultimate development of TESI. Future work will evaluate in vivo degradation and tissue formation of seeded aligned tubular constructs.

Abbreviations: SBS=short bowel syndrome
TESI=tissue-engineered small intestine
SMC=smooth muscle cells
rpms=rotations per minute
 α -SMA= α Smooth Muscle Actin
SEM = scanning electron microscopy
MPa=megapascals



Wednesday, May 7, 2025

Scientific Session 1 - Basic Science 1

2:05 PM – 3:35 PM

S1

REGIONALLY ISOLATED HUMAN AIRWAY-DERIVED DECELLULARIZED LUNG BIOINKS INFLUENCE THE MORPHOLOGY AND TRANSCRIPTIONAL PROFILE OF EMBEDDED HUMAN AIRWAY ORGANOID.

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Abstract: Purpose: Novel tissue engineering approaches for debilitating pediatric airway diseases/defects such as chronic obstructive pulmonary disease (COPD) and cystic fibrosis (CF) are desperately needed. To address this, 3D bioprinting can be used to construct patient-specific implantable and functional lung tissues combined with autologous stem cells. However, the “bioinks” used for printing oftentimes lack the biochemical cues required for cell growth and differentiation. The study herein utilizes human airway-derived lung dECM (AW-dECM) bioinks embedded with human induced pluripotent stem cell (hiPSC)-derived airway epithelial basal stem cells (iBCs) to encourage appropriate growth and differentiation. Additionally, the feasibility of 3D bioprinting pediatric-sized airways derived from AW-dECM is demonstrated, further laying the foundation for novel approaches to repair pediatric airway injuries/defects.

Methods: Human lungs obtained from UVM were decellularized and processed into bioinks using established protocols. iBCs obtained from the Center for Regenerative Medicine of Boston University were seeded at 20,000 in 50 μ L of 15 mg/mL or 30 mg/mL AW-dECM or 8 mg/mL Matrigel. Cells were cultured in PneumaCult EX medium + 1 μ M A8301 + 1 μ M DMH-1 + 10 μ M Y-27632 + 1x Pen/Strep for 21 Days and harvested for qPCR and morphological/histological assessments analyzing mucociliary and secretory gene and protein expression. 15 mg/mL AW-dECM + Col I 17.5 mg/mL bioinks were prepared and used for bioprinting of pediatric-sized airways derived from a CT scan.

Results: In 15 mg/mL and 30 mg/mL AW-dECM, iBCs successfully aggregated into 3D organoids exhibiting enhanced mucociliary (FOXJ1, MUC5B) and secretory cell (SCGB1A1) expression over 21 days as well as excellent viability and growth compared to Matrigel. Additionally, we demonstrated an increase in surfactant gene expression (SP-A and SP-B) in iBCs cultured in increasing concentrations of AW-dECM. AW-dECM + Col I bioinks were also successfully used to bioprint pediatric-sized airways with high resolution and fidelity.

Conclusion: This work reveals the influence of AW-dECM on airway organoid development, viability, growth, and differentiation. Additionally, we demonstrate the feasibility of 3D bioprinting pediatric-sized airways using this material. This work sets the stage for the development of novel tissue engineering approaches for the treatment of pediatric airway diseases/defects.

Abbreviations: COPD, CF, AW-dECM, hiPSC, iBCs

S2

THE ROLE OF EPITHELIAL-TO-MESENCHYMAL TRANSITION (EMT) IN ESOPHAGEAL TISSUE REGENERATION

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Abstract: Background: Epithelial-to-mesenchymal transition is critical for esophageal regeneration, especially for conditions like esophageal atresia. Adipose-derived mesenchymal stem cells (AD-MSCs) secrete cytokines, growth factors, and microRNAs that enhance EMT in epithelial cells during wound healing. However, manipulating this process in esophageal injuries is challenging. Tissue engineering with biomimetic scaffolds and MSCs presents promising strategies for regeneration. We employ a 2D wound assay and a 3D bioprinted esophageal-like model to investigate how stem cell secreted factors influence esophageal tissue regeneration.

Methods: Human esophageal epithelial cells (EECs) were induced with TGFβ1 and IL1β (20 ng/mL) for 15 days, qPCR measured marker expression of Vimentin, N-cadherin, E-cadherin, Mucin 1, and Interleukin-6. Further analysis included the effects of factors from AD-MSCs on EECs, gap closure in prefabricated scratch assay plates, bioprinted EECs and human fibroblasts, and the biocompatibility and viability of AD-MSCs on 3D bioprinted esophageal-like scaffolds from biodegradable alginate + nanofibrillar bioinks.

Results: Cells treated with TGFβ1 or IL1β displayed an elongated, fibroblast-like morphology by day 5, suggesting EMT induction. TGFβ1-treated EECs showed enhanced gap coverage and fibroblast-like characteristics after 24 hrs. in scratch assays. Mesenchymal marker expression was significantly higher than epithelial markers at 48 hours and continued to rise by day 5, with E-cadherin (CDH1) decreasing and mucin-1 (MUC1) declining. Elevated levels of pro-inflammatory cytokines IL-8 and IL-6 were confirmed in EECs cultured in conditioned media from AD-MSCs. 3D bioprinted scaffolds with human EECs and fibroblasts maintained their phenotype for 5 days. Live/dead analysis showed excellent viability of AD-MSCs on these scaffolds for 7 days. A pilot study with euthanized rats successfully evaluated a 3D bioprinted scaffold sutured into place, establishing a viable model for future studies.

Conclusion: The findings suggest that EECs can respond to EMT-inducing cues, further exploring esophageal regeneration and the influence of secreted factors from AD-MSCs. Our work shows the feasibility of a biodegradable 3D bioprinted scaffold for covering a rat esophageal defect. This study sets the stage for innovative regenerative strategies for congenital esophageal defects or injuries. Future research will evaluate the efficacy of stem cell-seeded 3D bioprinted scaffolds in promoting in vivo esophageal regeneration.

Abbreviations: EMT - Epithelial-to-mesenchymal transition
AD-MSCs - Adipose-derived mesenchymal stem cells
EECs - Esophageal Epithelial Cells
TGFβ1 - Transforming Growth Factor beta 1
IL1β - Interleukin 1 beta

NON-INVASIVE TRANSCUTANEOUS AURICULAR VAGUS NERVE STIMULATION ATTENUATES INTESTINAL INFLAMMATION IN A MOUSE MODEL OF NECROTIZING ENTEROCOLITIS

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Abstract: Introduction: Necrotizing enterocolitis (NEC) is a devastating disease of premature infants, leading to death in up to a third of patients. Despite extensive research on NEC, effective therapeutic strategies remain limited. Emerging studies suggest that transcutaneous auricular vagus nerve stimulation (aVNS), a novel non-invasive technique that activates vagal efferents, reduces inflammation in various conditions such as inflammatory bowel disease. Here, we evaluate the efficacy of aVNS in a mouse model of NEC to explore its potential in attenuating intestinal inflammation.

Methods: NEC was induced in 7d-old mice via intermittent hypoxia and formula gavage supplemented with stool from an infant with NEC. Breastfed control animals remained with their mothers and received breast milk ad lib. Two non-invasive vagus nerve stimulation modalities were tested: auricular vagus nerve stimulation (aVNS) and cervical vagus nerve stimulation (cVNS). On postnatal days (P) 9 and 10, the mice were anesthetized and subjected to sham stimulation or transcutaneous aVNS/cVNS for 30 minutes, using the following parameters: 1.5-2 mA, 20 Hz. Body weight was monitored daily. Intestinal architecture was assessed via microscopy, and inflammatory cytokine levels in the ileum were quantified using qRT-PCR. Statistical analyses were conducted using Student's t-test and one-way ANOVA, with significance defined as $p < 0.05$. All experiments were approved by the Animal Care and Use Committee of our university.

Results: NEC mice developed patchy necrosis of the small bowel, similar to human NEC. aVNS treatment significantly reduced NEC severity on P11, as determined by reduced expression of inflammatory cytokines Tnf (NEC=1.63 vs NEC+aVNS=0.66, $*p < 0.05$) and Lcn2 (NEC=9.24 vs NEC+aVNS=4.28, $*p < 0.05$). In contrast, cVNS treatment did not produce significant improvements in the NEC group. Additionally, aVNS treatment led to a 1.4% increase in body weight in NEC mice, compared to a 3.4% weight loss in untreated NEC mice and a 15.87% weight loss in cVNS-treated mice ($*p < 0.05$ on P11).

Conclusion: Transcutaneous aVNS treatment attenuates intestinal inflammation and improves weight outcomes in NEC mice, suggesting a promising non-invasive approach for NEC patients.

Abbreviations:

BILIARY ATRESIA IS ASSOCIATED WITH CASS4-EXPRESSING CD8+ T-CELL EXPANSION

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Abstract: PURPOSE: Biliary atresia (BA) is a rapidly progressive fibrosing cholangiopathy characterized by inflammatory and fibrotic cell infiltration. The objective of this study was to characterize the cell populations driving activation of pro-fibrotic cellular machinery using transcriptomic data derived from single-cell RNA sequencing (scRNA-seq)

METHODS: Single-cell RNA sequencing was performed on freshly isolated liver cells from 5 patients with BA and 2 with hepatoblastoma using 10X Genomics Chromium technology (Fig. 1A). Hepatoblastoma-adjacent normal liver was sampled at the time of transplant and used as normal liver control for downstream analyses. Cell-type annotation was conducted based on gene expression profiling. T-cell subpopulations were compared between normal and BA samples, and differential gene expression was analyzed.

RESULTS: The study cohort was 57% female, with a median age of 7 months (IQR: 6-15). 7,211 cells were captured from the livers of 7 infants. 6,204 cells passed quality control for downstream analysis, 4,108 from BA liver and 2,096 from normal liver. Manual annotation of cell type demonstrated T-cells comprising the majority cell type in our dataset (Fig. 1B). Further investigation of isolated T-cells revealed a diverse variety of subpopulations represented (Fig. 1C). Comparison of T-cell subpopulation distribution between BA and normal liver demonstrated expansion of naive CD8+ T-cells in BA livers (Fig. 1D-E). Pathway analysis of this T-cell subpopulation revealed enrichment of pro-inflammatory and pro-fibrotic CD95, NFAT, JAK-STAT, and CKAP signaling (Fig. 1F). Analysis of differentially expressed genes in the naive CD8+ T-cell subcluster between normal and BA samples revealed increased expression in BA samples of CASS4, a docking protein that regulates PTK2/FAK1 activity and focal adhesion integrity (Fig. 1G). Immunofluorescence performed to validate our scRNA-seq findings confirmed increased expression of CASS4 in BA liver relative to normal liver (Fig 1H).

CONCLUSION: Comparison of transcriptomic scRNA-seq data between BA and normal infant liver revealed a relative increase in CASS4-expressing CD8+ T cells, with activation of pro-fibrotic signaling pathways. Notably, CASS4 has previously been implicated in inflammatory and fibrotic disease processes in other organs. Future studies interrogating downstream mediators and cellular interactions may clarify the pathogenesis of rapidly progressive fibrosis in BA.

Abbreviations: biliary atresia (BA), RNA (ribonucleic acid), single-cell RNA sequencing (scRNA-seq), interquartile range (IQR), nuclear factor of activated T cells (NFAT), uniform manifold approximation and projection (UMAP), Janus kinase/signal transducers and activators of transcription (JAK-STAT), cytoskeleton-associated proteins (CKAP), Cas scaffold protein family member 4 (CASS4), protein tyrosine kinase 2/focal adhesion kinase 1 (PTK2/FAK1).

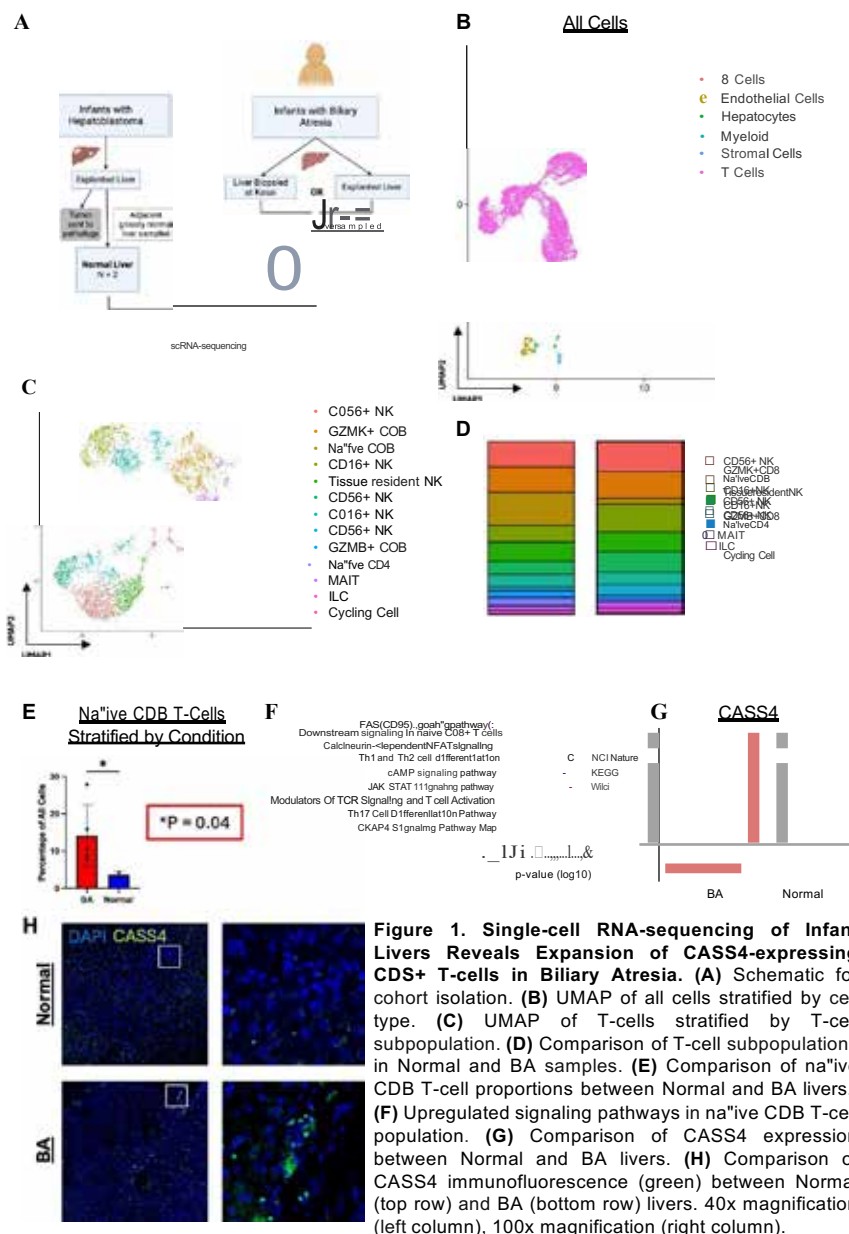


Figure 1. Single-cell RNA-sequencing of Infant Livers Reveals Expansion of CASS4-expressing CDS+ T-cells in Biliary Atresia. (A) Schematic for cohort isolation. (B) UMAP of all cells stratified by cell type. (C) UMAP of T-cells stratified by T-cell subpopulation. (D) Comparison of T-cell subpopulations in Normal and BA samples. (E) Comparison of na'ive CDB T-cell proportions between Normal and BA livers. (F) Upregulated signaling pathways in na'ive CDB T-cell population. (G) Comparison of CASS4 expression between Normal and BA livers. (H) Comparison of CASS4 immunofluorescence (green) between Normal (top row) and BA (bottom row) livers. 40x magnification (left column), 100x magnification (right column).

INTEGRATIVE META-ANALYSIS OF SINGLE-CELL RNA-SEQUENCING DATA FROM INFANT LIVERS REVEALS HETEROGENEOUS STROMAL CELL POPULATIONS IN BILIARY ATRESIA

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1Stanford University School of Medicine, Stanford, CA, USA, 2Stanford University, Stanford, CA, USA, 3Stanford, Stanford, CA, USA, 4Stanford University School of Medicine, Lucile Packard Children's Hospital, Palo Alto, CA, USA, 5Stanford University School of Medicine, Palo Alto, CA, USA, 6Stanford University, Palo Alto, CA, USA

Abstract: **PURPOSE:** Biliary atresia (BA) is characterized by rapidly progressive liver fibrosis resulting in end-stage liver disease for the majority of afflicted infants. Its etiology is unknown, as are the mechanisms that drive this unique liver fibrosis, occurring over the course of months rather than years. Prior studies utilizing single-cell RNA-sequencing (scRNA-seq) technology in BA have focused on immune cell populations. We sought to characterize the stromal cell populations involved in BA using publicly available scRNA-seq data.

METHODS: The Gene Expression Omnibus (GEO) database was used to identify infant liver scRNA-seq datasets. All data derived from BA liver were included for analysis in our study. Data derived from hepatoblastoma-adjacent normal liver was also included and used as normal liver control. Stromal cells were identified using canonical markers for fibroblasts and hepatic stellate cells. Subpopulations of stromal cells were compared between normal and BA samples, with subsequent pathway characterization.

RESULTS: 131,051 infant liver cells, comprising all cell types, were included from 12 BA livers and 8 hepatoblastoma-adjacent normal livers (Fig. 1A). Cluster 10 was identified as the stromal cell cluster of interest, based on increased gene expression of the canonical fibroblast and hepatic stellate cell markers ACTA2 and COL1A1 (Fig. 1B). Cluster 10 were isolated for focused analysis of stromal cell subpopulations. This subset of data comprised 3,074 stromal cells, with 2,189 cells derived from BA liver and 885 cells derived from normal liver. Subcluster analysis of stromal cells revealed 6 unique subclusters. Comparison of stromal cell subpopulation distribution between BA and normal liver showed relative enrichment of Cluster 0 and relative depletion of Cluster 1 in BA (Fig. 1C). Pathway analysis of stromal cell Cluster 0 revealed upregulation of shared pathways involved in PDGFRA-beta signaling, muscle contraction, and nonalcoholic fatty liver disease (Figure 1D, top). Conversely, pathways enriched in Cluster 1 included VEGFR3 signaling, angiogenesis, and extracellular matrix (ECM) receptor interactions (Figure 1D, bottom).

CONCLUSION: Comparison of infant liver stromal cell subpopulations revealed relative upregulation of pathologic fibroblast and liver disease signaling and downregulation of angiogenesis and normal ECM microenvironment signaling in BA.

Abbreviations: biliary atresia (BA), RNA (ribonucleic acid), single-cell RNA sequencing (scRNA-seq), Gene Expression Omnibus (GEO), actin alpha 2 smooth muscle (ACTA2) collagen type 1 alpha 1 chain (COL1A1), platelet-derived growth factor receptor alpha (PDGFRA), vasculotropin receptor 3 (VEGFR3), extracellular matrix (ECM).

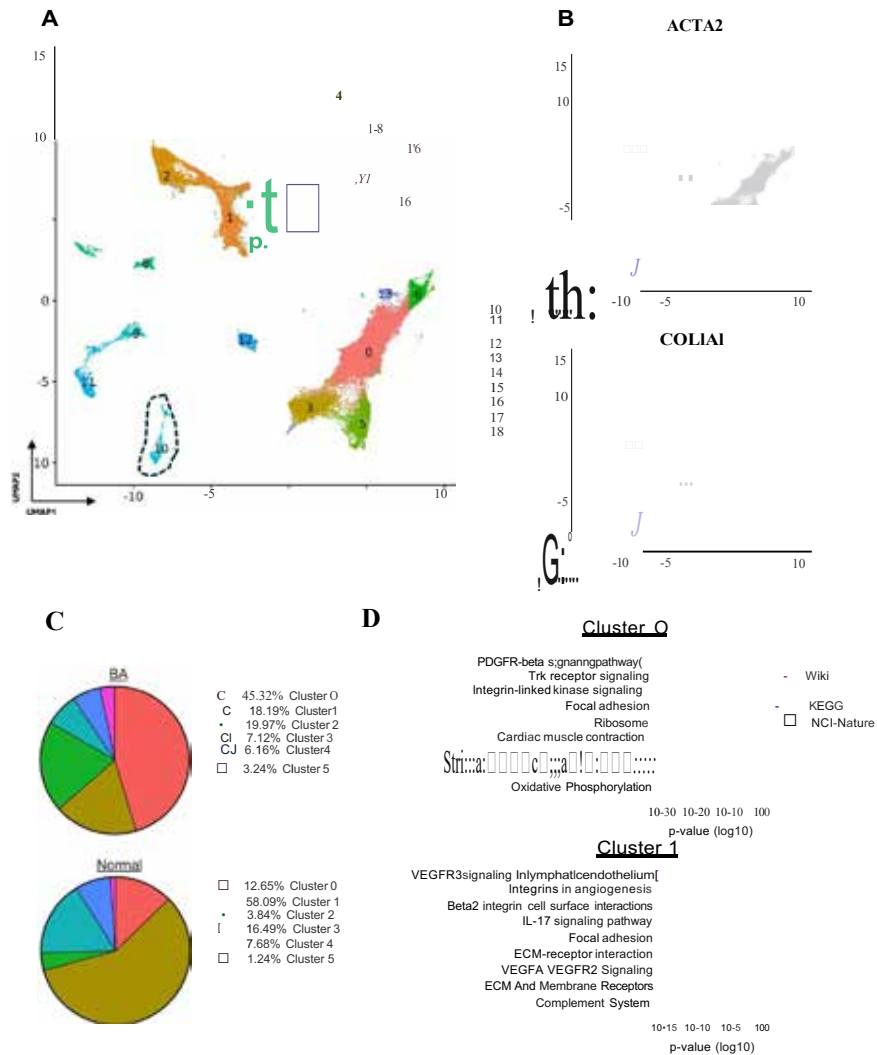


Figure 1. Single-cell RNA-sequencing of Infant Livers Reveals Heterogeneous Stromal Cell Populations in Biliary Atresia. (A) UMAP of all cells stratified by Seurat cluster. Cluster 10 is outlined with dotted line as cluster of interest. (B) Feature plot of all cells demonstrating high expression of canonical fibroblast and stromal markers in cluster 10. (C) Comparison of stromal cell subpopulations in Normal and BA samples. (D) Upregulated signaling pathways in stromal cell subcluster O (top) and subcluster 1 (bottom).

EFFECT OF ANTI-INFLAMMATORY PEPTIDE ON LUNG BRANCHING IN THE NITROFEN RAT LUNG EXPLANT MODEL

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Abstract: 【Purpose】

Congenital diaphragmatic hernia (CDH) is associated with lung hypoplasia. The underlying mechanism of lung hypoplasia remains poorly understood. We recently published that inflammatory response pathways are upregulated in nitrofen-induced CDH using proteomic profiling. Here, we investigated the anti-inflammatory effects of a cathelicidin-derived peptide on lung branching in CDH.

【Methods】

To examine the immunomodulatory effects of the anti-inflammatory peptide, control and nitrofen-induced CDH lungs were isolated on embryonic day 13 (E13) and cultured with or without the peptide for 4 days. Branching morphogenesis was assessed by blinded lung bud counting. After 4 days, quantitative reverse transcription PCR (RT-qPCR) was performed to measure cathelicidin, interleukin-1 β (IL-1 β), and IL-10 expression. Additionally, lungs from control and CDH rats were collected on E15, E18, and E21 for further RT-qPCR analysis during lung development. For each stage, lungs were obtained from three different mother rats in both nitrofen-treated and control groups. Moreover, immunofluorescence (IF) was performed on human CDH and control lung tissues to evaluate the abundance of cathelicidin in human CDH patients.

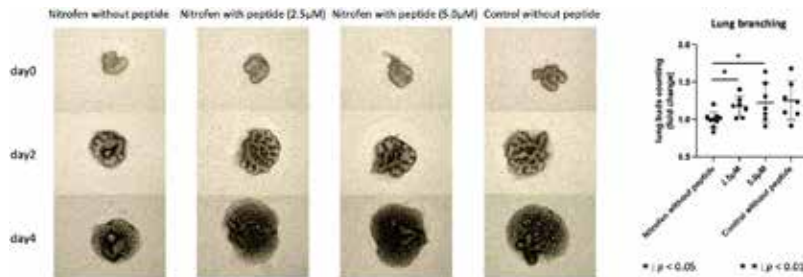
【Results】

Compared to controls, the number of lung buds was significantly lower in Nitrofen-treated lungs, indicating impaired branching morphogenesis. However, treatment with the cathelicidin-derived peptide restored lung branching to levels observed in the control lungs. RT-qPCR analysis showed that, in untreated nitrofen-induced lungs, cathelicidin expression was elevated by 4.66-fold at E15 ($p = 0.013$) and 3.60-fold at E18 ($p < 0.001$). IL-1 β expression increased by 3.07-fold at E15 ($p = 0.021$) and 2.56-fold at E18 ($p = 0.001$). IL-10 expression was upregulated by 7.81-fold at E18 ($p < 0.001$) and 2.55-fold at E21 ($p = 0.046$). In contrast, in lung explants treated with the peptide, IL-1 β expression was significantly suppressed to 0.53-fold ($p = 0.030$). IF revealed that the abundance of cathelicidin was higher in human CDH lung tissues compared to controls.

【Conclusions】

These findings suggest that a cathelicidin-derived peptide can suppress inflammation and improve lung branching in the nitrofen-induced CDH model, highlighting its therapeutic potential to improve lung hypoplasia in CDH.

Abbreviations: CDH: Congenital diaphragmatic hernia,
 E13: embryonic day 13
 RT-qPCR: quantitative reverse transcription PCR
 IL: interleukin
 IF: immunofluorescence



HEPATOPROTECTIVE EFFECTS OF IMEGLIMIN THROUGH MITOCHONDRIAL ACTIVATION AND ENHANCED ANTIOXIDANT CAPACITY IN A MURINE BILE DUCT LIGATION MODEL

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Abstract: Purpose

Imeglimin, a novel hypoglycemic agent approved for type 2 diabetes treatment, activates mitochondrial function and antioxidant defense. This study investigates its hepatoprotective effects against liver damage induced by obstructive jaundice in common bile duct ligation (BDL) mice.

Methods

The common bile ducts of 4- to 5-week-old C57BL/6 mice were ligated twice using 6-0 thread under general anesthesia. Imeglimin (675 µg/kg/day), dissolved in dimethyl sulfoxide (DMSO), was administered intraperitoneally for 7- or 14-days post-surgery, with DMSO alone administered to the control group (n = 5, respectively). Blood and liver samples were collected on days 7 and 14. Serum levels of aspartate aminotransferase (AST), alanine transaminase (ALT), and total and direct bilirubin were measured on days 7 and 14. Mitochondrial morphology in hepatocytes was assessed by transmission electron microscopy (TEM) on day 7. The intensity of 8-hydroxy-2'-deoxyguanosine (8-OHdG), a biomarker of oxidative DNA injury, in albumin-positive hepatocytes was measured by immunofluorescence on day 7. RNA-Seq analysis was performed on liver samples collected on day 7. The survival rates up to day 14 were evaluated in a separate cohort of 7 BDL mice per group.

Results

Elevated levels of AST, ALT, total bilirubin, and direct bilirubin were reduced in the Imeglimin group compared to the DMSO group on days 7 and 14 (day 7: p = 0.102, 0.031, 0.007, and 0.001; day 14: p = 0.041, 0.342, 0.031, and 0.043, respectively; Figure A). In the Imeglimin group, both the number and the long axis of mitochondria observed by TEM increased (p = 0.0007 and p = 0.0004, respectively), and mitochondrial membrane permeability was retained as indicated by maintained electron density (Figure B). The Imeglimin group also showed decreased fluorescence intensity of 8-OHdG (Figure C). Gene ontology enrichment analysis revealed upregulated molecules associated with oxidoreductase activity, superoxide metabolic processes, and negative regulation of gluconeogenesis in the Imeglimin group (Figure D). The Imeglimin group had a higher survival rate compared to the DMSO group (42.9% vs. 85.7%, p = 0.045; Figure E).

Conclusion

Imeglimin may offer hepatoprotective effects in BDL mice by enhancing mitochondrial function and boosting antioxidant capacity.

Abbreviations: bile duct ligation (BDL)
dimethyl sulfoxide (DMSO)
aspartate aminotransferase (AST)
alanine transaminase (ALT)
transmission electron microscopy (TEM)
8-hydroxy-2'-deoxyguanosine (8-OHdG)

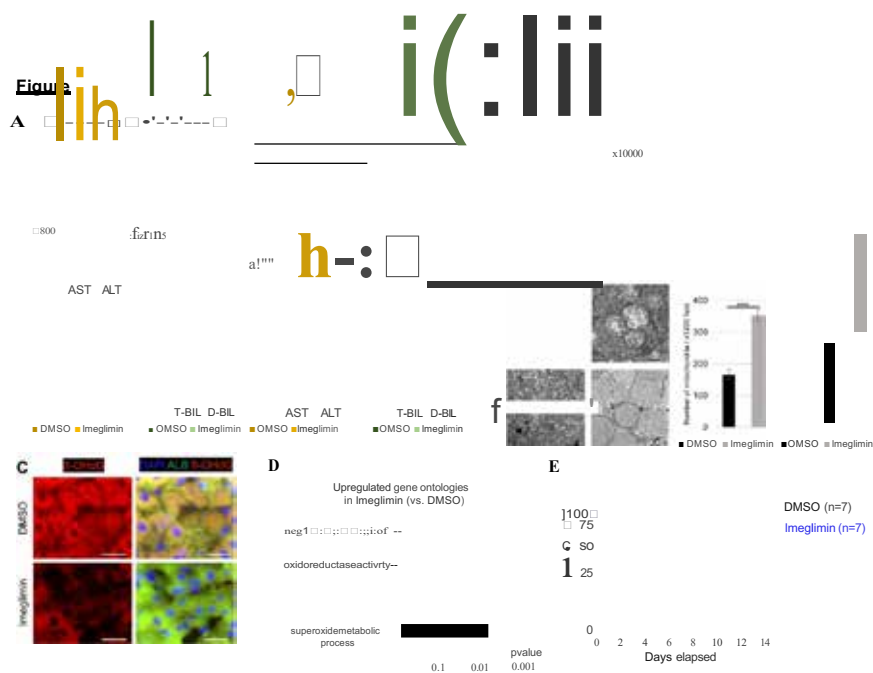


Figure 4

- A) Mean serum values of AST, ALT, T-Bil, and D-Bil 01 days 7 and 14 are graphed ($p < 0.05$ and $p < 0.01$). N.S.: not significant.
- B) Representative mitochondrial images in hepatocytes captured by TEM at low (x2000) and high (x10000) magnification. The mean number of mitochondria per x1000 field and the mean lumen area of the mitochondria are graphed ($*p < 0.001$).
- C) Representative immunofluorescence images of ROS and ALP in hepatocytes. Scale bar: 25 μm.
- D) RNA-Seq data showing upregulated gene ontologies in the Imeglimin group compared with the DMSO group.
- E) Kaplan-Meier survival plots showing survival for the Imeglimin and DMSO groups (n = 7 per group).

FROM CARTILAGE TO CURE – CHONDROITIN SULFATE'S IMPACT ON GUT HEALTH IN A PORCINE MODEL OF NECROTIZING ENTEROCOLITIS

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Abstract: Necrotizing enterocolitis (NEC) is a disease of premature infants that results in devastating intestinal injury caused by inflammation and immunologic dysregulation that can lead to sepsis and death. Chondroitin sulfate (CS) is an anti-inflammatory modulator and prebiotic that has improved outcomes in various diseases including a murine model of NEC. To validate these findings and perform final preclinical testing in an animal that was similar in size to a human neonate, we developed a large animal piglet model of NEC. We hypothesized that chondroitin sulfate would improve intestinal outcomes and limit inflammation in piglets with NEC.

Premature piglets were delivered via cesarean section at 103 gestational days (normal gestation 115 days), representative of infants born at < 37 weeks. Piglets were stimulated, resuscitated, given maternal plasma for passive immunity, and placed in a temperature-controlled incubator. A five-day NEC model was initiated with immediate initiation of TPN (5mg/kg/hr) via CVL, and starting on day 3, enteral feeds (15mg/kg/feed) every 3 hours. Three groups were evaluated: control pigs euthanized 3-6 hours postnatally (n=7), NEC piglets (n=6), and NEC piglets that had CS-supplemented formula (200mg/kg/day, n=3). Weight, temperature, and clinical sickness were evaluated throughout, and piglets underwent necropsy once euthanasia criteria were met or at the end of experimentation. Groups were compared using one-way ANOVA and post-hoc multiple comparisons tests as appropriate with $p < 0.05$ considered significant.

Macroscopic injury scores in piglets treated with CS were reduced compared to their NEC counterparts ($p=0.0002$) and no difference was noted when compared to control. Clinical sickness scores were worse in the NEC compared to control (2.25 vs 0, $p < 0.0001$) and CS (2.25 vs 1.67, $p=0.02$).

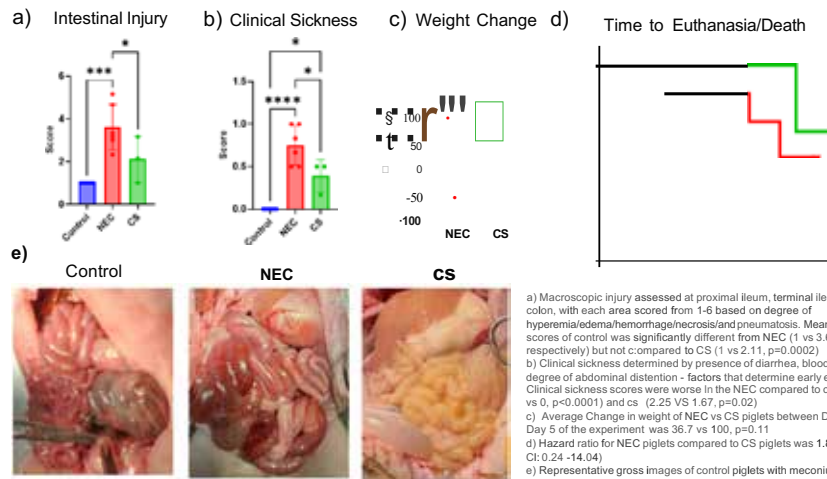
CS-supplemented formula provides protection to piglets with NEC. This study validates previous murine studies. Future studies will aim to identify long term effects and safety profiles in piglets with NEC prior to the initiation of a phase 1 human clinical trial.

Abbreviations: NEC- necrotizing enterocolitis

CS – chondroitin sulfate

TPN – total parenteral nutrition

CVL – central venous line



a) Macroscopic injury assessed at proximal ileum, terminal ileum, and colon, with each area scored from 1-6 based on degree of hyperemia/edema/hemorrhage/necrosis and pneumatosis. Mean injury scores of control was significantly different from NEC (1 vs 3.61, respectively) but not compared to CS (1 vs 2.11, $p=0.0002$)

b) Clinical sickness determined by presence of diarrhea, bloody stool, and degree of abdominal distention - factors that determine early euthanasia. Clinical sickness scores were worse in the NEC compared to control (2.25 vs 0, $p<0.0001$) and cs (2.25 vs 1.67, $p=0.02$)

c) Average Change in weight of NEC vs CS piglets between Day 1 and Day 5 of the experiment was 36.7 vs 100, $p=0.11$

d) Hazard ratio for NEC piglets compared to CS piglets was 1.833 (95% CI: 0.24 - 14.04)

e) Representative gross images of control piglets with meconium in colon, NEC piglets with local hyperemia, and CS-treated pigs without lesions.

ROCK INHIBITION ATTENUATES THE INFLAMMATORY RESPONSE IN NECROTIZING ENTEROCOLITIS

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Abstract: Introduction: Necrotizing enterocolitis (NEC) is a life-threatening gastrointestinal disease in premature infants. The disease is a multifactorial process involving a hyperinflammatory response and the dysregulation of cellular pathways. Rho-associated protein kinase (ROCK) is a ubiquitous protein involved in many cellular functions including inflammatory signaling. We hypothesize that ROCK inhibition will attenuate the inflammatory response by decreasing inflammatory marker expression. We aim to further investigate the role of ROCK in inflammatory regulation and how this contributes to necrotizing enterocolitis.

Methods: Enteroids were generated from intestinal tissue collected from wild-type mice and divided into four groups once confluent. The two experimental groups were treated with 100µg/mL lipopolysaccharide (LPS) and subjected to 24 hours of hypoxia to induce experimental NEC. One experimental group was also treated with 10µM of ROCK inhibitor (RI). One control group was treated with 10µM of RI while the other was untreated. RNA and protein expression of multiple inflammatory markers was evaluated using RT-qPCR and ELISA. ANOVA was used to determine statistical significance ($p < 0.05$).

Results: Enteroids exposed to NEC conditions had a significant decrease in RNA expression of IL-1β and TNFα when RI was added. There was also a significant increase in TNFα protein expression in experimental NEC compared to control. When RI was added, there was a significant decrease in TNFα protein expression compared to the experimental conditions without RI. Additionally, the experimental group with RI showed no significant difference in TNFα protein expression compared to control. Protein expression for KC/CXCL2, a murine homologue of IL-8, also significantly increased in experimental NEC and then decreased the addition of RI.

Conclusion: Expression of TNFα protein was significantly elevated in enteroids exposed to experimental NEC. When enteroids were treated with RI expression of IL-1β and TNFα RNA and protein significantly decreased. TNFα protein expression was also reduced to a level not significantly different from that of the control group. This points to ROCK having a potential role in the inflammatory process of NEC and suggests that inhibiting ROCK may abate the expression of inflammatory markers and maintain levels similar to control.

Abbreviations: Necrotizing Enterocolitis (NEC)
Rho-associated protein kinase (ROCK)
ROCK Inhibitor (RI)

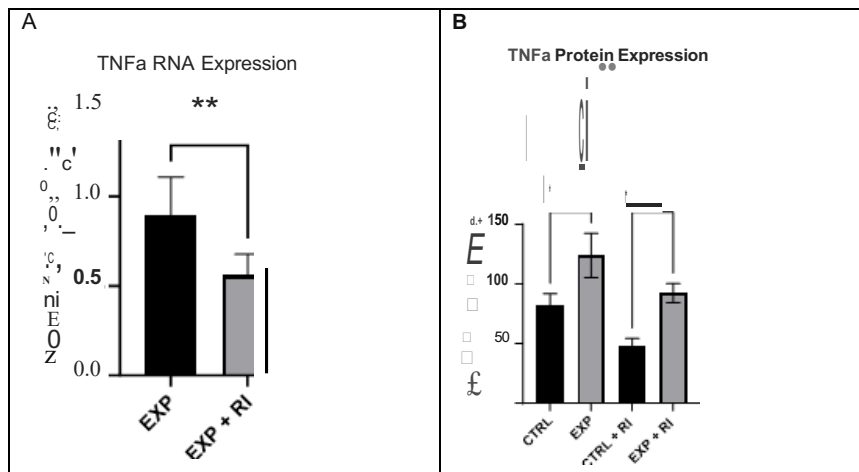


Figure 1: RNA and protein expression in experimental NEC conditions with and without RI. **A)** Experimental NEC conditions shows a significant decrease in RNA expression levels of TNFa when RI is added. **B)** There is a significant increase in levels of TNFa protein in experimental NEC compared to control conditions. With RI, there is a significant decrease in TNFa protein expression compared to the experimental group without RI. The experimental group with RI shows no significant difference in TNFa protein expression compared to control.

NECROTIZING ENTEROCOLITIS IS ASSOCIATED WITH ELEVATED IRON LEVELS, TOXIC LIPID RADICALS, AND PLASMALOGENS

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Abstract: Purpose: Necrotizing enterocolitis (NEC) is a devastating disease that continues to plague neonates in neonatal intensive care units, despite over sixty years of research. Ferroptosis, a recently discovered version of programmed cell death similar to Apoptosis, is characterized by the accumulation of lipid radicals and iron. While Ferroptosis has been illustrated in NEC, its role has yet to be defined. We hypothesize that patients with active NEC will have higher levels of iron compared to other groups. We also hypothesize that there will be elevated levels of the toxic lipid radicals 4-hydroxyl-2-hexenal (4-HHE) and 4-hydroxynonenal (4-HNE), as well as plasmalogens.

Methods: Intestinal tissue was collected from control patients, patients with a history of NEC, and patients with active NEC. The tissue underwent acid digestion and subsequent colorimetric assay with a bathophenanthroline-based colorimetric assay to evaluate iron levels. Additionally, enteroids were grown from active NEC and control patients. These subsequently underwent NEC induction. These were then harvested, processed, and analyzed using mass spectrometry lipidomics to evaluate lipid profiles. Statistical analysis was then performed using One- or Two-way ANOVA and Students t-test as appropriate.

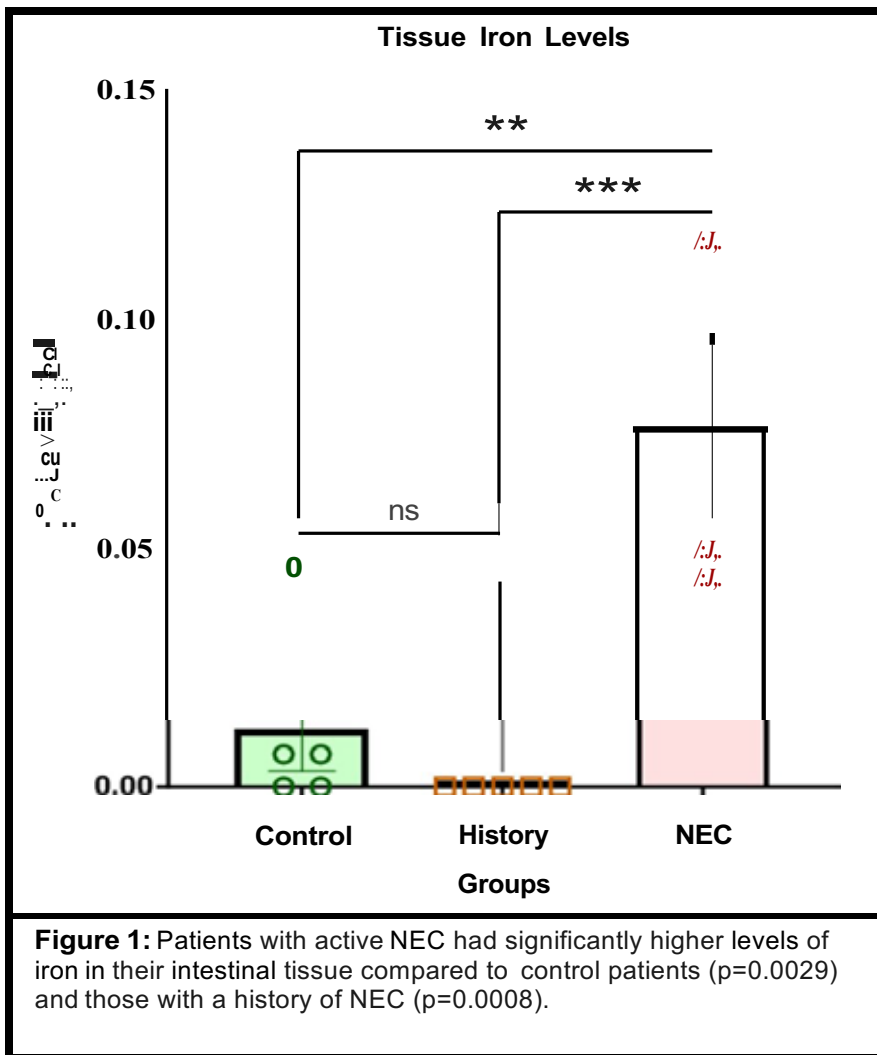
Results: Patients with active NEC had significantly elevated levels of iron when compared to control ($p=0.0029$) and those with a history of NEC ($p=0.0008$). There was no significant difference between control patients and those with a history of NEC ($p=0.6699$). Enteroids who underwent NEC induction had significantly elevated levels of 4-HHE ($p=0.0114$). While these enteroids had decreased levels of 4-HNE compared to control, this difference did not reach statistical significance. Enteroids from active NEC patients had significantly higher levels of plasmalogens compared to controls ($p<0.0001$). Plasmalogens significantly increased after NEC induction for both control ($p<0.0001$) and NEC ($p<0.0001$) patients. The significant elevation in plasmalogens remained after NEC induction ($p<0.0001$).

Conclusion: Patients with active NEC had significantly higher levels of iron compared to controls and those who had recovered from NEC. Additionally, NEC enteroids had significantly elevated levels of 4-HHE and plasmalogens. In line with our lab's previous research, this strongly implies that Ferroptosis plays a role in the pathology of NEC.

Abbreviations: NEC: Necrotizing enterocolitis

4-HNE: 4-Hydroxynonenal

4-HHE: 4-hydroxyl-2-hexenal



Wednesday, May 7, 2025

Scientific Session 2 - Education/Innovation

2:00 PM – 3:30 PM

S17

RESOLVING PILONIDAL DISEASE IN A SINGLE OFFICE VISIT WITHOUT EVEN A SHOT

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Abstract: Purpose: Treatment of pilonidal disease traditionally involves a large operation which is associated with a significant period of postoperative disability and a high recurrence rate. Various less invasive techniques have been devised to lessen treatment morbidities but may still require general anesthesia and extensive postoperative care regimens. We report a novel treatment for pilonidal disease performed in the office using a pneumatic lidocaine injection device and associated with no need for pain medication, no period of disability and no post-procedure care regimen, other than washing the area twice daily.

Methods: Patients presenting to our Pilonidal Care Clinic with gluteal crease pits were offered pit excision using the technique as standard care. Prospectively collected patient data including demographics, pain scores (Likert scale 0-10) and outcomes were entered into a REDCap database. Under sterile conditions, patients underwent pneumatic injection of 1% buffered lidocaine with epinephrine around their gluteal crease pits. They underwent laser follicle ablation and then de-epithelialization of the pits using 1.5mm or 2mm skin punches without suture closure. Pit holes were probed to remove embedded hair and debris, but sinus tracts were not excised. Patients were asked to wash the area twice daily, maintain normal activities and return in 6 to 8 weeks for re-evaluation. Patients that required nidus drainage or no documented follow up were excluded.

Results: From February to June 2024, 130 patients underwent pit excision. Five were excluded for simultaneous I&D of a nidus or wound and 25 were lost to follow up, leaving 100 patients for review. Their mean age was 18.1 years and 50% were male. At follow-up 60 patients healed all of their pits and 144 of 224 total pits (64%) were healed. Patients with 3 or more pits were more likely to need an additional pit excision. Mean patient-reported intra-procedure pain score was 1.6 (SD 1.21) of 10. No patient reported taking pain medication or experiencing any period of disability.

Conclusion: In many patients, pilonidal disease may be resolved in a single outpatient clinic visit, without even a shot.

Abbreviations:

Scientific Session 2 - Education/Innovation

2:00 PM – 3:30 PM

S70

A NOVEL APPROACH FOR DETECTION AND REDUCTION OF UNPLANNED EXTUBATION IN THE PEDIATRIC ICU

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Abstract: Purpose: Unplanned extubations in the pediatric ICU setting occurs in about 3% of cases. These events are associated with increased length of stay, higher hospital costs, morbidity, and mortality as rates of cardiovascular collapse in this population are reported to be as high as 20%. Though several quality improvement projects have evaluated causes of unplanned extubation, we propose a novel continuous ET tube position monitoring device that may help to detect and/or prevent unplanned extubation.

Methods: This solution uses an Arduino code base and 3 RFID sensors (placed on either cheek and one placed external to the ET tube) to give real time position data. Testing was conducted using the proposed device, which was fixed firmly in contact on a mannequin with a sensor positioned within 1cm of an RFID sticker. While in contact, the device was run for 9 hours with a sampling rate of four times per second. The sensor data was tracked using an onboard LCD screen, and the device was removed every 30 minutes to detect if it was still reading appropriately. The study was repeated with the RFID sticker placed 2 cm away from the sensor (i.e. out of range) and the corresponding results were recorded.

Results: We report preliminary testing data assessing read accuracy, sensor detection area profiles, and fatiguability of our system. Our tests revealed a sensitivity of 99.98% while sensor was within range and specificity of 1, since there were no detected positive values while outside of the range. Fatigue testing revealed no change in device read accuracy over the tested period, indicating that our system would be effective for use in extended monitoring of tube position.

Conclusion: Based on the results of our initial testing, we conclude that this device can accurately detect unplanned extubation with an accuracy of 99.98%. Although clinical bedside testing will be necessary, our current results indicate that our solution, when combined with the current quality improvement driven approach, can reduce associated costs, morbidity, and mortality within the ICU setting.

Abbreviations: ICU -- Intensive Care Unit

ET Tube-- Endotracheal Tube

RFID -- Radio-frequency Identification

Predicted	Actual		
	N•259'Ito	Within Range	Outside of Range
	Read: True	129573	0
	Read: False	27	129600
Sensitivity: 0.999791667		Specificity: 1	Accuracy: 0.999896

N =#of Read Cycles

ASSESSMENT OF USER EXPERIENCE IN VIRTUAL REALITY-BASED PEDIATRIC TRAUMA TRAINING MODULE FOR HEALTHCARE PROVIDERS

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Abstract: Purpose

To evaluate the effectiveness, acceptance, usability, and impact on cybersickness of a virtual reality (VR)-based training module for healthcare providers in pediatric trauma.

Methods

This prospective study involved two cohorts participating in a pediatric trauma course incorporating PeTIT VR, an immersive multiplayer VR training platform for pediatric trauma simulations. The first cohort (May 2024) included 17 participants, and the second (August 2024) 10 participants - paramedics, medical officers, nurses, and emergency technicians, all active in trauma care. Participants completed four questionnaires: the Technology Acceptance Model (TAM) for perceived usefulness and ease of use, the System Usability Scale (SUS) for usability assessment, the VR Sickness Questionnaire (VRSQ), and a confidence survey in pediatric trauma. The second cohort's questionnaires were modified for clarity, excluding demographics, SUS, and TAM. Descriptive analyses were performed.

Results

Participants included paramedics (53%), medical officers (18%), and nurses (12%). The age range was 18–55 years old, with 47% aged 26–35 years (first cohort data). The table compares all data between the two cohorts. Most participants had no prior VR experience (65% and 90% in the first and second cohorts, respectively), and previous trauma training was reported by 82.4% and 80%, respectively. Usability and acceptance of the VR module were high, with a strong interest in repeating the module, increasing from 82% to 90% from the first to second cohort. Cybersickness symptoms were reported to varying degrees but overall decreased from 31.6% to 15% from the first to the second cohort, with increasing team expertise in adjusting the headsets. Confidence in managing pediatric trauma increased by 18% in both cohorts.

Conclusion

In this study, VR-based trauma training improved confidence and was well-accepted by pediatric trauma providers. Increasing willingness to use VR training indicates a growing acceptance of VR technology in trauma education. On the other side, persistent mild cybersickness symptoms among some participants highlight the need for ongoing VR content and interface improvements to reduce discomfort. Our findings support integrating VR training modules to enhance the accessibility and efficacy of pediatric trauma surgical education.

Abbreviations: VR: Virtual Reality

PeTIT VR: Pediatric Trauma Innovative Training in Virtual Reality

TAM: Technology Acceptance Model

SUS: System Usability Scale

VRSQ: VR Sickness Questionnaire

Table: Summary of Key Findings. TAM= Technology Acceptance Model; SUS= System Usability Scale

Measure	First Cohort (May 2024)	Second Cohort (Aug 2024)
Total Participants	17	10
No Prior VR Experience(%)	65%	90%
Previous Trauma Training(%)	82.4%	80%
TAM - Useful (%)	77.8%	N/A
TAM - Easy to Use(%)	63.1%	N/A
SUS Score (Mean)	63.4	N/A
Willingness to Reuse VR Module(%)	82.2%	90%
Cybersickness		
• General Discomfort(%)	23.5%	20%
• Eyestrain(%)	47.0%	30%
• Difficulty Focusing(%)	47.0%	10%
• Fullness of Head(%)	11.8%	0%
• Blurred Vision(%)	47.0%	30%
• Dizziness(%)	35.3.%	10%
• Vertigo(%)	23.5%	10%
• Headache(%)	17.6%	10%
Confidence Increase After Training(%)	17.6%	18%

ACCEPTABILITY AND FEASIBILITY OF URGENT TELEMEDICINE PEDIATRIC SURGICAL CONSULTATIONS TO REFERRING EMERGENCY DEPARTMENTS: A PILOT STUDY

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Abstract: Purpose

To assess the feasibility of performing telemedicine pediatric surgical consultations (TPSC) for patients in referring Emergency Departments to improve rural access to care and triage efficiency.

Methods

We performed a prospective feasibility study via the statewide children's hospital system from September 2023 through August 2024. TPSCs were offered to providers referring a patient for transfer for a possible surgical problem. Real-time audiovisual consultations were performed via a secure link functional on any internet-enabled device. Available imaging was uploaded and reviewed by the pediatric surgeon and a pediatric radiologist when requested. Primary outcomes included consultation acceptance, ability to technically complete the consultation, and ability to complete a patient evaluation via telemedicine. Secondary outcomes included time to consultation, provider and family satisfaction, patient disposition, and receipt of operation.

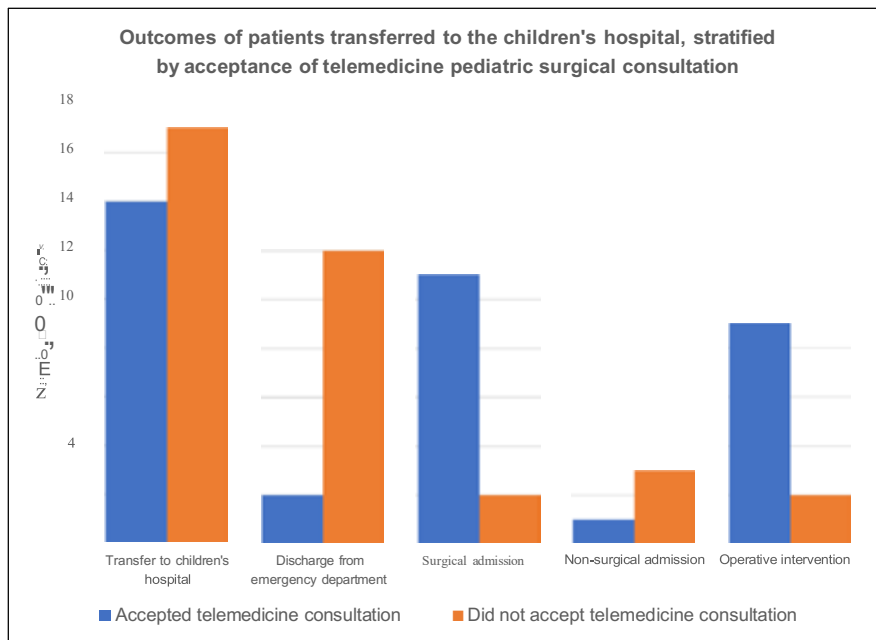
Results

Over 12 months, 67 providers were offered TPSC. Mean patient age was 7.3 years (SD=5.7) with 58% male. The most common chief complaints were foreign body ingestion (n=31, 46%) and abdominal pain (n=23, 34%). Forty-six providers (69%) accepted the consultation. Of accepted consultations, 5 (11%) were not completed due to technical difficulties or difficulties obtaining radiology overreads. The pediatric surgeon was able to form a care plan via telemedicine in all remaining consultations (n=41, 100%). Mean time from initial contact to TPSC was 53 minutes (SD=30.4). Participating providers and families reported high mean satisfaction (family=4.9/5, provider=4.8/5). After consultation, transfer for pediatric-specialized surgical care was recommended for 14 patients (34%); 27 patients avoided transfer. Of those transferred, 64% underwent operation. Among those declining consultation, 15 (71%) were transferred with 8 (53%) receiving surgical consultation upon arrival and only 2 (10%) requiring operation (Figure). Reasons for declining consultation included provider or family preference for transfer and limited resources at the referring facility.

Conclusion

TPSCs were feasible and improved triage of children referred for surgical evaluation. Over two-thirds of providers accepted a TPSC and satisfaction among participating families and providers was high. TPSC has potential to improve access to pediatric surgical care in rural settings and resource utilization among patient referred for transfer, but adaptations are needed to improve provider acceptance.

Abbreviations: TPSC: telemedicine pediatric surgical consultation
SD: standard deviation



EVALUATION OF SMALL GROUP INSTRUCTION WORKSHOPS ON LEARNER INTERACTIVITY, SATISFACTION, AND PERCEIVED VALUE AT AN ACADEMIC PEDIATRIC SURGICAL CONFERENCE

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1Mass General for Children, Massachusetts General Hospital, Boston, MA, USA, 2Warren Alpert Medical School of Brown University, Providence, RI, USA, 3Louisiana State University School of Medicine, New Orleans, LA, USA, 4Pennsylvania State University, University Park, PA, USA, 5Montreal Children's Hospital of the McGill University Health Centre, Montreal, PQ, Canada, 6NYU Grossman School of Medicine, Hassenfeld Children's Hospital at NYU Langone, New York, NY, USA, 7UC Davis Children's Hospital, Sacramento, CA, USA, 8University of Chicago, Chicago, IL, USA, 9Vanderbilt University Medical Center, Nashville, TN, USA, 10State University Of New York Upstate Medical University, Syracuse, NY, USA, 11Stanford School of Medicine, Palo Alto, CA, USA, 12Boston Children's Hospital, Boston, MA, USA

Abstract: Purpose:

Academic conferences traditionally rely on lecture-based instruction, which can lack the interactivity essential for attendees' engagement, learning, and satisfaction. A national pediatric surgical conference recently implemented a novel session format involving small group instruction (SGI). We aimed to evaluate for relationships among these sessions' quality of instruction, learner interactivity, satisfaction, and perceived value.

Methods:

Proposals for SGI workshops, which were 45 minutes and did not include audiovisual support, were submitted by conference attendees and selected by Program Committee (PC) members. Workshop facilitators were advised on best practices for SGI. PC members attending the workshops assessed for incorporation of prespecified effective SGI techniques and interactivity. Participants rated satisfaction via the conference mobile application and value via a post-conference survey. Associations between use of SGI features, interactivity, satisfaction, and perceived value were analyzed using parametric and non-parametric tests.

Results:

The 44 workshops had a median of 39 (IQR 25–64) participants. Thirty-one (70%) were assessed by the PC. The median interactivity rating was 4.0 of 5 (IQR 2.8–5), and sessions used a median of 1 (IQR 0–2, range 0–6) SGI feature. Greater interaction was associated with clearly stated learning objectives (mean 3.9 [SD 1.2] vs. 2.6 [1.6], $p=0.03$) and positively correlated with greater number of SGI features ($R^2=0.11$, $p=0.03$). Workshops with maximum interactivity scores (39%) incorporated more SGI features (2.3 [1.6] vs. 0.86 [1.0], $p=0.002$), more frequently had pre-workshop contact with participants (80% vs. 33%, $p=0.04$), and used open-ended questions (58% vs. 21%, $p=0.02$). Sixty-six participants rated a mean satisfaction score of 8.1 of 10 (SD 1.5, range 5–10). The post-meeting survey had 95 responses (12%) with a median of 20 (IQR 17–23) ratings per workshop. Most workshops were rated as valuable (Table). A valuable rating was positively correlated with greater use of SGI features ($R^2=0.17$, $p=0.01$), particularly summarizing key points (66.8% vs. 58.5%, $p=0.009$).

Conclusions:

The implementation of SGI workshops at a national surgical conference is feasible and effective in promoting learner interactivity and satisfaction. In these workshops, stating clear learning

objectives and using effective SGI techniques are associated with increased learner interaction, satisfaction, and perceived value.

Abbreviations: SGI, small group instruction; PC, Program Committee; IQR, interquartile range; SD, standard deviation

Workshop Feature	Result
Incorporation of effective SGI techniques (percent of workshops)	
Contacting participants prior to workshop	13%
Changing room layout to promote interaction	16%
Asking open-ended questions and pausing to allow reflection	50%
Summarizing key discussion points/takeaways	42%
Value ratings, median for each workshop (IQR), [range]	
Valuable	65.0% (57–70), [42–79]
Somewhat Valuable	32.7% (28–40), [16–50]
Not Valuable	3.3% (0–6.4), [0–16.7]

PC members attending the workshops assessed whether eight prespecified effective SGI techniques were incorporated, with the most frequent displayed above. Others included starting with an ice-breaker activity, dividing the larger group into smaller groups or pairs, allowing individual work prior to group work, and using role plays. Attendees (n = 95) provided value ratings for each of the workshops in a post-conference survey.

COMPOSING THE CLINICAL SUMMARY: SURGEON VERSUS GENERATIVE ARTIFICIAL INTELLIGENCE

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Abstract: Introduction

Clinical summaries are crucial to communication between surgeons to transition care and between primary and consulting surgical teams. Generative artificial intelligence (AI) has demonstrated ability in some domains to summarize a patient's clinical information. However, AI summarization has not yet been rigorously evaluated in a clinical environment. Our study compared the performance of AI summarization to physician written summaries. We hypothesized that AI summaries would not be inferior to physician written summaries.

Methods

For patients admitted to the pediatric surgical floor at our large, free-standing children's hospital in June 2024, we compared AI summaries, written by a proprietary adversarial generative AI model implemented in the electronic health record production environment, to physician written summaries. We used the validated nine item Physician Documentation Quality Instrument (PDQI-9), which uses a 5-point Likert scale to evaluate documentation quality across 9 domains: Up-to-date, Accurate, Thorough, Useful, Organized, Comprehensible, Succinct, Synthesized, and Internally Consistent. Grading was performed by three physician graders.

Results

We evaluated summaries for 50 patients (50 AI and 50 physician summaries) (Table 1). Patients had a mean age of 8.3 years (IQR 1.4 – 14) and were primarily male (60%). Seven patients (14%) were admitted for trauma. Physician-generated summaries scored significantly higher in the categories of "Accurate" (4.01 vs 3.73, $p = 0.003$) and "Succinct" (4.25 vs 3.75, $p < 0.001$). In contrast, AI generated summaries scored significantly higher for "Organized" (4.11 vs 3.77, $p < 0.001$) and "Comprehensible" (4.24 vs 2.99, $p < 0.001$). No significant differences were observed for the other five PDQI-9 items or the total score.

Conclusion

Overall, AI generated summaries were non-inferior to physician written summaries. We found stylistic differences between groups, and the frequent use of locally defined shorthand may limit the usefulness of physician written summaries to non-surgeon providers or trainees. However, AI summaries were less succinct, which may reduce adoption in a field that values efficiency. Lastly, neither physician nor AI generated summaries were free of error. We plan to evaluate how surgeons modify AI generated summaries and will determine the quality of the hybrid approach.

Abbreviations: AI - Artificial Intelligence, PDQI-9 - Physician Documentation Quality Instrument

Table 1. Examples of highest and lowest scoring summaries from each group

Summary	Example	Score
Highest Scoring		
Physician	S/p RL Lobectomy 6/17 (SM). HPI: <input type="checkbox"/> sequestration, s/p LLobectomy . Plan: DAT, saline lock, monitor tachypnea and pain, home later today if improved	43
AI	38 day old M admitted 1 day ago, admitted for laparoscopic pyloromyotomy due to pyloric stenosis. Tolerating feeds, no emesis, pain managed. Discharge planned with oral feeds and Tylenol. Discharge scheduled for today.	45
Lowest Scoring		
Physician	16 ¥ 9,F admitted 1 day ago, patient with PMH of ADAT, MMPC is recovering well post-total thyroidectomy. Pain is controlled, with no acute events or numbness/tinglingnoted.	22
AI	S/p lap pyloromyotomy 6/13. Lytes normal. Plan: Protocol	22

DESIGN AND VALIDATION OF A LOW-COST MODULAR SIMULATOR FOR TRAINING IN NEONATAL LAPAROTOMY AND ATRESIA REPAIR

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Abstract: Purpose

The surgical treatment of neonatal jejunoileal atresia requires highly specialized skills; however, the rarity of this pathology makes training opportunities sparse. We aimed to address this by developing and evaluating a low-cost, high-fidelity, modular simulator to enable comprehensive training in neonatal laparotomy and atresia repair.

Methods

Our design consisted of three primary components: bowel, skin, and abdominal cavity. 3D-printed molds were used to cast silicone models of type II and type IIIa atretic bowel with its mesentery. The skin was created by layering a combination of molded silicone and fabric. A small plastic container, modified with an opening in the lid and 3D-printed bony landmarks attached to it, was used to simulate the neonatal abdomen. The material cost of a single model was approximately \$19.60 Canadian dollars. Seven attending pediatric surgeons and two pediatric surgery fellows (n = 9) performed a simulated jejunoileal atresia repair with our model. The participants provided ratings on a 5-point Likert scale for various questions related to task completion, realism, face validity and content validity. The procedures were recorded and later evaluated by an attending pediatric surgeon.

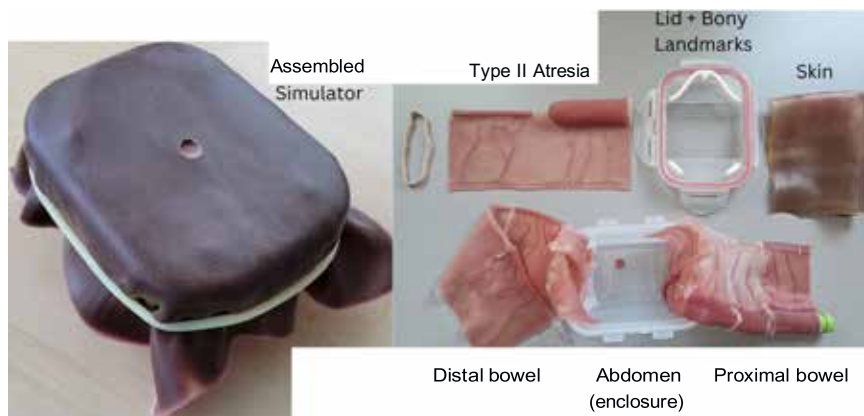
Results

The participants provided positive ratings for the simulator in all categories. The mean ratings for the categories were: 4.2 (task completion), 4.3 (task realism), 4.5 (content validity), 3.6 (face validity), and 4.1 (overall assessment). No significant difference in overall mean ratings between fellows and attendings was observed (p=0.67). Apart from one participant who was neutral, all participants agreed or strongly agreed the model should be implemented as part of surgical training. Additionally, the attendings offered valuable feedback which will be used to improve future iterations of the model.

Conclusion

Our simulator received positive scores in realism, content validity, and face validity. Our analysis indicates our low-cost, accessible simulator can add value to surgical training, especially in low-resource regions with a low surgical workforce density.

Abbreviations:



SUPPLY AND DEMAND: PEDIATRIC SURGICAL SPECIALTIES FELLOWSHIP MATCH TRENDS

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Abstract: Introduction: Surgical specialization plays a critical role in medical training, with fellowships serving as key pathways for career advancement and shaping the pediatric surgical workforce. Given the overlap between subspecialties, skills often complement each other to enhance comprehensive pediatric care. This study examines the balance of supply and demand across pediatric surgical fellowship positions, evaluating trends in individual fields and their collective impact on pediatric surgical care.

Methods: We analyzed available fellowship match data from 2004 to 2024 across nine pediatric subspecialties: Anesthesiology, Cardiac Surgery, General Surgery, Gynecology, Neurosurgery, Orthopedics, Otolaryngology, Plastic Surgery, and Urology. Data were obtained from the National Resident Matching Program, San Francisco Match, and the Pediatric Orthopedic Society of North America. Applicant-to-position ratios were calculated, with values of 1 indicating balance, >1 reflecting higher demand, and <1 indicating lower demand. Statistical analysis was performed using Least Squares Regression and ANOVA in SPSS.

Results: Nine subspecialties were assessed (excluding Ophthalmology due to incomplete data). Higher demand than available positions was found in Pediatric General Surgery (1.80, SD=0.22), Cardiac Surgery (1.58, SD=0.59), Gynecology (1.35, SD=0.20), and Orthopedics (1.10, SD=0.20). Specialties with lower demand included Urology (0.81, SD=0.08), Plastic Surgery (0.90, SD=0.12), Anesthesiology (0.93, SD=0.20), Otolaryngology (0.95, SD=0.14), and Neurosurgery (0.98, SD=0.21). An analysis of trends showed that two subspecialties (Urology and Orthopedics) saw a rise in applicant interest while seven (Otolaryngology, Gynecology, Neurosurgery, General Surgery, Cardiac Surgery, Anesthesiology, and Plastic Surgery) saw a decline in applicant interest. This decline was most notable for three fields with an average number of unfilled positions for Anesthesiology (19, SD=38), Urology (5, SD=2), and Plastic Surgery (3, SD=3).

Conclusion: The findings suggest that while Pediatric General Surgery, Cardiac Surgery, Gynecology, and Orthopedics continue to attract strong interest, other fields such as Urology, Plastic Surgery, and Anesthesiology face challenges with unfilled fellowship positions. This trend poses potential risks for the future of pediatric surgical care, as an imbalance between the supply of specialists and the growing demand for specialized care could lead to gaps in patient services. Addressing these imbalances is crucial to sustaining a well-rounded, highly qualified pediatric surgical workforce.

Abbreviations: ANOVA - Analysis of Variance

SPSS - Statistical Package for Social Sciences

SD = Standard deviation

A RANDOMIZED FEASIBILITY STUDY OF VIRTUAL AND FACE-TO-FACE CARE USING A NOVEL MOBILE HEALTH SOLUTION FOR OUTPATIENT PEDIATRIC BURNS

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Abstract: Introduction: Pediatric burn injury remains a major public health issue, with approximately 120,000 injuries annually in the US. Historically, more than 90% of pediatric burns can be managed on an outpatient basis, with many patients traveling long distances to reach a burn center. To address these geographic disparities, we created a smartphone application, Telemedicine Optimized Burn Intervention (TOBI), to provide expert burn care while the patient is treating a burn at home in the acute phase of care. We performed a feasibility study to determine the contingency of a future multicenter randomized control trial of burn care utilizing TOBI.

Methods: 65 patient/caregiver dyads were recruited from the outpatient burn clinic or emergency room and were randomized to burn care enhanced with TOBI (n=32) or face-to-face (FTF) standard care (n=33). Participation, study retention and clinical outcomes were assessed at baseline and each TOBI or clinic visit to determine signals of efficacy for future power calculations.

Results: The average participant age was 7.8 (1-16) vs. 5.5 (1-17) years with 2.4 (1-7.5) vs 2.2 (1-6) % TBSA partial thickness burns in the TOBI and FTF groups respectively. Retention rates for TOBI were 65.6% compared to 54.5% in the FTF group (p=0.37). We also noted a trend toward better adherence to burn care (84.9% vs. 76.8%, p=0.36), decreased travel time (2.3 vs. 4.0 hours, p=0.04) and less cost to families (\$605.87 vs. \$726.41, p=0.76) in the TOBI group. Interestingly, patients and their parents using TOBI reported significantly lower pain scores over the course of the study. Overall, both groups endorsed high satisfaction with their care and a highly usable app with few technology issues and no adverse events or infections reported in either group.

Conclusion: We conclude that the use of mHealth and virtual visits for outpatient burn management in children shows potential to improve treatment adherence for burn care as well as decrease the overall cost and travel time for follow up. This study demonstrates the feasibility of testing TOBI, a scalable, low-cost intervention, in a multicenter RCT.

Abbreviations: TOBI-Telemedicine Optimized Burn Intervention

FTF-Face to face

TBSA-Total Body Surface Area

mHealth-Mobile health

RCT-Randomized Control Trial

TOBI 2 Feasibility Measures

Number of participants agreeing to participation	65/83 (78.3%)	
Reasons for not participating (n=18)		
Does not qualify	8/18 (44.4%)	
Not interested in telemedicine	7/18 (38.9%)	
Time restraints	3/18 (16.7%)	
Participants retained in study		
Total	39/65 (60.0%)	
TOBI Group	21/32 (65.6%)	
<u>EfEGroup</u>	18/33 (54.5%)	
Reason for lack of retention (n=26)	TOBI Group (n=11)	FTF Group (n=15)
Lost to follow up	11/11 (100%)	14/15 (93.3%)
Not interested	0/11 (0%)	1/15 (6.7%)
Number of participants with adverse events	0/65 (0%)	
Number of <u>reported technology</u> issues	1 <u>reported</u>	

ASSESSING THE FEASIBILITY OF SHAPE-SENSING ROBOTIC BRONCHOSCOPY MAPPING TO LUNG NODULES IN PEDIATRIC PATIENTS

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Abstract: Purpose

Pulmonary nodule localization is essential for many minimally invasive diagnostic and therapeutic procedures in children with cancer. Unlike CT-guided coil, wire, and dye localization techniques which require CT facilities, robotic bronchoscopy can be performed intraoperatively for nodule identification. Robotic bronchoscopy is becoming the preferred localization modality in adult thoracic surgery, but its utility in pediatric cancer surgery is unknown. In this study, we examined the feasibility of robotic bronchoscopy including bronchial tree mapping and nodule localization in children.

Methods

We identified 14 pulmonary nodules in 11 patients aged 2-17 years on existing thin-slice chest CT scans from 2021-2023. Nodules were categorized into central (near tracheobronchial tree) or peripheral (near visceral pleura). For each lesion, Ion PlanPoint™, a 3D navigation software, generated a bronchoscopy route to the nodule recording the target-to-lesion throw distance and the airway diameter. If the generated pathway had a distance greater than 3 cm or target airway diameter less than 3 mm, we manually adjusted the pathway to satisfy these conditions. If after manual adjustment the size parameters were still not met, then the pathway was considered unfeasible. For validation, we randomly placed 34 virtual nodules in existing chest CT scans for 17 patients ages 10 months to 17 years. These nodules underwent similar pathway modeling and testing.

Results

Of the 11 patients with the existing nodules, 67% of peripheral nodules (8/12) and 100% of central nodules (2/2) were feasibly mapped. When examining the feasibility of the virtual nodules, 65% of peripheral nodules (11/17) and 100% of central nodules (17/17) were mapped. The average target-to-lesion throw was 28.4 mm for peripheral nodules and 9.4 mm for central nodules. Notably, patient age did not predict feasibility.

Conclusions

Given the success of our bronchial tree mapping and nodule identification, we conclude that robotic bronchoscopy is a feasible approach to pulmonary nodule localization within a broad range of the pediatric population. Peripheral location, but not young age, was a detriment to successful pathway mapping. Future studies will aim to use robotic bronchoscopy in pediatric practice, which may serve as an alternative to more invasive and time-consuming procedures.

Abbreviations:

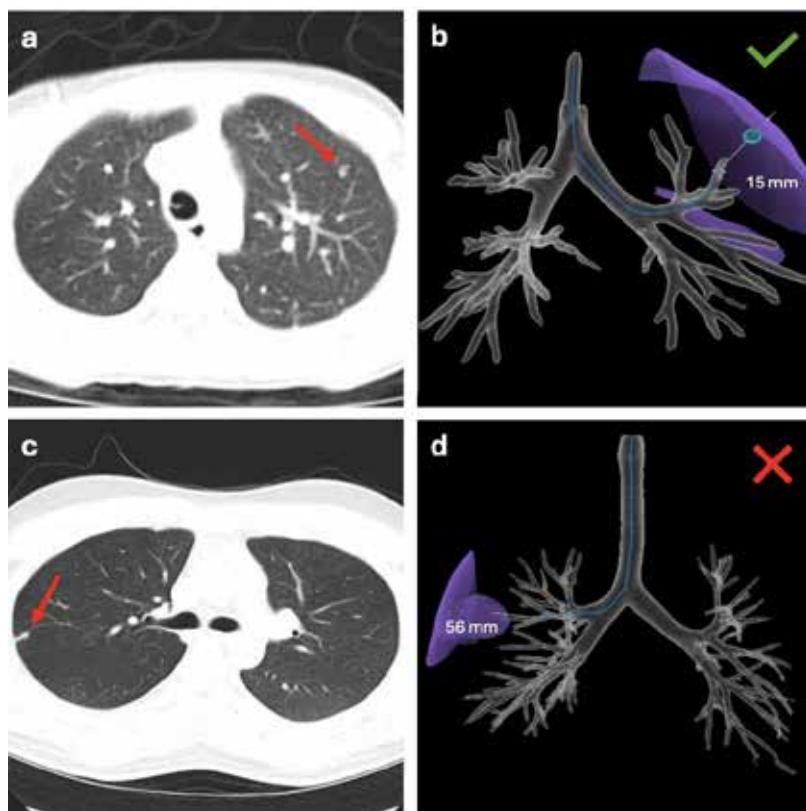


Figure 1. Comparison of bronchoscopy mapping between 4-year-old and 17- year-old.
 (a) An axial CT demonstrating a left upper lobe nodule in a 4-year-old female and (b) the corresponding tracheobronchial tree and feasible 15 mm throw mapped with PlanPoint.
 (c) An axial CT demonstrating a right upper lobe nodule in a 17-year-old male and (d) the corresponding tracheobronchial tree and unfeasible 56 mm throw mapped with PlanPoint.

Wednesday, May 7, 2025

Scientific Session 3 - Trauma

2:00 PM – 3:30 PM

S80

ANALYSIS OF PROPER RESTRAINT USAGE AMONGST PEDIATRIC PATIENTS - A NATIONAL REVIEW

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Abstract: Purpose: State-specific laws on restraint use in children is inconsistent. Many laws reference height and weight categories, while others only reference age limits. Studies have shown that proper restraint usage in children dramatically reduces serious injury in motor vehicle crashes (MVCs). Given this, our objective was to describe reported vehicle restraint use and type with respect some of the commonly used age, height and weight limits contained in various US state laws.

Methods: This was a retrospective study utilizing data from the American College of Surgeons Trauma Quality Project (TQP) database. Patients aged 1 to 17 injured in MVCs were selected for further analysis. The variables of interest were age-specific height and weight and how these related to vehicle restraint type. The percentiles for age were used to assist exclusion of outliers. A search of restraint laws, the most commonly used height for shoulder/lap belt restraint use was 57 inches. Commonly used restraint law specifications were used to define potentially improper restraint use. A descriptive and graphical analysis was used to summarize the data with respect to the commonly used restraint law specifications.

Results: Following application of inclusion/exclusion criteria, 63,002 children had complete information for height and weight. More than a quarter (27.7%) of the children fell below the 57" height requirement for shoulder/lap restraint use. Among those not meeting the height requirement, 24.3% were reported as using a shoulder/lap restraint without and additional child restraint device and another 33.3% had no restraint recorded. Of the children under 20lbs, 22.1% had no restraint use reported. At the 40 lb cutoff child restraint dropped to 54.4%, and 33.3% had no restraint. Child restraint use was 42.4% in children < 60 lbs., shoulder/lap belt use was 15.4%, and no restraint 33.3%. No restraint proportion was 33.6% in the < 80lb group, and 22.1% were using a shoulder/lap belt.

Conclusion: In addition to high proportions of children being unrestrained in MVCs, we found many are potentially improperly restrained based commonly used age, height and weight requirements. In state laws that only contain age limits even larger proportions would not meet the height/weight requirements.

Abbreviations: MVC: Motor vehicle crash
TQP: Trauma quality project

Percent Restraint Usage				
	Child Restraint System	Shoulder/ Lap Belt	Lap Belt Only	None
Wt <20lbs	73.5%	1.77%	2.65%	22.1%
Wt <40lbs	54.4%	6.96%	5.26%	33.3%
Wt <60lbs	42.4%	15.4%	8.86%	33.3%
Wt <80lbs	33.6%	22.1%	10.7%	33.6%
Ht <57in	31.1%	24.3%	11.4%	33.3%

WHY DID THE CHILDREN CROSS THE ROAD? THE RELATIONSHIP BETWEEN ROADWAY DESIGN AND SEVERE PEDIATRIC TRAUMA IN PEDESTRIANS STRUCK BY MOTOR VEHICLES

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1Yale New Haven Children's Hospital, New Haven, CT, USA, 2Nationwide Children's Hospital, Columbus, OH, USA, 3Burton Planning Services, Columbus, OH, USA, 4Division of Pediatric Surgery, Department of Surgery, Nationwide Children's Hospital, The Ohio State University College of Medicine, Columbus, OH, USA, Columbus, OH, USA, 5Yale University School of Medicine, New Haven, CT, USA

Abstract: Purpose: Driving speed can be statutorily controlled through speed limits but also modulated through changes to the built environment. Increasing intersection density has previously been shown to lower driving speeds. This study hypothesized that decreased intersection density would correspond with more severe injuries when children were struck by motor vehicles.

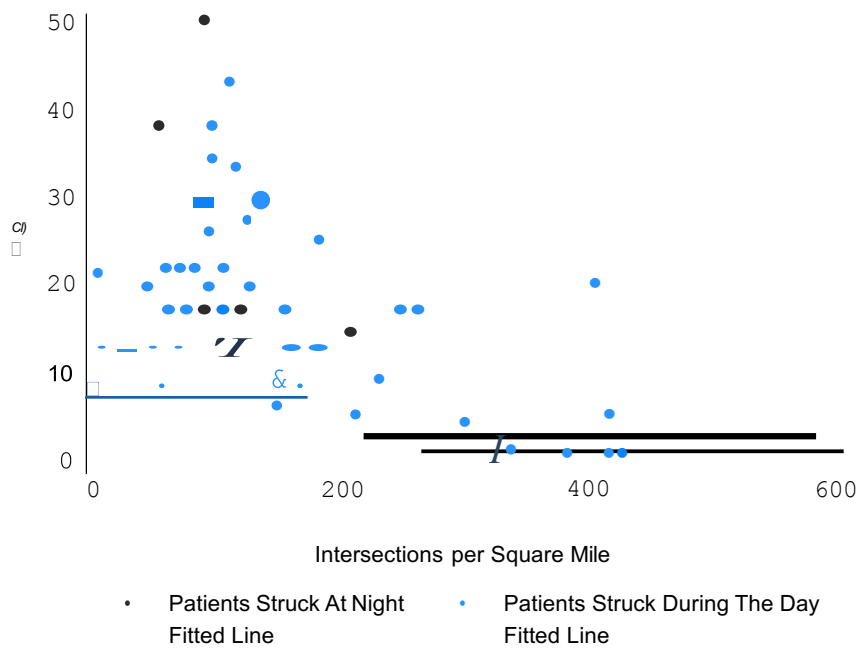
Methods: The Ohio Department of Transportation collision dataset was queried for all pedestrians/cyclists younger than 18, who were struck by a motor vehicle between 2019-2023. Each collision was mapped to a census tract. Intersections and road miles per square mile were derived from the National Walk Index. Individuals identified in the dataset were matched on crash proximity to hospital, age, gender, and date to patients in the Pediatric Health Information System at five pediatric hospitals in Ohio, with a diagnostic code for pedestrian/cyclist struck by motor vehicle. Primary outcome was mean calculated injury severity score (ISS), as derived from ICD-10 diagnostic codes.

Results: There were 2,518 pedestrians struck by a motor vehicle, 440 of whom (17.5%) were successfully matched to encounters at a children's hospital in Ohio. Patients were predominantly male (62.3%), non-white (70.0%), without commercial insurance (82.7%), and with an average age of 10.6 years (SD=4.5). Median calculated ISS was 3 (IQR 1-5), with 33 severely injured patients (7.6%) and four patients who died (0.9%). Multivariate analysis controlling for road miles per square mile, sex, age, race, payor, tract SVI, tract population, crashes related to speed, alcohol or drugs, and crashes occurring at nighttime, demonstrated that for each additional 10 intersections per square mile there was a 2.8% reduction in ISS (IRR 0.972, 95%CI 0.96-.985, Figure 1). Patients struck at night had an ISS 60% higher than those struck during the day (IRR 1.59, 95%CI 1.40-1.82).

Conclusion: We conclude that when child pedestrians are struck by a motor vehicle, low intersection density and nighttime collisions correlate with increased injury severity. This highlights tangible local policy changes—such as, increased crosswalks and roadway designs to slow traffic, which could affect traffic similarly to intersections, and street lighting—that could be implemented to decrease the severity of injuries in struck pediatric pedestrians.

Abbreviations: ISS: Injury Severity Score

ICD-10: International Classification of Diseases, Tenth Revision



IMPACT OF HOSPITAL MORTALITY IN PEDIATRIC PATIENTS WITH SEVERE BLUNT ABDOMINAL TRAUMA

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Abstract: Background: Blunt abdominal trauma is a significant cause of mortality in pediatric patients. This study evaluates the impact of hospital volume on mortality rates in trauma patients < 18 years with an injury severity score (ISS) > 25 and blunt abdominal trauma, hypothesizing that lower volume centers are associated with increased mortality.

Methods: We analyzed severely injured pediatric patients suffering blunt abdominal trauma (ISS ≥ 25) within the National Trauma Data Bank (NTDB) 2017-2019. Using the median of the total volume distribution of abdominal trauma (ISS ≥ 25) cases per year, hospitals were categorized into higher-volume centers (HVCs) (≥ 8 cases/year) and lower-volume centers (LVCs) (< 8 cases/year) for Bivariate analysis. Multivariate mixed effect logistic regression was also conducted where facilities were divided by volume tertiles.

Results: Of 6499 included patients, 3252 (50.1%) were treated at HVCs and 3247 (49.1%) at LVCs. HVC patients were younger (mean: 12.36 vs. 13.91 years, $p < 0.0001$) and had less males (63.8% vs. 67.4%, $p = 0.002$). HVCs had increased rates of intubations (31.0% vs. 24.1%, $p < 0.0001$) and ICU admissions (53.3% vs. 49.8%, $p < 0.0001$). Additionally, patients at HVCs were more often treated in verified American College of Surgeons Level I trauma facilities (55.0% vs. 34.8%, $p < 0.0001$) and verified pediatric Level I facilities (47.7% vs. 9.6%, $p < 0.0001$). The in-hospital mortality rate at LVCs was higher (15.8% vs. 17.5%, $p < 0.001$) compared to HVCs. Multivariable analysis showed that treatment at low-volume centers was associated with a significant increase in mortality risk (OR=1.29, 95% CI 1.06-1.68, $p = 0.01$).

Conclusion: Pediatric patients with severe blunt abdominal trauma treated at LVCs had a significantly higher in-hospital mortality rate. Future research should focus on identifying and standardizing best practices to improve outcomes, morbidity and mortality across trauma centers of varying patient volumes.

Abbreviations: ISS: injury severity score
NTBD: national trauma database
HVC: high volume center
LVC: low volume center

Table I: Distribution of Patient Characteristics Stratified by Volume of Facility Providing Treatment

Characteristic	Volume ≥ S (n=3252)	Volume < S (n=3247)	p-value
Age (mean, median standard deviation)	111236, 14, 5.27	111391, 16, 4.83	$p < 0.0001$
Sex: Male	112011 (63.87%)	112191 (67.48%)	ICJ
Sex: Female	111009 (36.1%)	111056 (32.52%)	
Intubation: Yes	111009 (31.03%)	111784 (24.15%)	$p < 0.0001$
Emergency admission	111677 (53.31%)	111393 (49.87%)	$p < 0.0001$
Operating Room	111126 (35.79%)	111243 (44.50%)	$p < 0.0001$
ACS Verification Level I	111791 (55.07%)	111132 (34.86%)	$p < 0.0001$
Pediatric Verification Level I	111154 (47.79%)	11314 (9.67%)	$p < 0.0001$
Patient Expired: Yes	111515 (15.84%)	111569 (17.52%)	$p < 0.0001$

WHOLE BLOOD RESUSCITATION IN PEDIATRIC TRAUMA: A NATIONAL ANALYSIS OF USE AND ASSOCIATED OUTCOMES

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1University of Colorado, Plain City, OH, USA, 2Children's Hospital of Colorado, Denver, CO, USA, 3Center for Children's Surgery / Research Outcomes in Children's Surgery / Children's Hospital Colorado, Aurora, CO, USA, 4Departments of Anesthesiology and Emergency Medicine, Aurora, CO, USA, 5University of Colorado / Children's Hospital Colorado, Aurora, CO, USA, 6Children's Hospital of Colorado, Aurora, CO, USA

Abstract: Purpose: Hemorrhagic shock and need for blood transfusion are predictors of mortality in pediatric trauma. In adult trauma patients, the use of whole blood (WB) as the primary resuscitative fluid is increasing due to the documented improvement in survival. WB resuscitation in pediatric trauma patients is increasing with limited data documenting similar benefits. This study aimed to evaluate trends in use of WB in pediatric trauma over time and assess its impact on mortality and outcomes.

Methods: We performed a retrospective cohort study of the Trauma Quality Improvement Program (TQIP) database from 2017-2022. Patients ≤ 18 years who received a blood transfusion within 24 hours of hospital arrival were stratified into those receiving any WB and those receiving only component therapy (CT). The primary outcome was total volume of blood transfused. Generalized linear regression was used to predict secondary outcome measures including mortality, hospital length of stay (LOS), ICU LOS, mechanical ventilation days, sepsis, acute kidney injury (AKI), acute respiratory distress syndrome (ARDS), and unplanned ICU admission.

Results: We identified 20,338 patients: 1,780 received WB and 18,558 received CT. From 2017 to 2022, there was a 14.0% increase, 12.9% increase, and 1.3% decrease in patients receiving WB at adult, mixed adult-pediatric, and pediatric facilities, respectively. WB had increased volume of blood transfused as compared to CT (3.04 vs 2.04 units, $p < 0.001$). Adjusting for age, sex, injury mechanism, injury severity score (ISS), total units of blood products transfused and hemorrhage control interventions, WB group had a 12% decrease in hospital LOS (Table1). In contrast, WB and CT patients had no statistically significant differences in risk of mortality and other secondary outcomes when adjusting for the same aforementioned variables.

Conclusion: In pediatric trauma, patients who received WB resuscitation received one more unit of blood products than those receiving CT. After controlling for confounding factors, there were no differences in outcomes, including mortality, between children receiving WB and those receiving only CT. In the study period, there is a steady increase in the number of children receiving WB at adult and mixed adult-pediatric facilities, but an overall decrease at pediatric facilities.

Abbreviations: WB- Whole blood

CT- component therapy

TQIP - trauma quality improvement program

LOS- length of stay

ICU - intensive care unit

AKI - acute kidney injury

ARDS - acute respiratory distress syndrome

ISS- injury severity score

Figure 1. Negative Binomial or Logistic Regression Analyses Predicting Outcomes in the Pediatric TQIP Population Receiving Whole Blood and Component Therapy vs. Component Therapy Alone

<i>Predictor Outcomes</i>	<i>Incidence Rate/Odds Ratios</i>	<i>CI</i>	<i>p</i>
Inpatient mortality	1.07	0.93, 1.23	0.321
Hospital LOS	0.88	0.84, 0.93	<0.001*
ICU LOS	0.99	0.94, 1.05	0.774
Ventilator days	0.98	0.93, 1.05	0.613
Sepsis	1.19	0.68, 1.96	0.519
AKI	1.06	0.73, 1.51	0.735
ARDS	0.93	0.61, 1.37	0.737
Unplanned ICU Admission	1.18	0.86, 1.57	0.294

Models are adjusted for age, sex, weight, injury mechanism, ISS, total units of blood products and hemorrhage control intervention

A PEDIATRIC-FOCUSED HOSPITAL-BASED VIOLENCE INTERVENTION PROGRAM IMPROVES EDUCATIONAL AND JUVENILE COURT OUTCOMES IN VIOLENTLY INJURED PEDIATRIC TRAUMA PATIENTS

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Abstract: Purpose: Hospital-based Violence Intervention Programs (HVIPs) are multidisciplinary programs that combine the efforts of medical staff with community-based partners to provide safety planning, wraparound services, and trauma-informed care to violently injured people, many of whom are those most marginalized in our society. The SHIFT (Supporting and Healing Individuals from Trauma) Program at an ACS-verified Level 1 Pediatric Trauma Center supports victims of violent injuries and their families to decrease the risk of continued violence and long-term effects of adverse childhood experiences. We seek to prove enrollment in the SHIFT Program leads to a positive impact in the lives of pediatric victims of violent trauma.

Methods: All victims of violent injury (< 18 years of age) were eligible for enrollment into SHIFT for 6-12 months depending on need. Violent injuries include gunshot wounds (GSW), knife stab wounds (KSW) and assault. Domestic violence, child abuse and sexual assault were excluded. Victims are provided links to community-based services, mentoring, home visits, follow-up assistance, and long-term case management. Primary outcomes were school enrollment, violent injury recidivism, and juvenile court involvement at one year. Chi square analysis was used to compare outcomes to baseline data (level of significance $p=0.05$).

Results: Over 2 years, 142 patients and families were enrolled with a mean age of 12.9 years. Injuries included 74% GSW, 20% assault, and 6% knife stab. On enrollment, 56% of patients were enrolled and regularly attending school which improved to 84% after enrolling in the program ($p<0.001$). Previous violent injury occurred in 12% of patients at enrollment and violent injury recidivism was 8% at 1 year follow up ($p=0.3753$). Overall, 8% of patients had been adjudicated by juvenile court in the past with only 5% with juvenile court involvement after enrollment ($p<0.0001$). Most of these patients had been previously adjudicated (46%). Six of the previously adjudicated kids did not have further charges after enrollment.

Conclusion: A Pediatric Hospital-based Violence Intervention Program providing resources to positively impact the lives of child victims of violence improves outcomes by significantly increasing educational achievement and decreasing juvenile court involvement.

Abbreviations: HVIP (Hospital-Based Violence Intervention Program)
SHIFT (Supporting and Healing Individuals From Trauma)
ACS (American College of Surgeons)
GSW (Gunshot Wound)
KSW (Knife Stab Wound)

THE ROLE OF DIAPHRAGM PACING IN PEDIATRIC SPINAL CORD INJURY: DECREASING INVASIVE MECHANICAL VENTILATION

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1University Hospitals/ Case Western Reserve University, Cleveland, OH, USA, 2Case Western Reserve University/University Hospitals, Cleveland, OH, USA, 3Rainbow Babies and Children Hospital, Cleveland, OH, USA

Abstract: Purpose: Pediatric spinal cord injury (SCI) is a rare but morbid condition, as pediatric injuries are often in the cervical spine, with higher levels of injury more likely requiring tracheostomy for ventilation. Diaphragm pacing may be a novel way to reduce the amount of total mechanical ventilation for these patients. This study aims to evaluate our institution's outcomes following diaphragm pacing in pediatric patients with SCI.

Methods: This is a retrospective study of all pediatric patients undergoing diaphragm pacing associated with SCI at a single institution from 2000 to 2023. Descriptive statistics were performed and measures of patient dependency on the ventilator were examined.

Results: Of the 42 pediatric patients (ages 0 to 18 years) that have undergone diaphragm pacer placement, 18 (13 male) patients were diagnosed with traumatic SCI with etiologies including motor vehicle accidents (15), sports injury (2), and gun violence (1). Their median ages at injury and at implantation were 4.50 years (range: 0.9-17.0) and 9.59 years (range: 1.10-17.5), respectively, with a median weight at surgery of 27.7 kg (range: 8.1-81.0). Highest SCI levels were C1 (8), C2 (8) and C4 (2). Before pacing, patients spent a median of 16.4 months (range: 0-91.9) on mechanical ventilation. Ten (55.5%) patients were able to replace mechanical ventilation with pacing full-time. Three (16.7%) patients were paced 12-16 hours daily with one patient pacing 3-4 hours daily. Four patients regained autonomous breathing with tracheostomies decannulated in 3 and tracheostomy placement avoided in 1. The median months of continuous pacing use was 111.5 months (range: 6.0-188.0). There were 3 (16.7%) deaths in our cohort, but none were respiratory-related, and 2 patients lost to follow-up.

Conclusion: We conclude that there is utility in diaphragm pacing to reduce or replace mechanical ventilation in pediatric patients with traumatic spinal cord injuries, without additional perioperative or long-term complications. Future comparative studies will help further identify its benefits as an adjunct in treatment of pediatric patients with spinal cord injuries.

Abbreviations: SCI - Spinal Cord Injury

UNDER PRESSURE: IDENTIFYING FACTORS FOR PEDIATRIC PATIENTS WITH SEVERE TRAUMATIC BRAIN INJURY WHO BENEFIT FROM EXTERNAL VENTRICULAR DRAINAGE

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Abstract: Purpose:

The role of external ventricular drainage (EVD) in the management of pediatric traumatic brain injury (TBI) has been poorly defined. Guidelines for EVD use to manage intracerebral pressure (ICP) remain vague. Recent analysis demonstrated that EVDs were associated with better discharge disposition compared to ICP monitoring alone. Using a large, national database we sought to identify factors associated with improved survival from EVD placement to control ICP.

Methods:

Children (< 16 years) with a severe blunt TBI (GCS < 8 or categorized as incapacitated) who received an EVD within 48 hours of admission were identified in the Trauma Quality Improvement Program (TQIP) from 2016-2022. Those who experienced penetrating trauma, underwent craniotomy/craniectomy within 48 hours of admission, or had an open skull fracture were excluded. Primary outcomes were in-hospital mortality and disposition location. EVD procedure volume at each center was also evaluated. Competing risks frailty models were utilized for multivariate analysis and were stratified by length of stay (LOS) < 48 hours, 48 hours to 5 days, and > 5 days.

Results:

A total of 898 patients were included with a mean age of 8.44 (SD 4.91) years. There were 194 deaths (21.6%). On univariate analysis, there was no effect of age or center EVD volume on mortality or disposition while ISS, head AIS, and GCS were significant (all $p < 0.05$). On multivariate modeling, center EVD volume was associated with decreased mortality for patients with a LOS < 48 hours (though this group failed to meet clinical significance (HR=0.84, CI: 0.69-1.03, $p=0.089$)) and for those with a LOS >5days with a HR of 0.81 (CI 0.69-0.95, $p=0.009$). This relationship persisted despite including a frailty factor to account for the clustering of individual centers.

Conclusion:

Patients admitted to higher-volume centers for EVD are more likely to survive. These centers, which handle a greater number of EVD procedures for severe pediatric traumatic brain injury, may exhibit key advantages such as faster response times, standardized management protocols, access to specialized treatments, and advanced neurorehabilitation options. Understanding these differences can shed light on the improved outcomes observed in high-volume centers.

Abbreviations: external ventricular drainage (EVD)

traumatic brain injury (TBI)

intracerebral pressure (ICP)

Glasgow Coma Scale (GCS)

Trauma Quality Improvement Program (TQIP)

length of stay (LOS)

Injury severity score (ISS)

Abbreviated injury score (AIS)

Hazard Ratio (HR)
Confidence Interval (CI)

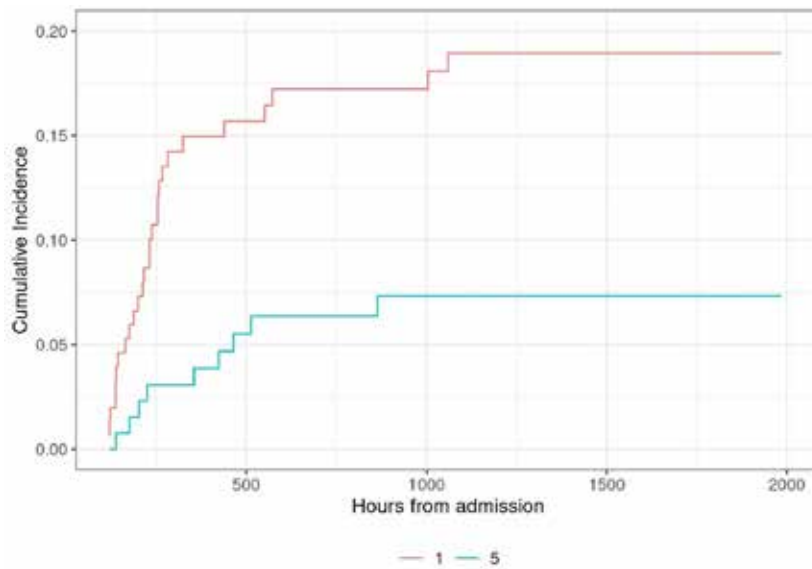


Figure 1: Cumulative Incidence of mortality from Competing Risks Frailty Multivariable Model comparing the highest and lowest EVD volume centers in patients with a LOS > 5 days

COMPARATIVE OUTCOMES OF PROXIMAL STOMA VERSUS PRIMARY ANASTOMOSIS IN PEDIATRIC COLORECTAL TRAUMA

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Abstract: Introduction: There is a lack of consensus regarding optimal surgical management of pediatric colorectal trauma (PCRT). Historically, fecal diversion via proximal stoma (PS) was the standard of care. However, recent studies have suggested that primary anastomosis (PA) is safe. We aimed to compare national outcomes between PS and PA for PCRT, hypothesizing improved mortality with PA.

Methods: A retrospective study using the National Trauma Data Bank (2018–2022) was conducted. Patients ≤18 years old with a colon and/or rectal injury who underwent either PS or PA were included. PS was defined as fecal diversion using an end stoma proximal to the colorectal injury; PA was defined as any colon and/or rectal anastomosis without proximal fecal diversion. Descriptive statistics, Kaplan-Meier survival curves and logistic regression were performed to compare outcomes.

Results: 2,920 patients were included: 371 (12.7%) PS vs. 2,549 (87.3%) PA. There were no differences in age, sex, race, and ethnicity (all $p > 0.05$) between cohorts. Injury Severity Score (ISS) was also not significantly different between cohorts ($p = 0.11$). PS patients had a higher proportion of rectal injuries (56.3% vs. 11.4%, $p < .0001$). After surgery, PS patients had increased ICU length of stay (8.2 vs. 9.4 days, $p < .0001$), deep space surgical site infections (3.5% vs. 1.8%, $p = .05$), returns to the operating room (6.19% vs. 2.98%, $p = .003$), and discharge to long-term care facilities (10.5% vs. 5.29%, $p < .05$). PS patients also had a decreased rate of mortality (1.6% vs. 5.45%, $p = .0007$) as well as decreased odds of mortality (OR 0.96, $p = .001$) when controlling for age, gender, ISS, rectal injury, solid organ injury, and TBI.

Conclusions: Mortality rates after fecal diversion with PS for PCRT were lower than with PA. However, PS comes with a variety of worse outcomes such as return to OR, and surgical site infections when compared to PA. Proper selection is likely key to achieving optimal outcomes in this patient population. Future prospective studies are needed to ascertain which subgroup of children benefit most from PS.

Abbreviations: PCRT= Pediatric Colorectal Trauma

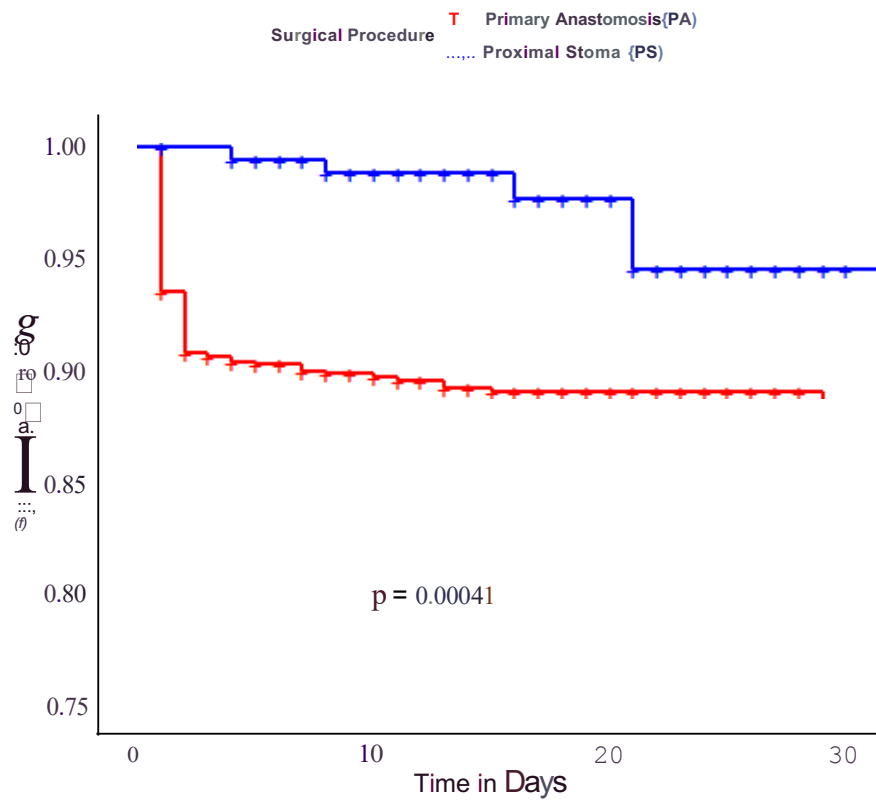
PS= Proximal Stoma

PA= Primary Anastomosis

ISS= Injury Severity Score

TBI= Traumatic Brain Injury

Thirty Day Survival Probability After Colorectal Trauma: Anastomosis vs. Stoma



S88

RURAL PEDIATRIC TRAUMA: ARE ALL TRANSFERS NECESSARY?

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Abstract: Purpose: The purpose of this study is to delineate transfer patterns to a rural Level 2 pediatric trauma center by identifying common diagnoses associated with potentially avoidable transfers to a higher level of care with the end goal of optimizing resource utilization in the center's catchment area.

Methods: Using trauma registry data, every pediatric trauma patient (< 15 years old) transferred to our Level 2 trauma center from January 2017 to December 2023, was included. "Potentially avoidable transfers" were characterized as patients who, upon arrival at the trauma center, did not undergo any additional testing or intervention and were discharged from the emergency department or after one midnight. Descriptive statistical analysis was performed to characterize the transferred population and identify diagnoses frequently associated with potentially avoidable transfer.

Results: 890 patients were identified who met the inclusion criteria. The average age of all patients was 5.8 and the mode was < 1 year of age. 66% of this cohort were Caucasian, and 25% were Native American. Of these patients, 504 were discharged from the ER or after a single midnight in the hospital and 113 underwent no additional testing or intervention. The cohort of patients discharged in less than a day had an ISS of 6.14, while the length of stay >1 midnight cohort had a mean ISS of 13.3. Of the patients whose length of stay was 1 midnight or less and had no intervention at the pediatric trauma facility, 93 were considered potentially avoidable. 34% of patients in this cohort were uninjured, 27% had a closed skull fracture, 19% suffered a concussion, and the remainder were found to have only superficial abrasions or contusions.

Conclusion: In conclusion, resource utilization in a catchment area involving vast rural areas is crucial to ensuring that services needed in times of emergency are available in a timely fashion. Initial analysis of transfer patterns reveals consistent diagnoses associated with potentially avoidable transfers. Additional evaluation of data may yield other diagnoses that could be monitored at referring centers. These findings are vital to developing appropriate patient centered transfer protocols for our rural state.

Abbreviations: ISS = Injury Severity Score

COMPARATIVE OUTCOMES BETWEEN MILITARY AND CIVILIAN CHILDREN AFTER NON-ACCIDENTAL TRAUMA: A MULTICENTER RETROSPECTIVE STUDY

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Abstract: Background

Non-accidental trauma (NAT) or child physical abuse (CPA) is associated with many social factors including low socioeconomic status, mental health difficulties, and substance use. Military families are uniquely vulnerable to experiencing abuse, and NAT in military children has been linked to periods of increased stress, including deployments. NAT outcome data in military-dependent children are limited to a single-center study showing longer length of stay (LOS), higher mortality, and more complications.

Methods

A retrospective review was conducted of children (≤ 18 years) at 8 US children's hospitals from 2018-2023 with NAT confirmed by each center's multi-disciplinary child abuse team. Exclusion criteria included sexual abuse, neglect, or unconfirmed cases of NAT. Military affiliation was determined by insurance coverage (TRICARE or CHAMPVA) or caregiver self-identification documented in the clinical notes. The primary outcome was mortality and LOS. Secondary outcomes included the number of specialty consultations, need for operations, and 30-day readmissions. Comparisons were made between military and civilian patients.

Results

A total of 415 patients were diagnosed with NAT (61 [14.7%] were military-affiliated and 61.9% were male). Military patients were significantly younger and lived in areas with a lower median area deprivation index (ADI) both in terms of national and statewide comparisons (Table). Mechanism of injury, median Glasgow Coma Scale (GCS), injury severity score (ISS), and abbreviated injury scores (AIS) did not differ between cohorts. Military children were more likely to have a skull fracture (29.5 vs. 17.5, $p=.02$). There was no difference in the number or type of specialty consults, need or type of operative intervention, and 30-day readmission or ED visits. However, military children had double the median LOS of civilian patients (2 vs. 4 days, $p=.05$).

Conclusion

In a large, multicenter study, military children affected by NAT were younger and had a longer LOS, despite equivalent injury severity. Although the mechanism of injury and AIS distribution were similar, military patients were more likely to have a skull fracture. Military children lived in areas with less socioeconomic deprivation. This is the first multicenter study performed to characterize a high-risk population and advocate for greater support for military families.

Abbreviations: Non-accidental trauma (NAT), CPA (child physical abuse), length of stay (LOS), area deprivation index (ADI), Glasgow Coma Scale (GCS), abbreviated injury scale (AIS)

Table:

	Civilian Patients (n=354)	Military Patients (n=61)	p
Age			
<6 months	204 (57.6)	46 (75.4)	.03
6-24 months	95 (26.8)	10 (16.4)	
2-18 years	55 (15.5)	5 (8.2)	
ADI national percentile, median (IQR)	55 (32-77)	38 (29-52.25)	<.01
ISS, median (IQR)	10 (5-22)	11 (5-18)	.69
# of specialty consults, median (IQR)	2 (1-3)	2 (1-3)	.37
In-hospital mortality, n (%)	31 (8.8)	5 (8.2)	.89
Total length of stay, median days (IQR)	2 (1-7)	4 (2-7)	.05
30-day readmission, n (%)	15 (4.2)	1 (1.6)	.33

Scientific Session 3 - Trauma

2:00 PM – 3:30 PM

S146

CRYOPRECIPITATE USE DURING HEMOSTATIC RESUSCITATION IN A PEDIATRIC TRAUMA COHORT: IS THERE A BENEFIT IN THE MODERN RESUSCITATION ERA?

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Abstract: Purpose: Use of cryoprecipitate during hemostatic resuscitation in injured adults and children have shown mixed results regarding survival benefit. This study aims to assess the impact of cryoprecipitate use in injured children in a modern trauma cohort.

Methods: Injured children age < 18 years who received any blood transfusion within 4 hours of hospital arrival across 456 US trauma centers were included from the 2020-22 ACS-TQIP database. Primary outcomes were survival at 4 hours, 24 hours, and 30 days. Multivariable regression determined associations between cryoprecipitate use and mortality, adjusting for age, sex, insurance, race, interfacility transfer, pediatric age-adjusted shock index (SIPA), mechanism of injury, injury severity score (ISS), Glasgow coma scale (GCS), hemorrhage control surgery, pediatric trauma center level, and whole blood, plasma, and platelet transfusion (cc/kg) within 4 hours.

Results: Of 7,438 pediatric patients included in final analysis, 767 (10.3%) received cryoprecipitate in the first four hours of resuscitation, and 6671 (89.6%) did not. The two groups were similar in age, race, and weight, although the cryoprecipitate group included more males (74% vs 70%, $p=0.03$) and more likely suffered penetrating injury (49% vs 41%, $p<0.001$). Compared to the no cryoprecipitate group, cryoprecipitate recipients were more likely to be in shock (68% vs 61%, $p<0.001$) and had higher median ISS (29 [IQR 24-41] vs 25 [16-34], $p<0.001$). Cryoprecipitate recipients were transfused greater total weight-adjusted volumes of blood products in the first 4 hours compared to those who did not receive cryoprecipitate (73 cc/kg [IQR 37-139] vs 16cc/kg [IQR 8-34], $p<0.001$), and greater volumes of each blood component—pRBC, FFP, and platelets. After adjusting for potential confounders, cryoprecipitate was associated with 49% decreased odds of mortality at 4 hours (aOR 0.51 [95% CI 0.33-0.79], $p=0.002$), and no difference in mortality at 24 hours (aOR 1.00 [0.75-1.33], $p=0.99$) or 30 days (aOR 1.16 [0.88-1.52], $p=0.29$). [FIGURE 1]

Conclusion: Use of cryoprecipitate was associated with an independent survival benefit at 4 hours, but not at 24 hours or 30 days post-injury time points. Further prospective study is warranted to guide optimal use of cryoprecipitate in pediatric hemostatic resuscitation algorithms.

Abbreviations: ACS-TQIP: American College of Surgeons Trauma Quality Improvement Program

IQR: interquartile range

SIPA: shock index, pediatric age-adjusted

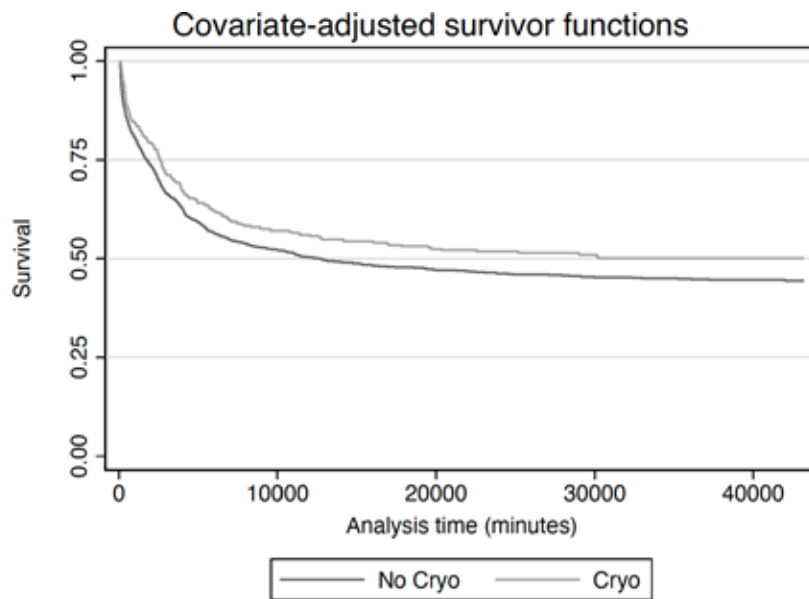
ISS: injury severity score

GCS: Glasgow coma scale

cc/kg: cubic centimeter per kilogram

pRBC: packed red blood cells

FFP: fresh frozen plasma
aOR: adjusted odds ratio
CI: confidence interval



Wednesday, May 7, 2025

Scientific Session 4 - Colorectal

2:05 PM – 3:35 PM

S92

OPERATIVE MANAGEMENT OF MECONIUM ILEUS WITH NEEDLE INJECTION OF N-ACETYL CYSTEINE: A MULTICENTER RETROSPECTIVE STUDY

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Abstract: Purpose

The operative management of meconium ileus (MI) in infants has evolved from enterostomy with saline irrigations to a less morbid approach, typically enterotomy or appendectomy with N-acetylcysteine (NAC) instillation. NAC breaks disulfide bonds, thereby reducing the viscosity of the meconium in MI. Some surgeons have adopted an approach whereby 2-4% NAC is directly injected into the ileum at multiple sites with a 27-gauge needle and the mobilized meconium is evacuated through the appendiceal stump or into the colon, allowing passage per rectum. We hypothesized that this technique would safely facilitate mobilization of meconium and, potentially, obviate the need for enterotomy.

Methods

We conducted a retrospective study of neonatal patients undergoing operative management for MI at six hospitals in the United States and Australia between 2010-2021. Patients who underwent NAC instillation via needle injection were compared to those in whom a catheter was passed through an ileal enterotomy or the appendiceal stump. Primary outcomes were operative duration and time to full enteral feedings. Secondary outcomes included time to first stool and the incidence of a secondary procedure for MI.

Results

Inclusion criteria were met in 51 patients of which 9 (17.6%) underwent needle injection of NAC. Injection patients had lower mean birthweight. After needle injection, all patients had meconium evacuation via either the appendiceal stump or per rectum compared to only 4 (9%) of patients that received NAC via enterotomy. Time to first stool, first enteral feeding, goal enteral feedings, and

post-operative length of stay did not differ based on operative approach. Median operative time in the needle injection group was significantly lower (90 vs. 155 min, $p=.009$). Very few patients in either group required a staged intervention for MI.

Conclusion

Needle injection of NAC was safe and effective in clearing inspissated meconium in infants with MI who required operative management. It obviated the need for enterotomy, enterostomy, or, in the majority of cases, any enteral violation. The reduced operative time with needle injection is clinically significant in newborns. A prospective study of this technique is needed to clarify whether there are additional associated benefits or morbidities.

Abbreviations: meconium ileus (MI), n-acetylcysteine (NAC)

Table:

	NAC via enterotomy or enterostomy (N=43)	Needle injection of NAC (N=9)	<i>p-value</i>
Birthweight, mean kg (SD)	2.73 (0.97)	1.81 (0.91)	.04
Operative time, median min (IQR)	155 (128-181)	90 (75-105)	.009
Bowel resection, n (%)	16 (37.2)	1 (11.1)	.24
Meconium evacuated via non-appendiceal enterotomy or enterostomy, n (%)	39 (91.0)	0	<.001
Second NAC approach needed, n (%)	2 (4.6)	1 (11.1)	.44
Time to first stool, median d (IQR)	3 (1-5)	6 (5.25-6.75)	.29
Time to initial enteral feeding, median d (IQR)	5 (2.5-7.5)	5.5 (3.25-7.5)	.73
Time to goal feeding, median d (IQR)	21 (2-41)	19 (12-27)	.32
Post-op LOS, median d (IQR)	57 (32-83)	39 (22-56)	.29

S91

SURGICAL MANAGEMENT OF VERY EARLY ONSET INFLAMMATORY BOWEL DISEASE

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Abstract: Purpose

The incidence of very early-onset inflammatory bowel disease (VEO-IBD) in children under six years old has been increasing. VEO-IBD has distinct clinical phenotypes, treatment response and outcomes, however the role of surgical intervention remains poorly understood. This study examines surgical management in this population.

Methods

We conducted a retrospective review of patients diagnosed with VEO-IBD at a single institution between January 2008 and December 2023. Data on demographics, clinical characteristics, and measures of disease severity were collected and analyzed using descriptive statistics.

Results

A total of 121 patients met criteria for inclusion. The majority of patients were diagnosed with a Crohn's disease phenotype (n=74, 61.2%). Disease was most frequently isolated to the colon (n=76, 62.8%) or ileocolic (n=38, 31.4%). Approximately half of the patients (n=60, 49.6%) had previously received treatment at another facility. Surgical intervention was required in 27 patients (22%). Of those who had surgery, 66.2% had an ostomy created, 33.3% had a bowel resection, 25.9% had an anorectal exam under anesthesia. Factors significantly associated with operative intervention included African American ethnicity (P=0.016), diagnosis before one year of age (P = 0.004), height velocity < 2SD (P = 0.007), perianal disease (0.006) and disease severity (P=0.015). Notably, family history (P=0.292), positive genetic findings (P=0.392), disease classification (P=0.829), and disease location were not significantly linked with the need for surgical intervention. Among children who had a bowel resection or stoma creation, there was no statistically significant difference in post operative height velocity, weight velocity or medication usage.

Conclusion

This study represents the largest single-center review of surgical interventions in VEO-IBD patients, with a 22% intervention rate. Ethnicity, age at diagnosis, and disease severity significantly influence surgical need. Given the heterogeneity of VEO-IBD, further research is necessary to elucidate the role of surgery, as well as surgical outcomes in managing this complex condition.

Abbreviations: VEO-IBD: Very Early Onset Inflammatory Bowel Disease

		Total (n, %)	Surgery (n, %)	No Surgery (n, %)	P-Value
Ethnicity	<i>White</i>	93(77%)	18(19%)	75(81%)	0.154
	<i>African American</i>	15(12%)	7(47%)	8 (53%)	0.016
Age at diagnosis	<i>< 1 year</i>	13(11%)	7(54%)	6(46%)	0.004
	<i>> 1 year</i>	108(89%)	20(19%)	88(82%)	
Height Velocity	<i>≥ -1SD</i>	42(46%)	10(24%)	32 (76%)	0.006
	<i>< -1SD</i>	43(47%)	7(16%)	36 (84%)	
	<i>< -2SD</i>	7(8%)	5(71%)	2(29%)	
Disease Severity	<i>Remission</i>	19(29%)	0(0%)	19(100%)	0.014
	<i>Mild</i>	30(45%)	10(33%)	20(67%)	
	<i>Moderate</i>	13(20%)	5(38%)	8(62%)	
	<i>Severe</i>	4(6%)	0(0%)	4(100%)	

PEDIATRIC SURGICAL CARE OF ANORECTAL MALFORMATIONS: A GLOBAL SURVEY

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Abstract: Purpose: Our goal is that all patients with anorectal malformations receive high-quality healthcare, regardless of where they are born in the world. This should start with appropriate neonatal screening, followed by adequate peri-operative management, and long-term follow-up. Our purpose is to study the management of Anorectal Malformations by pediatric surgeons around the world, in an effort to determine both the consensus and variability regarding perioperative care.

Methods: A survey was sent out through The Hendren Project, a global networked community of pediatric surgeons and urologists. Surgeons could participate by retrospectively reviewing the past ten patients who underwent reconstruction for anorectal malformations at their institution. Only primary cases, no reoperations, could be included. Each author was responsible for obtaining the local necessary approvals from their ethical review boards. The study received IRB approval.

Results: For this survey, 159 surgeons responded from 105 hospitals in 55 different countries and 90 different cities, reporting on 899 patients. Sacral radiographs, available everywhere, and considered an established prognostic factor for future bowel control in patients with anorectal malformations, are still not being done for all patients (37% not having lateral images, 22% not having AP images). Less than 50% of patients are being screened for a tethered cord. The overall complication rate after the PSARP was 28%, with the most common being dehiscence (12%), wound infection (10%), and stricture (6%). The majority of surgeons are creating divided stomas (66%) versus loop colostomies (29%). Post-operative anal dilations were performed by 91% of surgeons who responded to the survey. Selected preliminary results are in Table 1. Of note, pelvic ultrasounds for hydrocolpos screening were only an option in cases of cloacal anomalies.

Conclusions: Our findings show current practices in anorectal malformations amongst pediatric surgeons globally. This data will help guide educational outreach efforts and quality improvement initiatives, in an attempt to decrease surgical care disparity for patients with anorectal malformation.

Abbreviations:

Anorectal Malformation	Newborn Screening	Colostomy Prior to Repair	Type of Colostomy	Age of Primary Repair	Complications	Post-Op Anal Dilations	
Recto-perineal fistula	26% Sacral X-ray AP	79% Yes	64% Loop	29% Less than 6 months of age	42% Dehiscence	12% Yes	91%
Recto-vestibular fistula	24% Sacral X-ray Lateral	63% No	36% Divided Stomas	66% 6 months to 1 year of age	31% Wound Infection	10% No	9%
Recto-vaginal fistula	4% Kidney Ultrasound	90%	Hartmann Pouch	1% 1 to 2 years of age	18% Stricture	6%	
Cloaca	7% Spinal Ultrasound/MRI	48%	Other	3% 2 to 3 years of age	5% Prolapse	5%	
No fistula	11% Echocardiogram	80%		5% Greater than 3 years of age	5% Need for Reoperation	5%	
Recto-urethral bulbar fistula	13% Pelvic Ultrasound*	89%*			Mortality	1%	
Recto-urethral prostatic fistula	8%				No Complications	72%	
Recto-bladder neck fistula	5%						
Other	2%						

S94

FAILURE TO LAUNCH: PEDIATRIC COLORECTAL SURGERY CENTER UTILIZATION BY PATIENTS OVER 18 YEARS OF AGE

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Abstract: Purpose:

As patients with childhood colorectal diseases transition into adulthood, many continue to seek care at pediatric colorectal centers rather than transitioning to adult hospital systems. This preference often stems from a sense of comfort and familiarity with their pediatric care teams. Additionally, patients often perceive inadequacies in adult healthcare systems in managing their specific conditions. As these numbers of patients continue to grow, pediatric colorectal centers may face increasing demands on their resources, potentially diverting attention away from pediatric patients. The objective of this study was to assess the utilization of our pediatric colorectal center by patients aged 18 and older to determine whether they have successfully transitioned their care to adult hospital systems.

Methods:

We conducted a retrospective review of resource utilization at our colorectal center from August 2017 to August 2024 for patients aged 18 and older. Data collected included number of clinic visits, patient phone calls/messages, emergency room visits, hospitalizations, and OR usage. We also reviewed involvement of the multidisciplinary colorectal care team, including specialists in gynecology, urology, and neurosurgery. Patients who initiated care at our center after turning 18 were excluded.

Results:

Preliminary analysis of the data revealed 125 patients over 18 who continue to utilize our pediatric colorectal center. Age ranged between 19 to 27, with 44% males and 56% females. The median follow up was 44 months (range 12 – 100 months). Throughout this period there was an average of 2.8 ER visits, 3.11 hospital admissions, 20.0 clinic visits, 2.5 OR procedures and 19.3 radiologic studies per patient. Most notable was the amount of patient calls/messages, averaging 4.4 per month and 53.1 per year. Additionally, 100% of these patients utilized more than one of our center's multidisciplinary care teams.

Conclusions:

Our findings underscore the ongoing reliance of adult patients on pediatric colorectal surgery centers and highlight the need for further development of comprehensive transitional care clinics. Addressing these transitional challenges is critical not only for the well-being of adult patients but also to optimize resource allocation within pediatric centers, allowing them to focus on the younger patients for whom these services are intended.

Abbreviations: OR - operating room

INTESTINAL FAILURE OUTCOMES IN CHILDREN WITH SMALL-INTESTINAL HIRSCHSPRUNG DISEASE: A MATCHED ANALYSIS

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Abstract: Purpose:

Small intestinal-Hirschsprung disease (SI-HD) can cause intestinal failure (IF) leading to parenteral nutrition (PN) dependence, liver disease (IFALD), and bloodstream infection (CLABSI). We aim to identify factors associated with enteral autonomy in patients with SI-HD.

Methods:

Retrospective cohort study of 25 patients with IF from SI-HD matched 1:2 on percent expected small bowel length and rehabilitation duration to 50 patients with IF of other etiologies. Patients were managed 2013-2023 by an intestinal rehabilitation program. Statistical analysis performed with Stata v18.1 using univariate conditional logistic regression for clustering of cases and controls within matched sets.

Results:

SI-HD patients required 53.6 months (31.1, 97.7) of PN versus 22.7 months (9.4, 54.9) for non-SI-HD patients ($p = 0.015$). In patients with $< 50\%$ expected bowel length, SI-HD patients required longer PN duration (50.1 months) than non-SI-HD patients (26.7 months, $p=0.038$) (Figure 1). No difference exists in PN duration for patients with or without SI-HD with $>50\%$ expected bowel length.

Patients with SI-HD were less likely than those without SI-HD to achieve enteral autonomy (32% vs. 54%). At most recent visit, patients with SI-HD with $< 50\%$ expected bowel length received a median of 37.5% of their calories enterally, while non-SI-HD patients received a median of 87.5% ($p=0.002$). There was no difference in percent enteral calories in patients with $>50\%$ expected bowel length, regardless of etiology.

SI-HD patients were less likely to have intestinal continuity; 96% still had an ostomy versus 6% of patients without SI-HD ($p = < 0.001$). None of the SI-HD patients had colon in continuity, compared to 94% of non-SI-HD patients ($p < 0.001$). There was no difference in incidence of IFALD. SI-HD patients had a higher incidence of CLABSI (92% vs 66%, $p=0.03$).

Conclusions:

Patients with SI-HD were more likely to have persistent PN dependence and lower overall percent enteral tolerance than those with IF from other etiologies. This association seems to be driven by those patients with $< 50\%$ expected bowel length. Worse prognosis may be related to long-term ostomies and the absence of colon in continuity. These data suggest a need for tailored approaches to intestinal rehabilitation in patients with SI-HD.

Abbreviations: SI-HD = Small intestinal-Hirschsprung disease

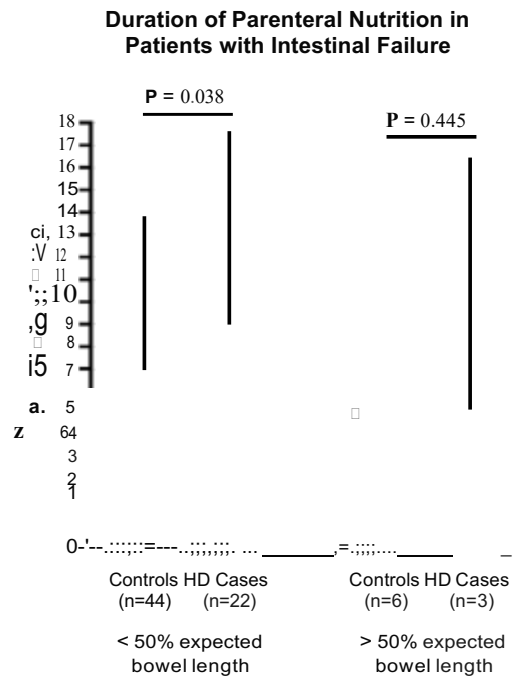
IF = intestinal failure

PN = parenteral nutrition

IFALD = intestinal failure associated liver disease

CLABSI = central line associated blood stream infection

Figure 1.



CONTRAST ENHANCED COLOSONOGRAPHY IS SAFE, SENSITIVE AND VERSATILE FOR EVALUATION OF ANORECTAL MALFORMATIONS

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Abstract: Introduction:

Anorectal malformations (ARM) require anatomic definition of the presence and level of the fistula and distal extent of the rectum relative to the coccyx for operative planning. The current modalities are fluoroscopic distal colostogram (FDC), which exposes children to ionizing radiation, and MRI which often requires sedation. We have previously validated contrast-enhanced colosonography (CECS) as an alternative to FDC to characterize ARM. The purpose of this study is to evaluate the widespread application of CECS in our center in the neonatal intensive care unit, operating room, radiology suite in the evaluation of patients with ARM.

Methods:

We performed a single-center retrospective case series of 49 patients with imperforate anus who underwent evaluation with CECS prior to posterior sagittal anorectoplasty (PSARP) from 2016 to 2024. Patients who had CECS with cloacal malformations were excluded. All patients underwent staged reconstruction with an ostomy. CECS findings were compared to intra-operative findings to evaluate for accuracy.

Results:

CECS alone accurately identified the presence and level of rectal fistula and position of the distal colon relative to the coccyx in 100% of patients: no fistula (n=8), bulbar rectourethral fistula (n=16), prostatic rectourethral fistula (n=21), bladder neck fistula (n=2), rectovestibular with vaginal atresia (n=1), complex rectourethral fistula (n=1).

CECS was performed in newborns (n=7), allowing for early prognostication and planning during the index admission. No newborns developed surgical site infections or mucous fistula stricture from early manipulation. CECS was used in a variety of settings including outpatient clinic (n=26), inpatient admission (n=7) and intraoperatively (n=6). CECS allowed for concurrent spinal (n=10) and renal (n=15) ultrasounds, and contrast-enhanced voiding urosonography (n=11) highlighting its strength in accommodating VACTERL screening simultaneously.

Conclusion:

Contrast enhanced colosonography is a validated alternative to distal colostogram with reliable and detailed anatomic characterization of ARM. CECS is gentle and safe for newborns, allowing for early prognostication, operative planning, and comprehensive parental counseling. CECS offers an advantage in its applicability in a variety of settings due to its portability, and ability to perform concurrent VACTERL screening.

Abbreviations: Anorectal malformations (ARM)

Fluoroscopic distal colostogram (FDC)

Contrast-enhanced colosonography (CECS)

posterior sagittal anorectoplasty (PSARP)

SAFETY AND UTILITY OF LONG-ACTING STEROID INJECTION FOR MANAGEMENT OF POST-OPERATIVE STRICTURE IN PATIENTS WITH ANORECTAL MALFORMATION AND HIRSCHSPRUNG DISEASE

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Abstract: Purpose: Anastomotic stricture leads to significant post-operative morbidity for patients with anorectal malformations (ARM) and Hirschsprung's Disease (HSCR). Skin-level strictures may be managed with dilations, but more complex strictures often require additional surgery. In adult patients with colorectal and esophageal strictures, the injection of the long-acting steroid triamcinolone (Kenalog) after stricture dilation has been used to decrease stricture recurrence and interventions needed to achieve resolution. The safety and efficacy of Kenalog injection in anastomotic stricture is yet to be explored in pediatric populations; we aimed to address this gap in our study of patients with ARM and HSCR.

Methods: We performed a single-institution retrospective review of patients with ARM or HSCR who underwent Kenalog injection with dilation for anastomotic stricture. Clinical history, procedural details, and post-injection outcomes were assessed, and analyzed by underlying diagnosis group using descriptive statistics.

Results: From 2018-2024, 50 patients, 30 with ARM and 20 with HSCR, underwent Hegar or balloon dilation of anastomotic stricture, followed by injection with Kenalog. Table 1 compares pre-operative patient characteristics by diagnosis.

Median follow-up in the ARM group was 1.24 years (IQR 0.78 - 1.93), and in the HSCR group 1.65 years (IQR 0.37 - 4.31). Stricture resolution was observed after injections alone in 21 patients (70.0%) with ARM, and 17 patients with HSCR (85.0%). The median number of injections to achieve resolution was 1 in both groups, with a maximum of 2 in the ARM group and 5 in HSCR. Nine patients (30.0%) with ARM and 2 with HSCR (10.0%) ultimately required a surgical procedure to achieve resolution. There were no significant differences in clinical characteristics between those who required surgery and those who did not within each diagnosis group. There were no intraoperative complications from Kenalog injection; 30-day complication rate was 2.2%.

Conclusions: Injection of the long-acting steroid triamcinolone (Kenalog) as an addition to dilation of post-operative stricture is a safe, minimally invasive approach to stricture management. The outcomes for our patients with ARM and HD are promising, and we plan for additional prospective study to further explore the benefits.

Abbreviations: Anorectal Malformation (ARM)
Hirschsprung's Disease (HSCR)
Interquartile Range (IQR)

	ARM (N=30) Median (!OR) or N (%)	HD (N=20) Median (!OR) or N (%)
Sex, Males	17 (56.7%)	18 (90.0%)
Age at initial surgery (years)	0.75 (0.46 - 1.71)	0.43 (0.15 - 0.87)
Age at first dilation (years)	4.61 (3.14 - 8.68)	1.29 (0.72 - 4.63)
Median number of prior surgeries	3 (2-4)	2(1-2.5)
N Patients with history of surgery for stricture	16 (53.3%)	6 (30.0%)
N patients with history of surgical complication	15 (50.0%)	8 (40.0%)
N patients with prior anal dilations for stricture	11 (36.7%)	13 (65.0%)
Median number of prior anal dilations for stricture	1 (1 - 2)	1 (1 - 5)

Table I: Pre-operative characteristics, by underlying diagnosis.

TIMING OF COLECTOMY AND SURGICAL OUTCOMES IN PEDIATRIC PATIENTS WITH ULCERATIVE COLITIS

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Abstract: Purpose: This study aims to understand the current trends in the timing of total abdominal colectomy (TAC) and the impact of timing of TAC on clinical outcomes in pediatric patients with ulcerative colitis (UC).

Methods: A retrospective study using the Pediatric Health Information System (PHIS) years 2004-2022 was conducted. 1,147 patients ≤ 18 years old diagnosed with UC who underwent TAC were included. Time to intervention was defined as the length of time between TAC and first entry of UC ICD code in the PHIS database. Patients were categorized into four quartiles: group A: < 1 month, group B: 1-6 months, group C: 6-24 months, and group D: >24 months from the diagnosis of UC. Mortality risk and disease severity were classified using the All-Patient Refined Diagnosis-Related Groups (APR-DRG) algorithm, as defined by PHIS. Groups were compared using descriptive and inferential statistics.

Results: Median age at the time of colectomy was lowest in group A (13.84 years), and highest in group D (16.72 years) ($p < 0.0001$). Disease severity was highest in group A (47.46%) and lowest in group D (21.2%, $p < 0.0001$). The use of biologics (32%) and steroids (84.71%) was lowest in group A ($p < 0.0001$). 25.2% of patients in the group D underwent elective surgery compared to only 2.54% in group A ($p > 0.0001$) with subsequent shorter median length of stay (LOS) in group D (3 days, $p < 0.0001$). Interestingly, 30-day complication rates were highest in group B (62.6%), followed by C (51.3%), D (47.6%), and A (41.5%). Patients in group A had the highest risk of mortality (11.7%, $p < 0.0001$) and return to the operating room (OR) within 30 days (35.80%, $p < 0.0001$).

Conclusions: TAC within 1 month of diagnosis occurs in patients with more severe UC with higher risk of mortality and length of stay post-operatively. Although the use of steroids and biologics is similar in groups B, C and D, the risk of mortality is lowest in patients undergoing TAC 6-24 months from diagnosis and return to OR is lowest in patients in the 1-6 months group.

Subsequent analysis is needed to determine optimal timing of colectomy in patient with UC.

Abbreviations: TAC - total abdominal colectomy

UC - ulcerative colitis

PHIS - Pediatric Health Information System

APR-DRG - All Patient Refined Diagnosis-Related Groups

LOS - length of stay

OR - Operating room

Table 1. Demographics, Treatment Characteristics, and Outcomes of Timing of Colectomy in Pediatric Patients with Ulcerative Colitis using PHIS years 2005-2022.

Characteristics	Group A (n=236) <1 month	Group B (n=324) 1-6 months	Group C (n=337) 6-24 months	Group D (n=250) >24 months	p-value
Median Age in years	13.80	15.0	15.29	16.72	<0.0001
Disease Severity*	112 (47.46%)	148 (45.68%)	87 (25.82%)	53 (21.2%)	<0.0001
Biologics used	76 (32.20%)	243 (75.0%)	244 (72.40%)	177 (70.8%)	<0.0001
Steroids used	207 (84.71%)	310 (95.68%)	331 (98.22%)	245 (98.0%)	<0.0001
Elective Surgery	6 (2.54%)	43 (13.27%)	84 (24.93%)	63 (25.2%)	<0.0001
Median LOS	9	8	3	3	<0.0001
Return to OR (30 days)	62 (26.27%)	116 (35.80%)	98 (29.08%)	47 (18.8%)	<0.0001
Complications**	98 (41.53%)	203 (62.65%)	173 (51.34%)	119 (47.6%)	NA
High mortality risk*	17 (7.20%)	38 (11.73%)	8 (2.37%)	8 (3.2%)	<0.0001

*Disease severity and high mortality risk were stratified using the A-Patient Refined Outcomes (APR-ORG) 11 (gornm, as defined by PHIS)

**complications: Anastomotic, stomaprolapse, ileitis, DVT, SSI, CAUTI, VAP, PU, CI, ABSI.

COLORECTAL CLOSURE BUNDLES MAY BE ASSOCIATED WITH LONGER OPERATIVE TIMES WITHOUT IMPROVED OUTCOMES

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Abstract: Purpose: Perioperative colorectal closure bundles (CB) have been utilized in adults to reduce complication rates; however, CB practices vary widely among pediatric institutions. The aim of this study is to evaluate peri-operative CB practices and impact on outcomes in pediatric colorectal surgery.

Methods: Multi-institutional retrospective review (2017-2023) among 16 centers was performed collecting CB practices in children < 2 years old undergoing colostomy reversals for diagnoses of anorectal malformation or Hirschsprung's disease. Specific CB elements, operative details, and post-operative complications were collected.

Results: 336 cases were collected where CB utilization was known. 81 cases (24.1%) used CB. The mean age at surgery was 10.6 months, 66.1% were male, 41.4% were White, 23.5% Black,

and 20.8% were of Hispanic ethnicity. Most patients (83.0%) had a diagnosis of anorectal malformation versus Hirschsprung's Disease (17%). Nine out of 16 (56.3%) institutions performed some or all operations using an element of CB. Elements of CB practices included opening of new sterile trays (55.6%), changing sterile gowns (8.6%), changing sterile gloves (54.3%), and utilizing an incisional wound-vacuum devices (8.6%). Wound closure technique of the prior ostomy site varied. Cases using CB were less likely to perform primary closures (75.3% v. 86.7% $p=0.003$) compared to cerclage closure (8.6% v 6.3%) or leaving the incision open (2.4% v 0%). Cases with CB were more likely to also perform rectal washout (46.9% v 22.0%, $p<0.001$) and pre-operative bowel preparation (51.9% v 40.4%, $p=0.070$). CB cases had significantly longer operative times (213 v. 159 minutes $p=0.001$). Overall, 28 patients (8.3%) had either a surgical site infection, deep infection, anastomotic leak, or wound dehiscence. The use of CB did not influence the rate of complications, length of stay, or readmissions (Table).

Conclusion: Intraoperative CB practices vary significantly between institutions and range from changing gloves to opening sterile closure trays. The heterogeneity in practice among institutions complicates the ability to assess its effect on outcomes. However, use of any CB element is associated with longer operative times and no differences in complication rates. Further study of CB practices and impact on outcomes are necessary to optimize pediatric best-practices while balancing resource utilization.

Abbreviations: CB: Closure Bundles

	Tu!!! N=336	NSt C los u r e B u l l d l e N=255	C:IO S U (e B U l l) l e N=81	~ ~ ~ l n ~
Surg.icaJSite Infecljon	7(2.1%)	5(2.0%)	2 (2.5%)	0.780
Deep Space Infection	3(0.9%)	3 (1.2%)	0(0%)	0.327
Anastomotic Leak	8(2.4%)	4(1.6%)	4(4.9%)	0.083
WoundDehisce.nce	10(3.0%)	10(3.9%)	0(0%)	0.070
Ope.rative Time (min)	172.4 (+/-98.1)	159.4 (+/- 89.9)	213.1 (+/-111.4)	0.001
Pos[Operative Lengthof Stay (days)	5.2 (+/- 6.6)	5.3 (+/- 7.3)	5.0 (+/- 3.9)	0.375
Readmission within 30 days	22 (6.5%)	16(6.3%)	6 (7.4%)	0.720

EVALUATING THE MODERN EPIDEMIOLOGY OF MECONIUM-RELATED OBSTRUCTION: A RETROSPECTIVE MULTI-INSTITUTIONAL CONSORTIUM STUDY

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Abstract: Purpose:

Textbooks attribute 80% of meconium-related bowel obstructions to cystic fibrosis (CF) and 15% of colonic obstructions to Hirschsprung disease (HD). These associations may be inaccurate for preterm infants due to immature intestinal motility. Our objective was to evaluate infants with meconium-related obstruction to describe the prevalence of disease risk factors (e.g., prematurity, CF, and HD), current treatment paradigms, rates of surgical intervention, and clinical outcomes.

Methods:

Our multi-institutional consortium retrospectively reviewed patients with ICD-10 diagnosis codes indicating possible meconium-related obstruction from 2018-2022 at seven children's hospitals. We included patients with radiographic or intraoperative confirmation of bowel obstruction associated with inspissated meconium. We assessed rates of CF and HD with respect to degree of prematurity (chi-squared tests) and rates of non-operative interventions such as irrigations or contrast enemas. Finally, we evaluated the outcomes of abdominal exploration and inpatient mortality. Multivariable logistic regression was used to assess the association of abdominal exploration with gestational age, fetal growth restriction, cystic fibrosis, and biological sex.

Results:

In total, 101 newborns were treated for meconium-related obstruction of which 56 (55%) were preterm. Term infants had higher rates of HD compared to preterm infants (31% versus 1.8%; $p < 0.001$). There was no difference in rates of CF (6.7% vs 5.4%; $p = 0.78$). Overall, 30% received glycerin suppositories, 27% rectal irrigation, 77% contrast enemas, 3.0% antegrade enteral n-acetylcysteine, and 26% abdominal exploration. Abdominal exploration was required by 41% of preterm infants versus 6.7% of term infants ($p < 0.001$; Figure 1). Of the 26 patients who underwent abdominal exploration, the most common indications were refractory obstruction (50%) and perforation (42%), with 54% undergoing ostomy creation and 39% small bowel resection. For adjusted analyses, a one week increase in gestational age was associated with a 24% decrease in

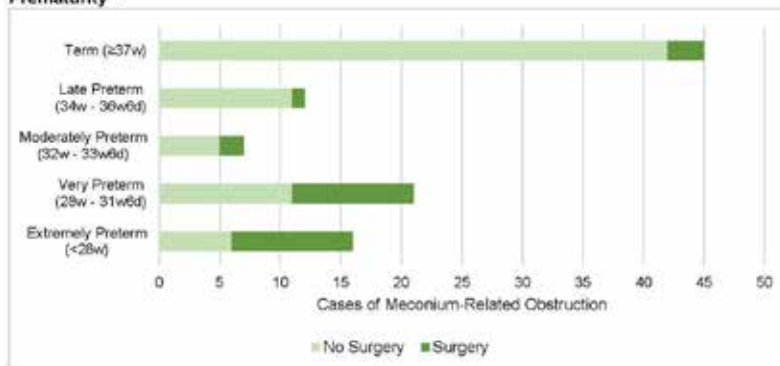
the odds of requiring abdominal exploration (OR 95%CI=0.66-0.87). Overall mortality rates for preterm vs term infants with meconium-related obstruction was 7.1% vs 0.0% (p=0.07).

Conclusion:

Meconium-related obstructions resulted in considerable morbidity for preterm infants with nearly half requiring operative intervention. For preterm infants with meconium-related obstruction, the incidence of Hirschsprung disease was low and, therefore, workup for Hirschsprung disease may be unnecessary.

Abbreviations: CF: cystic fibrosis; HD: Hirschsprung disease; OR: odds ratio; CI: confidence interval

Figure 1: Proportion of Patients Requiring Abdominal Exploration by Degree of Prematurity *



* Abdominal exploration excludes planned surgeries for Hirschsprung disease already diagnosed by suction rectal biopsy.

Wednesday, May 7, 2025

Scientific Session 5 - Fetal

4:00 PM – 5:30 PM

S100

MEDICAL AND ECONOMIC BURDEN OF CARE FOR CONGENITAL ANOMALIES: A REPORT FROM THE CHILD HEALTH EVALUATION OF SURGICAL SERVICES GROUP (CHESS)

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Abstract: Introduction:

Infants with surgically correctable congenital anomalies (SCCA) require timely, complex, and coordinated care; however, the impact of this care on families, including time spent in hospitalizations and medical appointments (medicalized days) is not well described. The aim of this study was to characterize the burden of care (including financial impact of medicalized days) of SCCAs in the first year of life.

Methods:

Market Scan Medicaid Database (2009-2021) identified children, continuously enrolled from birth, for at least one year, with one of 6 SCCA: congenital diaphragmatic hernia (CDH), esophageal atresia and tracheoesophageal fistula (EA/TEF), intestinal atresia (IA), Hirschsprung's disease (HD), anorectal malformations (ARMs), or gastroschisis/omphalocele (G/O). Patients with multiple anomalies were excluded. Medicalized days included inpatient days, outpatient and emergency room visits, or undergoing procedures. Validated codes for complex chronic conditions (CCC) and technology dependence (TD) (codes for implanted/invasive devices to support health (i.e. gastrostomy tube)), were used to risk stratify patients. Wages lost per medical day were based on median national household income (\$80,610.00). Lodging, travel, and childcare costs for siblings was not included. We performed descriptive statistics and multivariable regression analysis. Rate ratios (RR) for medicalization was adjusted for SCCA, CCC and TD.

Results:

Among 20,3321 children, G/O and HD were the most common SCCA (Table 1). Overall children with a SCCA had a median 47.4 (47.3, 47.5) medicalized days in the first year. The number of

medicalized days differed by SCCA; EA/TEF 74.3 (73.9, 74.7) had the highest median medicalized days (Table 1). After controlling for pertinent covariates, CDH, EA/TEF, IA, HD, and ARMS had significantly higher rate ratio (RR) of medicalized days compared to G/O (Table 1). More than three CCC's and TD were also associated with increased medicalized days. Financial impact on caregivers from ranged from 1.4 to 3.3 months of lost wages (\$9,658.27-\$22,173.72) in the first year of life. (Table 1)

Conclusion:

SCCA are associated with significant medical encounters and procedures in the first year of life. Better understanding the impact of this care on families can inform providers, families, patient advocates, and policymakers to develop best practices to optimize patient outcomes.

Abbreviations: Surgically correctable congenital anomalies - SCCA, Congenital diaphragmatic hernia - CDH, Esophageal atresia and tracheoesophageal fistula - EA/TEF, Intestinal atresia - IA, Hirschsprung's disease - HD, Anorectal malformation - ARM, gastroschisis/omphalocele - G/O, Complex chronic conditions (CCC), Technology dependence (TD), Rate ratio - RR

Variable	Number of Patients	Median Days in Treatment (IQR)	Median Financial Loss (Median National Income * Percentage of Work Days Lost)	Frequency of 3+ CCCs [number (%)]	Rate Ratio (95% CI)	p-value
Diagnosis						
Congenital Diaphragmatic hernia	2,256	66.3 (66.0, 66.7)	\$19,797.22	538 (23.8%)	1.5 (1.42, 1.57)	<.001
Esophageal Atresia	1,962	74.3 (73.9, 74.7)	\$22,173.72	439 (22.4%)	1.76 (1.67, 1.85)	<.001
Duodenal/jejunal/ileal Atresia	2,019	63.9 (63.5, 64.3)	\$19,871.75	315 (15.6%)	1.28 (1.21, 1.35)	<.001
Hirschsprungs	3,180	46.9 (46.7, 47.3)	\$14,911.21	281 (8.8%)	1.46 (1.4, 1.53)	<.001
Anorectal Malformation	2,925	45.0 (44.7, 45.2)	\$13,426.04	543 (18.6%)	1.26 (1.2, 1.32)	<.001
Gastroschisis/Omphalocele	7,979	32.4 (32.3, 32.5)	\$9,658.27	486 (6.1%)	Referent	
3+ CCCs					1.54 (1.47, 1.62)	<.001
Tech Dependence					1.86 (1.77, 1.95)	<.001

PRENATAL ESOPHAGEAL LENGTHENING BY DISTRACTION ENTEROGENESIS IN A FETAL LAMB MODEL OF LONG GAP ESOPHAGEAL ATRESIA

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Abstract: Purpose:

The Foker procedure has advanced management of long-gap esophageal atresia (LGEA) but is associated with significant morbidities including prolonged hospital length of stay, total ventilator days and high rates of post-operative stricture formation. Prenatal intervention to lengthen the esophagus could eliminate the need for staged repair and mitigate the morbidity of LGEA. We aimed to achieve prenatal esophageal lengthening by distraction enterogenesis using an intraluminal spring device in a fetal lamb model of LGEA.

Methods:

Time-dated pregnant ewes underwent hysterotomy at 116 days gestation. Fetal lambs underwent posterolateral thoracotomy and creation of an esophagotomy. A compressed nitinol spring encased in a gelatin capsule was placed in the proximal esophagus of experimental animals (n=2, Figure 1A). An encapsulated non-compressed spring was placed in the proximal esophagus of control animals (n=2). The esophagus was narrowed with a plication suture proximal to the spring (Figure 1B) and the esophagus was suture ligated distal to the spring (Figure 1C). The length between the two sutures was measured. The esophagus was then suture ligated near the diaphragm and the distal portion of the intrathoracic esophagus was removed (Figure 1D). The thoracotomy was closed, and the fetus was returned to the uterus to continue gestation. Delivery by cesarean section and euthanasia were performed at 134 days gestation (near term). The length of the proximal esophageal pouch was measured, and gross tissue was examined (Figure 1E).

Results:

The proximal esophageal pouch of experimental animals increased in length from 14 +/- 0 mm to 21 +/- 1 mm (p < 0.05). There was no significant change in esophageal length of control animals (14.5 +/- 0.5 mm to 14.5 +/- 0.5 mm, p=0.5). The proximal esophageal pouch appeared grossly healthy. The surgical model was well-tolerated with no observed attrition or preterm delivery.

Conclusion:

This study is the first demonstration of prenatal lengthening of the proximal esophagus using an intraluminal spring device in a fetal lamb model of LGEA. Distraction enterogenesis appears to be a safe and well-tolerated approach to prenatal esophageal lengthening. Future studies will focus on minimally invasive approaches to spring placement.

Abbreviations: LGEA - long gap esophageal atresia

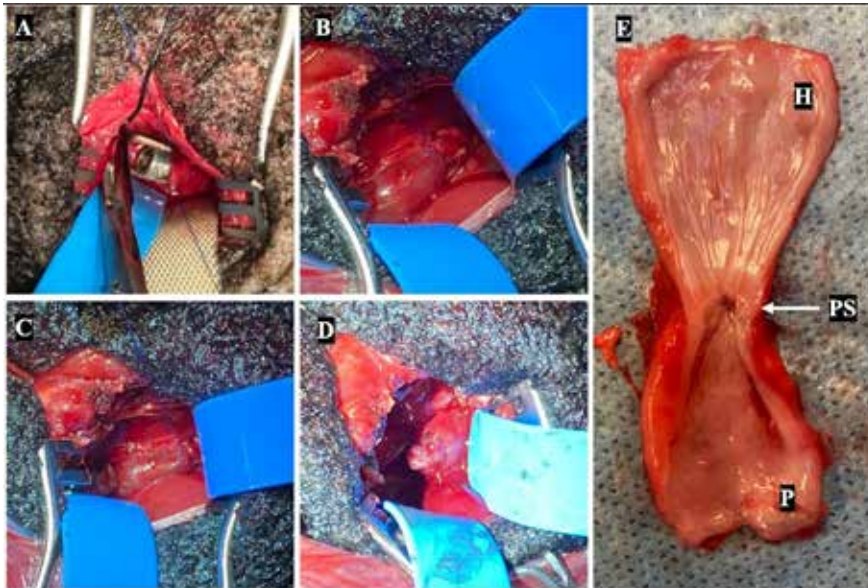


Fig. 1. Photographs of (A) spring placement, (B) proximal plication suture, (C) proximal pouch, (D) proximal pouch after removal of distal esophagus, and (E) gross specimen. PS = plication suture; P = lengthened proximal pouch; H = healthy tissue proximal to plication suture

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TRANSAMNIOTIC FETAL DELIVERY OF RECOMBINANT HUMAN IMMUNOGLOBULIN MONOCLONAL ANTIBODIES: A POTENTIAL NOVEL STRATEGY FOR PREVENTION OF NEONATAL RESPIRATORY SYNCYTIAL VIRUS (RSV) DISEASE

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Abstract: Purpose: Respiratory syncytial virus (RSV) is an exceedingly prevalent disease in infants and children that tends to be particularly morbid in newborns. The disease burden of RSV is among the highest in the US and globally. Currently there is no effective strategy for the prevention of RSV in that patient population, especially in the early neonatal period. Class-G antibodies have been shown experimentally to reach the fetal circulation after simple intra-amniotic injection per the transamniotic fetal immunotherapy (TRAFIT) principle. We sought to determine whether a clinically relevant monoclonal immunoglobulin-G (IgG) against RSV could be delivered via TRAFIT to the fetus and remain bioavailable after birth.

Methods: Fetuses (n=59) from five pregnant dams received volume-matched intra-amniotic injections on gestational day 17 (E17, term=E21-22) of either an FDA-approved and commercially available recombinant human immunoglobulin G1 kappa (IgG1 κ) monoclonal antibody against RSV (Nirsevimab®) at 5.9mg/mL (n=30) or of saline (n=29), the latter to control for possible interspecies IgG1 κ homology. Levels of IgG1 κ were quantified by ELISA in the serum and lungs at term and at postnatal day of life 7 (P7). An additional group receiving an unrelated intra-amniotic injection served as an added control at P11 (n=7). Maternal serum samples were also tested. Statistical analyses were by two-tailed Fisher's exact test, Wilcoxon rank sum test for non-nested values, and mixed-effects median regression for nested values (significance at $p < 0.05$).

Results: Overall survival to term was 59% (35/59) significantly higher in the IgG1 κ group ($p=0.015$). Levels of the IgG1 κ monoclonal antibody were significantly higher than that of controls in serum and lung samples at both term (both $p < 0.001$) and P7 ($p=0.002$ to < 0.001) (figure). IgG1 κ levels in maternal serum samples were not significantly elevated when compared to controls, though possibly due to type II error.

Conclusions: Transamniotic fetal immunotherapy (TRAFIT) with a clinically relevant recombinant human monoclonal antibody against respiratory syncytial virus (RSV) results in sustained levels of the antibody in the lungs and serum at term into the early neonatal period in a rat model. TRAFIT could become a viable option for the prevention against RSV in neonates.

Abbreviations: RSV = respiratory syncytial virus
TRAFIT = transamniotic fetal immunotherapy
IgG1 κ ,= immunoglobulin G1 kappa

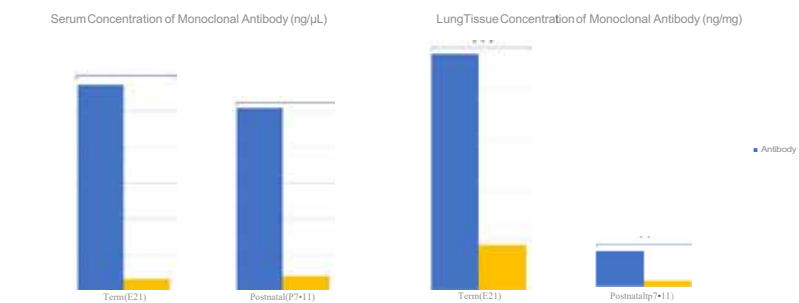


Figure1: Concentrations of the injected monoclonal antibody in serum (left) and lung tissue (right)....indicates $p < 0.001$, ... indicates $p < 0.01$.

VARIATION IN THE PRENATAL DIAGNOSTIC EVALUATION OF LUNG MALFORMATIONS AMONG FETAL CARE CENTERS IN THE UNITED STATES

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Abstract: Purpose: Congenital lung malformations (CLMs) represent a heterogeneous group of lesions that are usually diagnosed in the prenatal period. The aim of this study was to examine hospital-level variation in the utilization of various prenatal imaging modalities during the diagnostic workup of CLMs.

Methods: A retrospective cohort study of fetal CLMs managed at 12 established fetal care centers in the United States (2016-2023) was performed. Prenatal imaging studies, including echocardiography and MRI, were reviewed and correlated with 2D ultrasound findings and postnatal outcomes.

Results: Of 475 CLM patients, 414 (87.2%) were diagnosed by fetal ultrasound at a mean gestational age of 21.9+/-2.3 weeks. The most common diagnoses were congenital pulmonary airway malformation (CPAM, 43.6%) and bronchopulmonary sequestration (BPS, 30.5%). The incidence of hydrops was 2.4%. The mean number of ultrasound scans was 3.7+/-3.9 per case. At least one documented CPAM volume ratio (CVR) was noted in 336 (81.2%) fetuses. The initial CVR was 0.65+/-0.68 cm², and the mean maximum CVR was 0.88+/-0.90 cm² at 27.4+/-4.5 weeks. Maximum CVR was significantly associated with respiratory distress at birth (yes: 1.41+/-1.27 cm² vs. no: 0.80+/-0.69 cm², p< 0.0001) and neonatal lung resection (yes: 2.32+/-1.39 cm² vs. 0.79+/-0.68 cm², p< 0.0001). Fetal echocardiography was obtained in 272 (65.7%) and varied widely by institution (range, 0-100% of cases). A structural cardiac anomaly was identified in eight (1.9%) fetuses. Fetal MRI was performed in 265 (64.0%) cases. There were 54 (20.4%) who had two or more MRIs prior to delivery. MRI utilization varied substantially by institution (range, 0-100% of cases) and did not correlate with ultrasound findings (Table) or postnatal CT use (p>0.99).

Conclusions: This large, multicenter study suggests substantial variation across institutions in the prenatal evaluation of CLMs. Given that imaging overutilization contributes to additional time and resources and may not have clear outcome benefits for the maternal-fetal dyad, these data support the need to collaborate with our maternal-fetal medicine colleagues to develop evidence-based consensus guidelines on the frequency, use, and timing of prenatal imaging studies in the diagnosis and management of fetal CLMs.

Abbreviations: CLM = congenital lung malformation

CPAM = congenital pulmonary airway malformation

CT = computed tomography

CVR = CPAM volume ratio

MRI = magnetic resonance imaging

Table. Association between prenatal ultrasound findings and MRI utilization in fetal CLMs.

	US Finding	Fetal MRI Performed		P-value
		Yes	No	
Hydrops	10 (2%)	5 (50%)	5 (50%)	0.14
Max CVR>1.6	46 (11%)	37 (80%)	9 (20%)	0.49
Mediastinal Shift	175 (42%)	126 (72%)	49 (28%)	0.77
Polyhydramnios	28 (7%)	25 (89%)	3 (11%)	0.08
CPAM	279 (67%)	186 (67%)	93 (33%)	0.81
BPS	63 (15%)	48 (76%)	15 (24%)	0.21

FETAL GENE EDITING: THE LONG AND SHORT OF IT

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Abstract: Purpose: Many diseases caused by point mutations can result in pathology that begins before birth. We hypothesize that potential unique advantages of fetal gene editing exist. Here, we investigate short- and long-term consequences of fetal gene editing as compared to adult gene editing in both a diseased mouse model and a *Macaca fascicularis* nonhuman primate (NHP) model using a clinically relevant lipid nanoparticle (LNP) delivery method.

Methods: An LNP containing an adenine base editor (ABE) mRNA and our lead gRNA was delivered intravascularly at comparable doses into fetal and adult mice (n=10-12 mice/age group) as well as to four midgestation NHP fetuses and two 3-year-old juvenile NHPs. On-target gene editing was assessed at various intervals after treatment. Phenotypic effects were quantified including cytokine levels, liver function, changes in amino acid expression, and urine metabolite levels. Nonparametric data were analyzed using Mann-Whitney U test or Kruskal-Wallis test. Student's t-test was used for parametric data. Survival statistics were assessed with a log-rank test.

Results: Assessments after LNP injection demonstrated efficient on-target liver editing in both animal models. In the diseased mouse model, liver editing of treated mice conferred a significant survival advantage, as well as phenotypic benefits quantified by significant improvement in liver function and decreased levels of toxic metabolites. A small number of diseased mice kept for long-term studies showed persistent on-target liver editing, preserved liver function, and no evidence of tumors at one year of life. In the NHP model, on-target liver editing was approximately 2- to 4.5-fold higher in fetal NHPs. There were no significant short- or long-term differences in cytokine levels or liver function in the serum of NHP Dams.

Conclusion: This study demonstrates the feasibility of fetal liver gene editing via LNP delivery in two animal models. We find a protective long-term effect of LNP-mediated liver editing in the diseased mouse model. In the NHP model, treatment does not appear to have detrimental effects to NHP Dams and appears significantly more efficient in the fetal NHPs as compared to juvenile NHPs, highlighting potential advantages to gene editing during fetal development.

Abbreviations: Nonhuman Primate (NHP)
Lipid Nanoparticle (LNP)

Adenine Base Editor (ABE)

SUSTAINED EARLY POSTNATAL HUMORAL AND CELLULAR IMMUNITY AGAINST HUMAN CYTOMEGALOVIRUS AFTER TRANSAMNIOTIC FETAL MRNA VACCINATION IN A RODENT MODEL

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Abstract: Purpose: Gestational and early postnatal cytomegalovirus (CMV) infection is a common disease with significant fetal and neonatal morbidity and mortality, often resulting in permanent neurocognitive sequelae. It has been shown that transamniotic fetal mRNA delivery of a human CMV (hCMV) envelope glycoprotein B (gB) antigen can induce a humoral immune response in the immediate postnatal period in a healthy rat model. We sought to determine whether said humoral response can persist for months into early postnatal life, as well as to examine whether a cellular immune response also develops over time in that model.

Methods: Seven pregnant Sprague Dawley dams underwent volume-matched intra-amniotic injections in all their fetuses (n=82) of a suspension of a custom-made mRNA encoding for hCMV gB antigen encapsulated by a lipid- and synthetic cationic polymer-based composite on gestational day 17 (E17; term=E21-22). At three different time points spanning between 1 and 3 months after birth, serum levels of antigen-specific hCMV gB antibodies of the IgG class were measured by ELISA. In addition, splenocyte suspensions were incubated with either enriched media or enriched media combined with hCMV-gB recombinant protein for 5 days, followed by flow cytometry of culture supernatants to assess T-cell response. Statistical analyses included Wilcoxon rank sum test and Fisher's exact test ($p < 0.05$).

Results: There was no maternal mortality or premature labor. Overall neonatal survival was 44% (36/82), with no significant differences between the groups. Antigen-specific hCMV gB antibodies were present in the serum at all time points, albeit decreasing significantly from 1 to 3 months postnatally ($p=0.029$). Splenocytes from vaccinated pups showed significantly increased production of IFN- γ , IL-2, TNF- α , GM-CSF, and IL-6 following antigen-specific challenge ($p=0.021$ to < 0.001 vs. non-stimulated cells) (figure). Cellular response increased significantly over time ($p=0.043$ to < 0.001), indicating a mature Th1 response.

Conclusions: Transamniotic fetal mRNA delivery of a human cytomegalovirus antigen can induce a lasting adaptive cell-mediated immune response, while also exhibiting continued antigen-specific immunoglobulin production extending into the early neonatal period in a healthy rat model. Fetal mRNA vaccination via the minimally invasive transamniotic route may become a practical strategy for the prevention of perinatal infections.

Abbreviations: cytomegalovirus (CMV), human cytomegalovirus (hCMV), glycoprotein B (gB), immunoglobulin G (IgG), enzyme-linked immunosorbent assay (ELISA), interferon-gamma (IFN- γ), interleukin-2 (IL-2), tumor necrosis factor alpha (TNF- α), granulocyte-macrophage colony-stimulating factor (GM-CSF), interleukin-6 (IL-6), T helper 1 (Th1), E (gestational day), P (postnatal day), mo (months)

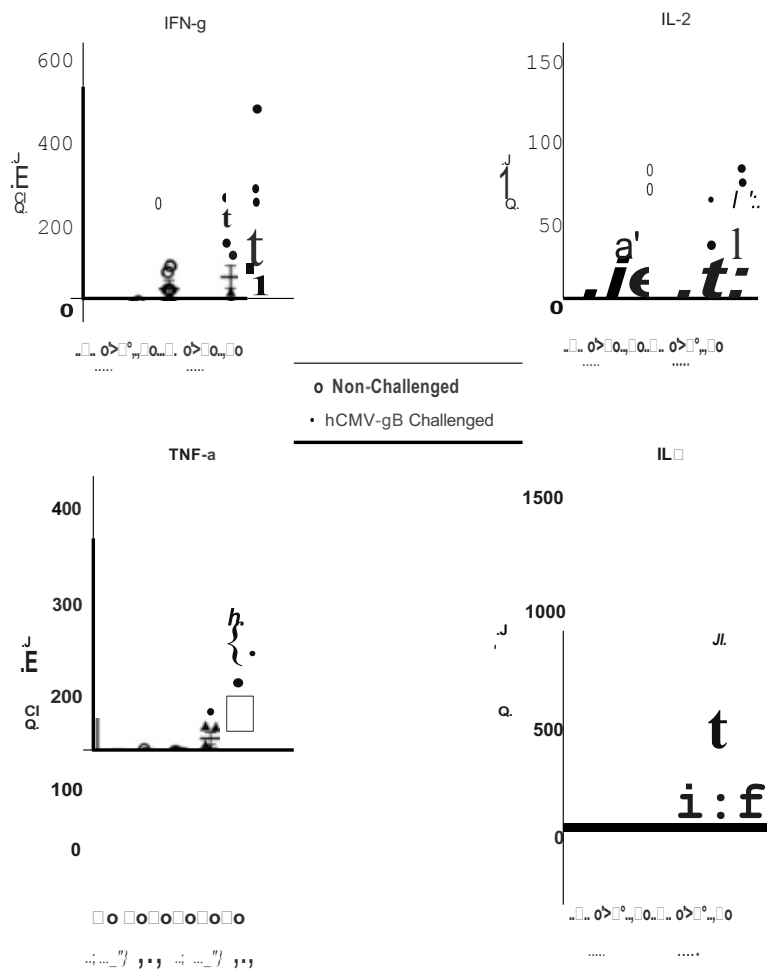


Figure: Flow cytometry showing production of multiple cytokines following incubation of splenocytes with or without hCMV-gB recombinant protein challenge at three different postnatal time points. Splenocytes from vaccinated pups showed significantly increased production of IFN- γ , IL-2, TNF- α , and IL-6 after challenge ($p=0.021$ to <0.001 vs. non-stimulated cells). Cellular response increased significantly over time ($p=0.043$ to <0.001), indicating a mature Th1 response. Mo= months

THE EFFECT OF EX-VIVO GRAVID UTERINE SUPPORT ON UMBILICAL VESSEL FLOW VELOCITIES AND DUCTUS ARTERIOSUS PATENCY

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Abstract: Purpose

Fetal lamb artificial womb (AW) and artificial placenta (AP) models rely on perfusion delivered via extracorporeal membrane support (ECMO) through umbilical or central vessel cannulation in the absence of the placenta. The patency of fetal circulation is paramount to prolong the fetus's survival prior to exposure to an air environment. Physiological stress and ECMO support may disrupt the physiologic environment required to maintain ductus arteriosus (DA) patency. Existing AW and AP models use continuous infusion of prostaglandins to maintain DA patency, exposing the fetus to side effects like dysrhythmias, edema, or hypotension. We aim to investigate fetal DA patency in an ex-vivo sheep model of gravid uterine support and describe the extent to which the placenta regulates umbilical vessel flow with extrauterine flow variations.

Methods

An ex-vivo placental perfusion model was employed with low transverse laparotomy, uterine delivery, and bilateral uterine artery and vein cannulation. To maintain adequate flow, there is constant manual titration of pump revolutions per minute, which leads to fluctuations in the pressure by which blood is delivered to the uterus. Ultrasound measurements were obtained at baseline (before laparotomy) and after transition to ECMO support to document shunt patency and flow velocities; velocities were measured at the umbilical cord vessels and ductus arteriosus. Baseline velocities were compared to velocities on ECMO support with student's paired t-tests.

Results

11 sheep were used, of which 6 had ultrasounds obtained on full ECMO support. There was no difference in peak average velocity through the ductus before or after ECMO cannulation ($p=0.26$; CI -0.41 – 0.13), umbilical vein peak velocity ($p=0.78$; CI -0.08 – 0.10), or umbilical artery peak velocity ($p=0.73$; CI -0.17 – 0.13). Velocity differences from baseline are specified in Table 1.

Conclusion

While perfusing a gravid uterus via the uterine vessels, we demonstrate a fetal patent ductus arteriosus and relatively constant umbilical vein flow velocities despite fluctuations in the ECMO pressure delivery to the uterus. The placenta therefore maintains regulation of umbilical vein blood flow velocity, facilitating physiologic shunt patency.

Abbreviations: AW, artificial womb; AP, artificial placenta; ECMO, extracorporeal membrane oxygenation; DA, ductus arteriosus

Table 1. Ductus arteriosus and umbilical vessel velocity differences from baseline after ECMO support with placental preservation

Sheep	Sex	Gestational age (days)	Time on ECMO (hh:mm)	Ductus arteriosus peak average velocity difference (m/s)	Umbilical vein peak velocity difference (m/s)	Umbilical artery peak velocity difference (m/s)
1	M	113	2:51	0.47	0.30	0.40
2		113	2:02	0.54	0.10	-0.08
			4:15	0.08	-0.01	-0.23
3	M	114	3:35	-0.06	0.14	0.37
			6:58	0.46	0.00	0.23
4		110	2:24	-0.29	-0.16	0.01
5		113	2:51	0.15	-0.18	-0.18
6	M	114	5:14	0.22	0.01	0.06

PRELIMINARY EFFICACY AND SAFETY FETAL INTERVENTION STUDIES IN THE LOWER URINARY TRACT OBSTRUCTION AND PLEURAL EFFUSION LAMB MODEL UTILIZING A NOVEL FETAL SHUNT – THE VORTEX SHUNT

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Abstract: Purpose

The suboptimal design of the currently available fetal shunt systems likely increases the risk of displacement, kinking, or obstruction, resulting in treatment failure. We aimed to evaluate the efficacy and safety of the newly developed Vortex shunt (Figure 1) in a lower urinary tract obstruction (LUTO) and pleural effusion fetal lamb model.

Materials

LUTO was created in 10 fetal lambs at a median of 75 days (range, 72-75) gestation (term=140 days). All fetuses developed severe LUTO with ultrasound features of megacystis, hydronephrosis, urinary ascites, and significant oligohydramnios/ anhydramnios. At a median of 96 days (range, 93-97) gestation, these fetuses underwent ultrasound-guided vesico-amniotic shunting using the Vortex shunt. Pleural effusion was created in four fetal lambs at a median of 96 days (range 96-99) by injecting 50cc (range 30-80) of sterile Hartman's solution in the fetal chest under ultrasound guidance, followed by thoracic-amniotic ultrasound-guided Vortex shunt placement immediately afterward. Near term, euthanasia was performed. Efficacy was assessed by the resolution of the key anatomical features of LUTO and the complete resolution of the simulated fetal pleural effusion on ultrasound and necropsy. Safety parameters included dislodgement rate, patency at term, and procedural side effects.

Results

Deployment of the Vortex shunt was successful for all fetuses. In the LUTO group, bladder drainage was observed immediately after placement, and shunts were confirmed functional throughout the implantation period. There was sustained bladder emptying, normalization of hydronephrosis, and amniotic fluid levels. Similarly, brisk drainage of the pleural effusion was observed after Vortex shunt insertion into the fetal chest. The Vortex shunt remained in an appropriate position throughout gestation for a median of 41 days (range, 38-43) in both LUTO and pleural effusion fetal lambs. None of the shunts dislodged. There were no shunt-related or procedure-related complications or abdominal and chest wall abnormalities.

Conclusion

In this preclinical large animal model of LUTO and pleural effusion, we showed that the Vortex shunt can be accurately deployed at midgestation under ultrasound guidance. We further demonstrate its long-term efficacy, function, and safety. This novel shunt system may improve the adverse outcomes of LUTO and congenital pulmonary conditions.

Abbreviations: Lower urinary tract obstruction (LUTO)

Figure 1. The Vortexshunt



CONTEMPORARY USE OF MATERNAL BETAMETHASONE IN THE TREATMENT OF FETAL LUNG MALFORMATIONS: RESULTS FROM A NATIONAL MULTICENTER COHORT STUDY

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Abstract: Background: Maternal betamethasone (BMZ) has been used for the treatment of microcystic fetal congenital pulmonary airway malformations (CPAM) at risk for hydrops and intrauterine demise for the past two decades. However, the current status of BMZ use in fetal lung lesions has not been well characterized using multi-institutional data. In this study, we sought to elucidate the impact of maternal BMZ administration on the management of lung lesions at fetal care centers nationwide.

Methods: A retrospective cohort study of prenatally diagnosed lung malformations was conducted within a newly established consortium of 12 established fetal care centers (2016-2023). Fetuses treated with maternal BMZ (12.5mg/d IM x2d) were identified, and those receiving BMZ for preterm labor were excluded. Statistical analyses were by Welch 2-sample t-tests and chi-squared tests ($p < 0.05$).

Results: Of 414 fetal lung malformations, maternal BMZ was used in 58 (14%) cases at a mean gestational age of 25.3+/-3.4 weeks (Figure). There were eight (1.9%) that received multiple rounds. Of the 43 fetuses with a CVR>1.6, 74% received BMZ. Indications for administration included large lesion (n=41, 71%) and signs of hydrops (n=7, 12%). The prenatal diagnosis was CPAM in 82% and macrocystic disease was present in 29%. The mean CPAM volume ratio (CVR) prior to treatment was 2.1+/-1.1 cm² (range, 0.4-6 cm²). The final CVR was 1.3+/-1.0 cm². The mean percent CVR reduction in BMZ-treated and BMZ-untreated cases was 45%+/-33% and 35%+/-32%, respectively ($p=0.07$). Six (9%) BMZ-treated fetuses subsequently underwent at least one fetal procedure, including one resection, four thoracenteses, five shunt placements, and two ex-utero intrapartum treatment (EXIT) deliveries. Fetal BMZ recipients reported a significantly higher occurrence of respiratory distress (BMZ: 34% vs. no-BMZ: 15%, $p < 0.01$), neonatal supplemental oxygen use (BMZ: 29% vs. no-BMZ: 11%, $p < 0.01$), and neonatal surgical resection

(BMZ: 29% vs. no-BMZ: 4%, $p < 0.01$). There was one (2%) neonatal death.

Conclusion: This multi-institutional study suggests high maternal BMZ use in management of large fetal lung malformations regardless of hydrops or lesion type and provides the strongest evidence to date of the possible effects of BMZ in slowing growth and improving outcomes for fetuses with large lung malformations.

Abbreviations: CLM: congenital lung malformation

CVR: congenital pulmonary airway malformation volume ratio

CPAM: congenital pulmonary airway malformation

betamethasone: BMZ

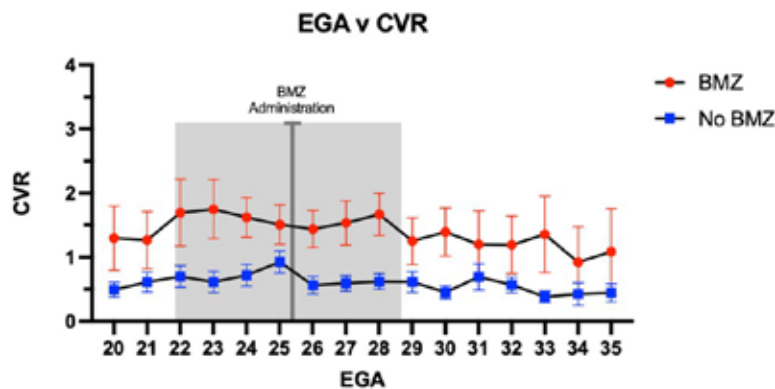


Figure. CPAM Volume Ratio (CVR) and estimated gestational age (EGA) with mean age at first dose of betamethasone administration \pm standard deviation shown in gray.

Wednesday, May 7, 2025

Scientific Session 6 - Thoracic

4:00 PM – 5:30 PM

S109

DIAGNOSTIC YIELD OF OPEN VS. THORACOSCOPIC LUNG BIOPSY TO DIAGNOSE NON-MALIGNANT PULMONARY DISEASE

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Abstract: Purpose:

Compare the diagnostic yield of open lung biopsy (OLB) to thoracoscopic technique (TT) in non-malignant pulmonary disease.

Methods:

Electronic medical record data at a single institution from 1/1/2013–6/1/2023 for patients < 18 years that underwent surgical lung biopsy for diagnosis of non-malignant pulmonary disease were retrospectively reviewed. 107 patients met inclusion criteria. Demographics, complications, and pathology results were analyzed. Categorical variables were compared with a chi-squared test. A T-test was used to compare continuous variables. A statistically significant difference was defined as $p < 0.05$.

Results:

The average age at surgery was 9.3 years and weight was 37kg. There was a slight male predominance [57/50 (53%)]. TT lung biopsy was performed in 62 (58%) patients and OLB in 44 (41%) patients. There was one conversion to open due to adhesions. Underlying medical history was similar between groups, though patients who underwent OLB were younger in age (4.5 vs. 12.5, $p < 0.0001$) and characterized by increased pre-operative respiratory support (18 vs. 9, $p = 0.003$). Post-operatively, there was no difference in the number of patients requiring escalation of respiratory support (10 vs. 9, $p = 0.31$) or days with a chest tube (2.0 vs. 2.0, $p = 0.91$). However, patients who underwent OLB experienced significantly longer post-operative length of stay (LOS) (8.0 vs 3.8, $p < 0.001$). OLB and TT resulted in similar diagnostic yields, with inconclusive pathology from 12 open and 13 TT biopsies ($p = 0.49$). Two patients required an additional procedure to clarify possible false negative results. One patient who underwent OLB required a second OLB (1 vs. 0, $p = 0.41$), and one patient who underwent TT biopsy required an IR biopsy (0 vs 1, $p = 0.99$). In both cases, pathology from the second procedure was similarly inconclusive.

Conclusion:

Despite the visual and tactile advantages of open surgical technique, diagnostic yield was similar between thoracoscopic and open lung biopsy groups. Given the shorter length of stay associated with thoracoscopic technique, one may consider it preferentially when feasible.

Abbreviations: OLB - Open Lung Biopsy
 TT - Thoracoscopic Technique
 LOS - Length of Stay

Table 1: Open versus Thoracoscopic Lung Biopsy Patient Characteristics, Complications, and Pathology Outcomes

	Open (n=44)	Thoracoscopic (n=62)	p-value
Age, median [IQR] (years)	4.5 [2.0-9.7]	12.5 [7.8-15.7]	<0.0001
Pre-Operative Weight, median [IQR] (kg)	34.2 [14.1-62.4]	28.7 [15.3-52.6]	0.52
Pre-Operative Respiratory Support Requirement	18 (40.9%)	9 (14.5%)	0.002
Time with Post-Operative Chest Tube, median [IQR] (days)	2.0 [1.0-4.0]	2.0 [1.0-3.0]	0.91
Post-Operative LOS, median [IQR] (days)	8.0 [2.6-59.2]	3.8 [2.0-12.0]	<0.0001
Pathology Inconclusive	12 (27.3%)	13 (20.9%)	0.45
Positive Diagnostic Yield	32 (72.7%)	49 (79.1%)	0.45
Return to the OR for Additional Biopsy Data	1 (2.3%)	0 (0%)	0.23
IR-Guided Biopsy for Additional Biopsy Data	0 (0%)	1 (1.6%)	0.40

CONTEMPORARY MANAGEMENT OF PECTUS EXCAVATUM: A SURVEY OF MEMBERS OF THE AMERICAN PEDIATRIC SURGICAL ASSOCIATION

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Abstract: Purpose: Widespread adoption and use of the Nuss procedure have led to numerous refinements and innovations in managing children with pectus excavatum (PE). Our aim in this project was to determine the common clinical and operative practices pediatric surgeons employ to care for children with PE. Additionally, we sought to identify opportunities to optimize current PE management strategies.

Methods: A 28-question IRB-approved survey was administered electronically to all APSA members. The APSA outcomes committee sanctioned the survey content.

Results: 140 members responded to the survey. We received responses from members in 36 states, with 97% performing the Nuss procedure at either a children's hospital or a children's center within an adult hospital. Key member response data is presented in the table. Cryoablation is the most common pain management routine (84%), and a majority use a commercially available titanium system (60%). There is variability in the technical aspects of passing the bar, with a most common approach of right thoracoscopy with bar passage right-to-left (51%). Notably, 33% have adopted intermittent or synchronous use of bilateral thoracoscopy. Use of stabilizer plates is routine (81%). Only 56% limit activities until >12 weeks post-op, with a remainder offering more liberal return to activity. Complications experienced by the respondent or a partner included bar migration requiring reoperation (76%), hemorrhage during insertion requiring intervention (17%), and hemorrhage during removal requiring intervention (20%).

Conclusions: The survey describes the contemporary US pediatric surgeon practice patterns with respect to pectus excavatum correction, including workup, surgical indication, and the use of cryoablation. There are a wide variety of successful technical approaches. Allergy testing is not commonly used, and very few surgeons offer correction at younger than 12 years. Prolonged activity restrictions may be overly conservative. Bar migration and bleeding complications may be more common than the reported incidence. Collaborative opportunities to harmonize the surveyed factors may be indicated.

Abbreviations: PE Pectus Excavatum

ASPA The American Pediatric Surgical Association

IRB Institutional Review Board

Pectus Survey Data Table

Respondents Demographics (N =140)				
Years in practice/Percent	>20 yrs/34%	10-20 yrs/25%	5-10 yrs/20%	<5 yrs/20%
# repairs per yr./Percent	1-5/41%	6-10/22%	11-20/18%	21-30/10%
Respondents Response Percentage				
Pre operative orders	CT/74%	ECHO/48%	PFT/49%	Allergy testing/11%
Indication for repair	HI>3.25/89%	Soc-Psy/69%	Cardiac/56%	Cosmetic/50%
Age to offer repair	13-14 yrs/57%	15-17 yrs/37%	10-12 yrs/5%	<10 yrs/1%

TRENDS AND OUTCOMES OF THORACOSCOPIC ESOPHAGEAL ATRESIA AND TRACHEOESOPHAGEAL FISTULA REPAIR 2016-2022

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Abstract: Purpose:

Thoracoscopic repair of esophageal atresia (EA) and tracheoesophageal fistula (TEF) is a technically demanding operation in a newborn with limited working space. Consequently, an open thoracotomy approach is commonly used. However, as pediatric surgeons are increasingly comfortable with minimally invasive surgery (MIS) techniques, we aimed to evaluate the rate of thoracoscopic repair of EA with TEF over time and the impact of the MIS approach on patient outcomes.

Methods:

NSQIP-P (National Surgical Quality Improvement Program-Pediatric) between 2016 and 2022 was used to identify patients < 1 month old diagnosed with EA and TEF (ICD-10=Q39.1) who underwent repair of both defects (CPT=43312 or 43314). Patients were divided into cohorts (1) MIS [MIS only/MIS converted to Open] and (2) Open repair. Reoperation was subcategorized into diagnostic endoscopy, therapeutic endoscopy, and non-endoscopic surgery. Comparison between cohorts utilized X2, Fisher's exact, and T-tests in SPSS with significance at $p < 0.05$.

Results:

Overall, 1,189 patients were identified. Rate of thoracoscopic repair increased from 2016 (5.1%) to 2022 (29.4%)($p=0.001$). MIS patients were less likely to have pre-operative ventilation (17% vs. 27%, $p=0.001$); otherwise, there were no preoperative clinical differences. Patients who underwent MIS repair had longer operative times (228 min vs 194 min, $p < 0.001$) and more frequent diagnostic endoscopy both at the time of surgery (38.7% vs. 28.4%, $p=0.002$) and postoperatively (5.0% vs. 1.9%, $p=0.013$). There were equivalent postoperative therapeutic endoscopic interventions (3.9% vs. 2.6%, $p=0.291$), and non-endoscopic reoperations (6.9% vs. 6.5%, $p=0.884$), including gastrostomy tube placements (0.9% vs. 1.3%, $p=0.744$). There were no 30-day differences in organ-space infections, unplanned intubations, transfusions, readmissions, or mortality (Table 1). MIS patients had a shorter hospital length of stay, but this was non-significant (17.66 days vs. 19.17 days, $p=0.131$).

Conclusion:

Thoracoscopic repair of esophageal atresia with tracheoesophageal fistula has increased to roughly 30% of repairs. Thoracoscopic approach is associated with more frequent pre- and post-operative endoscopic evaluation of the repair; however, this is occurring without more interventions (either surgically or endoscopically) and does not impact other complications. This analysis affirms the safety of thoracoscopic repair of EA and TEF as the repairs have become more frequent.

Abbreviations: Esophageal Atresia (EA); Tracheoesophageal Fistula (TEF); Minimally Invasive Surgical (MIS); NSQIP-P (National Surgical Quality Improvement Program-Pediatric)

Table I: Post-Operative Outcome Differences After Esophageal Atresia (EA) and Tracheoesophageal Fistula (TEF) Repair Comparing Minimally Invasive Surgical (MIS) and Open Approach

Post-Operative Outcomes	MIS: n - 276 (23.2%)	Open: n- 913 (76.8%)	p-value
Days from Operation to Discharge	17.66 (10.81)	19.17 (12.12)	0.131
Organ Space SSI	14 (5.1%)	34 (3.7%)	0.300
Unplanned Intubation	37 (13.4%)	124 (13.6%)	1.000
Transfusion	29 (10.5%)	111 (12.2%)	0.523
Readmission 30-day	9 (3.3%)	16 (1.8%)	0.149
Unplanned Reoperation: Diagnostic Endoscopy	13 (5.0%)	17 (1.9%)	0.013
Unplanned Reoperation: Therapeutic Endoscopy	10 (3.9%)	23 (2.6%)	0.291
Non-endoscopic Reoperation	17 (6.9%)	56 (6.5%)	0.884
Mortality 30-day	5 (1.8%)	17 (1.9%)	1.000

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COMPARING THE TIME OF SURGERY FOR CONGENITAL LUNG MALFORMATIONS IN CHILDREN THROUGHOUT THE UNITED STATES

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Abstract: Introduction

Congenital lung malformations in infancy present challenges for pediatric surgeons due to the variety of anatomical presentations and symptoms. Severity of symptoms, infection risk, and malignant transformation potential influence the timing of resection. This study aimed to compare the timing of surgery for congenital lung malformations in children across the US.

Methods

The Nationwide Readmissions Database (2016-2020) was queried for all patients under 1 year of age with congenital lung malformations. Patients undergoing pulmonary lobe resection during the index admission were excluded. Surgery timing was categorized as early (within 4 months), intermediate (4-6 months), and late (6-12 months). Additional categories included open vs. thoracoscopic surgery, anatomic location, birthweight, gestational age, gender, socioeconomic factors, and hospital characteristics. The primary outcome was prolonged length of stay (LOS >3 days), while secondary outcomes included prolonged mechanical ventilation (>96 hours) and blood transfusion. Univariable comparison was performed using chi-squared, and multivariable logistic regression was used for significant factors.

Results

A total of 615 patients met inclusion criteria. Early surgery was performed in 186 (30.3%) patients, intermediate in 221 (35.9%), and late in 208 (33.8%). Preterm patients made up 16.6%, while 10.2% had low birthweight. Open surgery was performed in 224 (36.4%) patients. Prolonged LOS occurred in 158 (25.7%) patients, prolonged mechanical ventilation in 12 (2.0%), and blood transfusion in 31 (5.0%). Late surgery was associated with a decreased risk of prolonged LOS (OR 0.37 [0.20-0.86], $p=0.002$) compared to early surgery. There was no difference in prolonged mechanical ventilation or blood transfusion based on surgery timing. Additional risk factors for prolonged LOS included Medicaid insurance (OR 4.3 [2.5-7.4], $p<0.001$) and investor-owned hospitals (OR 14.5 [2.7-77.2], $p=0.002$).

Conclusions

The timing of surgery for congenital lung malformations in infants varies across the US. Late surgery was associated with decreased prolonged LOS, while Medicaid insurance and investor-owned hospitals increased the risk for prolonged LOS. Further research is needed to optimize surgery timing and address disparities in care.

Abbreviations: US- United States

LOS- Length of Stay

S113

PRENATAL IMAGING CHARACTERISTICS PREDICT THE NEED FOR EARLY THORACIC SURGERY OR ADVANCED RESPIRATORY SUPPORT IN NEONATES WITH CONGENITAL LUNG MALFORMATIONS

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Abstract: Congenital lung malformations (CLMs) encompass a range of structural anomalies that can significantly affect neonatal outcomes. Advances in prenatal imaging have enhanced the detection of CLMs but clinical implications can widely differ. While most infants with CLMs are discharged within 48 hours after birth and undergo elective resection by 12 months of age, up to 15% may require immediate surgical intervention or advanced respiratory support at birth. This need is often clearer in preterm infants due to their immature pulmonary development; however, term infants present a more unpredictable clinical trajectory, complicating management strategies. In this study, we hypothesize that specific prenatal imaging characteristics can predict which term neonates with CLMs may need surgery or respiratory support at birth.

This was a single-center retrospective study of neonates with prenatally diagnosed CLMs from 2002 to 2023. Full term deliveries requiring early surgery or respiratory support were compared against controls not requiring early intervention. Prenatal Ultrasound and MRI markers were used to predict the need for early intervention using univariable and multivariable analyses, $p < 0.05$ was considered significant.

113 neonates were included. In the early intervention group, 14 required early surgery and 4 required advanced respiratory support at birth (i.e. HFNC, BiPAP, mechanical ventilation). 95 did not require early intervention (control group). Significant predictors for early intervention in term neonates included second trimester US lesion size, lesion growth on follow up US, and second trimester MRI lesion volume. There were trends towards larger CVR and smaller observed/expected TFLV in the early intervention group. The multivariable models based on US and MRI measures were moderately predictive (AUCs: 0.77 and 0.72).

Prenatal MRI and US characteristics—particularly those related to increased size, growth, and mass effect—are associated with an increased risk of requiring early intervention in neonates with CLMs. In addition to optimizing clinical care, identifying high-risk characteristics of CLMs in utero can assist providers in offering anticipatory guidance for families of neonates who may need surgical intervention or critical respiratory support at birth.

Abbreviations: CLM= Congenital Lung Malformations

MRI=magnetic resonance imaging

HFNC=High Flow Nasal canula

BiPAP= Bilevel Positive Airway Pressure

US= ultrasound

CVR= cyst volume ratio

TFLV= total fetal lung volume

AUC= area under the curve

GA= gestational age

Table 1. Univariable imaging characteristics associated with early intervention.

Prenatal imaging findings	Early intervention (n=18)	Control (n=95)	p-value
US lesion size (mm) (avg GA 18-23)	56.5	16.6	0.009
Lesion growth on US	71.4%	28.8%	0.023
CVR	1.3	0.43	0.053
MRI volume (mm ³) (avg GA 26-27 weeks)	22.5	10.2	0.015
Observed/Expected TFLV on MRI	0.71	0.9	0.058

S114

IMPACT OF PREMATURITY AND GESTATIONAL AGE AT SURGERY ON DIAPHRAGMATIC PPLICATION OUTCOMES

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Abstract: Purpose: Surgical plication for diaphragmatic eventration is an uncommonly performed procedure and large studies describing outcomes are lacking. Plication for acquired phrenic nerve injury typically occurs 4-8 weeks after watchful waiting to allow for resolution. In contrast, plication for congenital diaphragmatic eventration may be done earlier. We sought to determine outcomes of pediatric diaphragmatic plication in a large cohort. We further sought to characterize the impact of prematurity and gestational age at surgery (GAS).

Methods: The NSQIP pediatric participant use file was queried for all cases of diaphragmatic plication between 2016 and 2022. Outcomes of interest included incidence of major complications, mortality, hospital stay, and ventilator days. Chi squared analysis and multivariate regression compared impact of GAS and prematurity while controlling for medical comorbidities and operative approach.

Results: Results: We identified 252 children and infants undergoing diaphragmatic plication. 18% were premature. 27% had a GAS under 44 weeks and 26% between 44 and 60 weeks. Two patients died. History of prematurity was associated with major complications (41% vs 19% $p < 0.0001$), need for post-operative ventilation (40% vs 20% $p < 0.001$), prolonged ventilator days, and need for oxygen at discharge (40% vs 18% $p < 0.001$). Early GAS was significantly associated with increased risk of major complications (39% < 44 weeks, 31% 44-60 weeks, 2% 60-90 weeks, 10% 90-200 weeks, 14% >200 weeks), as well as transfusion, unplanned intubation, sepsis, and prolonged hospitalization. Operative approach did not significantly impact major post-op complications. On multivariable adjustment for ASA class and operative approach, both prematurity and early GAS were found to be independently predictive of major complications, with early GAS being a stronger predictor than prematurity. Early GAS was also a strong independent predictor for prolonged hospital stay while the history of prematurity was not.

Conclusions: Complication rates following diaphragmatic plication are significant. Early GAS is a stronger predictor of post-operative morbidity and longer hospital stay than prematurity. This suggests a difference in outcomes between plication for congenital and acquired diaphragmatic eventration. This should inform surgeons when counseling parents of infants with this condition.

Abbreviations: GAS Gestational Age at Surgery
ASA American Society of Anesthesiologists

S115

BIODEGRADABLE AND SELF-EXPANDING METAL STENTS IN THE TREATMENT OF PEDIATRIC BENIGN ESOPHAGEAL DISEASES

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Abstract: Purpose

The aim of the study was to investigate and compare the efficacy and complications of biodegradable stents (BDS, figure a) versus self-expandable fully covered metal stents (SEMS, figure b) in pediatric patients with benign esophageal disease.

Methods

This retrospective, dual-centre study included all children with esophageal atresia (EA) or caustic ingestion undergoing stent treatment from November 2016 through March 2024. Primary outcome measurements were reintervention rate, time to reintervention (TTR) and procedural success at 30, 60 and 90 days after placement and at the end of individual follow-up. Success was defined as no necessity of further reinterventions and a patent esophageal lumen. Secondary outcome measurements were all stent-related complications during the study period.

Results

A total of 79 stents (BDS: 33, SEMS: 46) were placed in 20 patients for stricture (64), fistula (3), anastomotic leakage (6), free perforation (1) or combined indication (5). If necessary, median TTR was 71 days for BDS vs. 35 days for SEMS. Patients treated with BDS had a 52 % lower risk for the occurrence of a relapse (HR: 0.48, CI: 0.36–0.64, $p < 0.001$, figure c). At the end of follow-up (median: 5 months), exclusive stenting was successful in 4 patients, stenting with other minimally invasive procedures in 2 patients and stenting with surgical revision in 3 patients. Most frequent stent-related complications were migration (24.1 %) and granulation tissue formation (20.3 %) with statistically significant higher risk of migration with SEMS (OR: 0.05, CI: 0.01–0.39, $p < 0.001$) and granulation tissue with BDS (OR: 4.10, CI: 1.26–13.31, $p = 0.014$).

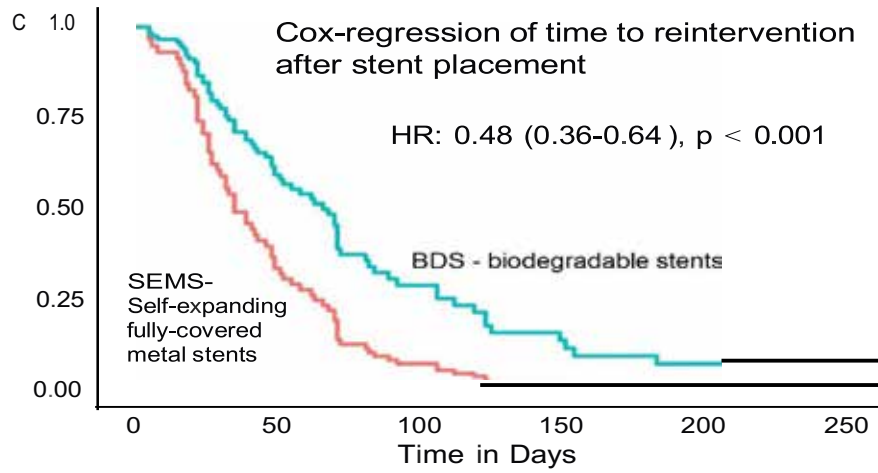
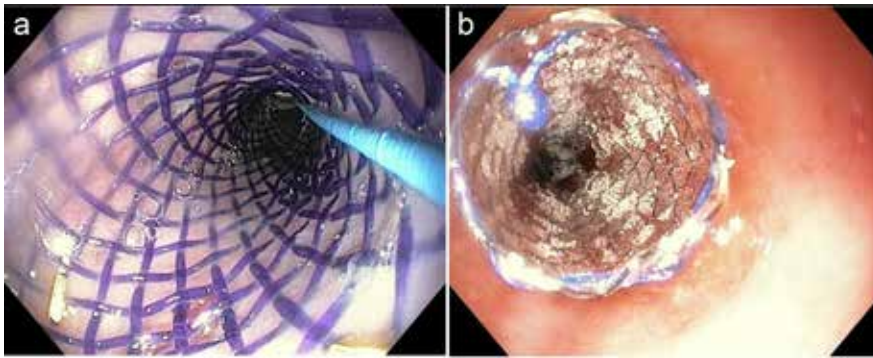
Conclusion

Stents are a simple, non-invasive therapeutic option in the management of esophageal atresia and caustic ingestion with only few and minor associated complications (notably: stent migration and granulation tissue potentially causing restenosis). Although a relapse occurs frequently in the long term, stenting can assure esophageal patency in the medium term. If placed for recalcitrant stricture, longer periods free of interventions are achieved in comparison to iterative dilatation, particularly when using BDS. According to our results, medium-term and sometimes long-term success justifies the therapeutic attempt by esophageal stenting to lower the risk of major surgical interventions.

Abbreviations: EA - esophageal atresia

BDS - biodegradable stents

SEMS - self-expanding metal stents



TELEMEDICAL INTERDISCIPLINARY CARE FOR PATIENTS WITH ESOPHAGEAL ATRESIA (TIC-PEA): A PROSPECTIVE; MULTICENTER COHORT STUDY EVALUATING THE EFFECT OF STRUCTURED TELEMEDICAL CONSULTATION ON OUTCOME

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Abstract: Purpose

Esophageal atresia (EA) is a rare disease that requires attention to detail for optimal outcomes. A major challenge for providing standardized, optimal care is low individual center patient volume. We therefore devised a multidisciplinary, telemedical program consisting of EA experts providing regular scheduled consultations to peripheral providers (TIC-PEA, Telemedical Interdisciplinary Care of Patients with Esophageal Atresia). This study reports the effects of the intervention on outcomes.

Methods

Pediatric surgeons were able to enroll their EA patients and thereby receive complimentary multidisciplinary, peer-based telementoring from high-volume centers during their patient's first year of life. Recommendations were based on current published guidelines. Simultaneously, parents were offered counselling by a parent-patient organization. Demographics and outcomes of the cohort were compared to a national registry control group. Rate of anastomotic dilatations was defined as the primary outcome parameter.

Results

In total, 100 patients were recruited into the study, of which 86 reached the follow-up age endpoint of 1 year. The remainder will complete follow-up in December 2024. The table shows the patient characteristics of the intervention and control groups. Twenty-eight pediatric surgical centers participated. Pediatric surgeons were inclined to enter smaller, more premature, and more complex patients into the TIC-PEA program, compared to controls. So far, TIC-PEA patients underwent an average of 7.8 dilatations per 100 person*months versus 16.2 in the control group ($p < 0.05$). Three patients (3%) died during the observation period in the TIC-PEA study group, compared to an overall mortality in non-participants of 14% (chi-square 8.1, $p < 0.01$).

Conclusion

This is the first interventional study to evaluate the effect of structured expert interdisciplinary telementoring on outcome in patients with esophageal atresia. Participating pediatric surgeons were more inclined to enroll complex cases into the TIC-PEA program. Although TIC-PEA patients on average were disproportionately smaller, more premature and more complex, participation in this telemedical consultation program was associated with lower anastomotic dilatation rates and mortality. We concluded that peer-telementoring has the potential to optimize management and improve outcomes of patients with esophageal atresia. Ideally, intervention should start at the time of birth. Similar telementoring programs may be beneficial for other rare pediatric surgical diseases.

Abbreviations: TIC-PEA Telemedical Interdisciplinary CAre for Patients with Esophageal Atresia
EA Esophageal atresia

ASSESSING CARDIAC COMPRESSION IN PECTUS EXCAVATUM: THE ROLE OF EXTERNAL CALIPER MEASUREMENTS

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Abstract: Purpose: Severe pectus excavatum (PE) can result in cardiac compression and reduced cardiopulmonary function. External caliper measurements (ECM) obtained during physical exam have been shown to provide equivalent information to cross-sectional imaging with respect to overall PE severity. However, the ability of ECM to predict cardiac compression is unknown. This study investigated the relationship between external caliper measurements and cardiac compression on preoperative imaging.

Methods: This was a secondary analysis of a prospective, multicenter, observational study including eight hospitals participating in a regional research consortium including patients aged 6-25 years with uncorrected PE. All patients underwent preoperative imaging with echocardiogram, computed tomography, or magnetic resonance imaging and ECM to include the deepest point of sternal depression to posterior midline (AP), and the posterior midline to maximal point of anterior chest protrusion bilaterally. These measurements were used to calculate the modified percent depth (MPD) of the defect. Preoperative imaging reports were reviewed for presence of cardiac compression. Associations between caliper measurements and cardiac compression were analyzed using Wilcoxon rank sum tests and multivariable logistic regression.

Results: The study population included 142 patients (85% male, mean age 16 years, mean AP 13.2 cm, mean MPD 25%). Forty-two percent had cardiac compression on any imaging. Seventy-two percent reported symptoms related to their PE defect. On unadjusted analysis, patients with cardiac compression were older (mean age 16 vs. 15 years, $p=0.15$). Cardiac compression patients had similar AP distances (13 vs. 13 cm, $p=0.55$); and greater MPD (26% vs. 23%, $p=0.05$), respectively. On logistic regression with adjustment for demographics, larger MPD was predictive of cardiac compression on CT scan (Odds ratio: 1.048 95% Confidence Interval 1.004, 1.094, $p=0.034$).

Conclusion: In patients with PE, a larger modified percent depth was associated with greater risk of cardiac compression on imaging. This finding further supports the utility of external caliper measurements in quantifying severity of PE and potentially avoiding cross-sectional imaging. Further study is needed to optimize clinical prediction of cardiac compression in this population.

Abbreviations: PE: pectus excavatum

ECM: External caliper measurements

MPD: modified percent depth

AP: Anterior to posterior

S118

TRACHEOBRONCHOPEXY IN BRONCHOPULMONARY DYSPLASIA INFANTS WITH SEVERE TRACHEOBRONCHOMALACIA

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Abstract: Background: Preterm infants with severe bronchopulmonary dysplasia (BPD) can suffer from prolonged intubation, tracheostomy or positive pressure ventilation (PPV) dependence. Some can also present with tracheobronchomalacia (TBM) leading to desaturation spells or high airway pressure requirements. Surgical tracheobronchopexy is effective in improving respiratory outcomes in children with TBM, both primary disease and secondary to esophageal atresia, however little is known about its efficacy in those with BPD. We describe our experience with tracheobronchopexy in severe BPD-TBM infants for desaturation spells, PPV, ventilator dependence, and preexisting tracheostomy with high ventilator settings.

Methods: We reviewed BPD patients who underwent tracheobronchopexy for desaturation spells, failure to wean PPV or extubate, or preexisting tracheostomy with high ventilator settings from April 2019 to August 2024 at a single institution. Patient characteristics, surgical techniques, and respiratory outcomes were reviewed.

Results: Nineteen BPD infants (male 62%; median gestational age 25 weeks) underwent 21 tracheobronchopexies at median corrected gestational age of 5 months for desaturation spells (38%), PPV (33%), ventilator dependence (29%), and preexisting tracheostomy with high ventilator settings (29%). On preoperative bronchoscopy, all demonstrated complete dynamic airway collapse. Surgical approach was posterior (86%) or anterior (14%), consisting of thoracic tracheopexy alone (24%), or combined tracheopexy and bronchopexy (76%). Concomitant procedures included cervical tracheopexy (29%), posterior descending aortopexy (14%), and resorbable external airway splints (5%). Comorbidities included gastroesophageal reflux disease in 81% (29% requiring fundoplication and 38% requiring gastrojejunostomy) and pulmonary hypertension on medication in 33%. At latest follow up of median 12.5 (IQR 9-34) months, there were no recurrent desaturation spells ($p < 0.0001$) and overall significant improvements in respiratory status from baseline ($p = 0.0002$) (Table). Only one infant (5%) required new tracheostomy. Of those with preexisting tracheostomies ($n = 8$, 38%), there was significant mean positive end expiratory pressure (PEEP) reduction of 6.25 ($p = 0.0104$). There were no significant surgical complications or mortalities.

Conclusions: In severe BPD-TBM patients, tracheobronchopexy significantly reduces desaturation spells, ventilator dependence, and PEEP requirement. This surgical strategy is safe and effective in select infants for improving respiratory status.

Abbreviations: bronchopulmonary dysplasia (BPD), positive pressure ventilation (PPV), tracheobronchomalacia (TBM), positive end expiratory pressure (PEEP)

Clinical Symptoms and Respiratory Status

	Preoperative (n=21 operations)	Postoperative* (n=21 operations)	P value
Desaturation spells	8 (38%)	0	<0.0001*
Respiratory status - Room air	0	7 (33%)	0.0049*
Positive pressure ventilation	6 (29%)	1 (5%)	0.057
Ventilator dependence	14 (67%)	7 (33%)	0.0155*

*At latest follow up

Wednesday, May 7, 2025

Scientific Session 7 - Quality

4:00 PM – 5:30 PM

S119

IMPLEMENTATION OF A CLINICAL PATHWAY FOR SHORTENED ANTIBIOTIC THERAPY IN CHILDREN WITH COMPLICATED APPENDICITIS

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Abstract: Purpose: We implemented a clinical pathway for complicated appendicitis guided by antimicrobial stewardship principles. Our institution had a 95.7% rate of discharge oral antibiotic utilization and was an outlier compared to NSQIP-P peer hospitals. We aimed to decrease oral antibiotics at discharge by 50% within 6 months, without increasing length of stay (LOS), organ-space surgical infection (OSI) rates, or Return ED Visits within 30 days.

Methods: A multidisciplinary care process team developed a clinical pathway directing postoperative antibiotic usage, clinically based discharge parameters, and indications for postoperative diagnostic imaging. Implementation began in April 2024 with corresponding provider education and an electronic health record order set. The primary outcome was the proportion of patients receiving oral antibiotics at discharge, with the secondary outcome of oral antibiotic duration, and balancing measures of length of stay (LOS), organ-space surgical site infection (OSI), and ED return within 30 days. Data were analyzed using run charts to detect special cause variation over the pre-implementation (1/2024-3/2024), transition (4/2024-6/2024) and post-implementation (7/2024-9/2024) periods.

Results: 89% of patients received oral antibiotics at discharge in the 3-month baseline pre-implementation period (n=44), with a mean LOS of 3.8 days (SD +/- 2.2) and 11% return ED visit rate. During the transition period (n=43), 58% of patients were discharged with oral antibiotics, with a mean LOS of 3.9 days (SD +/-2.2), and 23% rate of return ED visits. The post-implementation cohort (n=38) showed 45% patients discharged with antibiotics with a mean LOS of 4.3 days (SD +/-2.6), and 10% rate of return ED visits. Oral antibiotic duration decreased over time (Figure 1a), demonstrating a negative linear trend, while LOS remained stable (Figure 1b). There was no difference in OSI rates between baseline and post-implementation time periods (4.5 % vs. 6.2%, p=0.696).

Conclusions:

Implementation of a clinical pathway to promote antimicrobial stewardship in children with complicated appendicitis led to decreased antibiotic utilization without worsened clinical outcomes.

Abbreviations: NSQIP-P (National Surgical Quality Improvement Program- Pediatric)
 LOS (length of stay)
 OSI (organ-space surgical site infection)
 ED (emergency department)

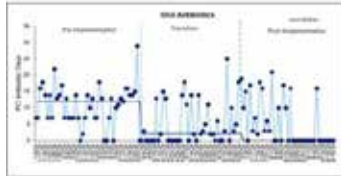


Figure 1a. Run chart depicting discharge and antibiotic utilization over time.

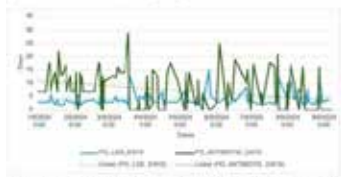


Figure 1b. Line chart depicting discharge oral antibiotic duration and postoperative hospital length of stay over time.

S120

IMPROVING SUCCESS RATE OF ENEMA REDUCTION FOR INTUSSUSCEPTION

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Abstract: Purpose: First-line management for reduction of ileocolic intussusception in children is air or contrast enema, and surgical intervention is required for patients who fail fluoroscopic reduction. Previous literature has demonstrated safety and efficacy of a delayed repeat enema after initial failed attempt to decrease the need for surgery. Additionally, the use of wall air, rather than manual pressure, provides more constant pressure and may increase success of intussusception reduction. We developed a protocol to increase the success rate of air enema by incorporating these two elements.

Methods: In March 2023, the delayed second attempt enema for those who failed initial reduction was introduced informally. In May 2023, there was an interdisciplinary conference between the surgery and radiology departments to disseminate information regarding the safety and efficacy of second attempt enemas. Finally, in October 2023, a standardized order set for all children presenting to the emergency department with intussusception was adopted, and wall air officially became the recommended modality for air enema reductions.

Results: After implementation of wall air and delayed repeat enema, there was an increase in the percentage of successful reductions from 83% to 94%. There was notable compliance with both the delayed repeat enema and the use of wall air. At baseline, only 28% of patients with failed first attempt enema underwent a second attempt, and since the third quarter of 2023, 100% of patients who failed the first attempt have undergone a second attempt. Wall air use has steadily increased from a baseline of 0% to 100%. Remarkably, only 2 patients were eligible for delayed repeat enema since the project began, likely due to the effectiveness of wall air and possibly more aggressive efforts to optimize success on the first attempt.

Conclusions: Using wall air may lead to improved success rates of fluoroscopic reduction. Education regarding the low risk of perforation and potential for second attempt air enema can also improve success rates of intussusception reduction and decrease the need for surgical intervention.

Abbreviations:



S121

IMAGING STEWARDSHIP FOR THE DIAGNOSIS OF PEDIATRIC APPENDICITIS: ONE INSTITUTION'S PATHWAY TO IMPROVE DIAGNOSTIC ACCURACY OF ULTRASOUND

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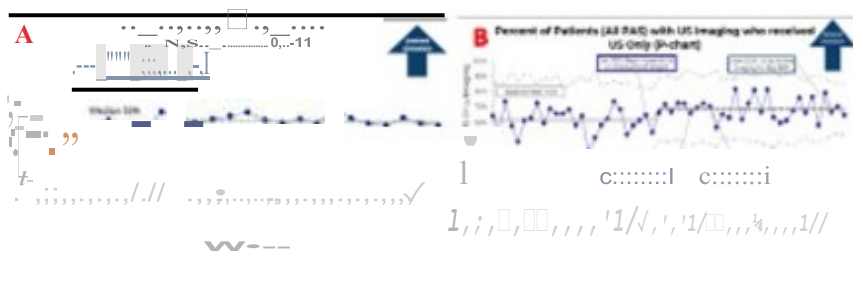
Abstract: Purpose: When ultrasound (US) is non-diagnostic, pediatric patients being evaluated for appendicitis may undergo additional imaging studies such as MRI or CT. This incurs increased cost, delays in diagnosis, and, in cases of CT, radiation exposure. In 2017, the diagnostic rate of US for appendicitis at our institution was approximately 27.1%. To improve the diagnostic rate and to reduce the need for further cross-sectional imaging we worked with stakeholders in the departments of radiology and emergency medicine to improve ultrasound performance.

Methods: First, in August 2022, sonographers underwent training on proper techniques for abdominal ultrasounds. In November 2022, a standardized template for the interpretation of ultrasound and MRI for evaluation of appendicitis was implemented by the radiology department. We also developed an imaging pathway in which patients underwent a specific imaging modality based on their Pediatric Appendicitis Score (PAS) at the time of presentation. All patients in the low PAS group (scores 0-3) were dispositioned by the emergency department, and those in the high PAS group (scores 7-10) underwent abdominal ultrasound. Because of the historically low diagnostic rate of ultrasound in the moderate PAS group (scores 4-6), these patients underwent MRI initially.

Results: Since the introduction of these initiatives, the diagnostic rate of US at our institution for children in all PAS groups has increased to 56%, from a baseline of 27.1%. Additionally, the percentage of children in all PAS groups who received US and did not require additional imaging has increased from 61% to 69%. Average costs per patient for imaging prior to introduction of our protocol was \$5390.59 compared to an average cost of \$4468.82 per patient post-intervention ($p < 0.001$). Because of the improvement in our diagnostic rate of US, our pathway was adapted in May 2024, so children in the moderate PAS group undergo US first, rather than MRI.

Conclusions: Ultrasound performance improved and is currently the first-line imaging modality for both the moderate and high PAS groups. Sonographer training and introduction of standardized template for reporting ultrasound findings can help to improve the diagnostic rate of ultrasound in these patients.

Abbreviations: US: ultrasound
CT: computed tomography
MRI: magnetic resonance imaging
PAS: pediatric appendicitis score



ASSOCIATION BETWEEN SAME DAY DISCHARGE AND READMISSION RATES FOR COMMON PEDIATRIC SURGICAL CASES: A NSQIP-PEDIATRIC ANALYSIS, 2012-2022

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Abstract: Purpose: Same-day discharge (SDD) has become increasingly common after elective pediatric surgical cases. This study aims to provide a contemporary analysis of SDD and readmission rates for seven common pediatric surgical procedures.

Methods: This is a retrospective cohort study of surgical procedures performed on patients < 18 years of age using the American College of Surgeons National Surgical Quality Improvement Program-Pediatric database. We included laparoscopic appendectomy, pyloromyotomy, and cholecystectomy, as well as hemithyroidectomy, Nuss procedure for pectus excavatum, gastrostomy tube placement and gastrostomy closure (2012, 2017 and 2022). Exclusion criteria were perforated appendicitis and length of stay (LOS) > 2 days. Variables included demographic data, cardiac and anesthesia risk factors, diabetes, steroid use and developmental delay. Outcomes included SDD, LOS, and 30-day hospital readmission. Chi-squared comparisons were used to determine statistical significance of differences in readmission rates for patients with SDD compared to patients with LOS > 24 hours. Stepwise forward logistical regression models were applied sequentially to each operation to account for confounding variables.

Results: Among 39,578 patients, 14,881 (37.6%) had SDD, and 24,697 (62.4%) patients had LOS > 24 hours. From 2012 to 2022, the proportion of patients discharged on the same day as their procedure increased for laparoscopic appendectomy, laparoscopic cholecystectomy, gastrostomy closure, and hemithyroidectomy (Figure). On adjusted logistical regression, the odds [95% CI] of readmission after SDD compared to discharge after 24 hours were lower in the following categories: laparoscopic appendectomy in 2012 (0.55 [0.38-0.78]), 2017 (0.57 [0.40-0.81]) and 2022 (0.55 [0.39-0.79]), laparoscopic cholecystectomy in 2012 (0.63 [0.41-0.96]), 2017 (0.64 [0.42-0.97]) and 2022 (0.64 [0.42-0.98]), and gastrostomy closure in 2012 (0.36 [0.19-0.67]), 2017 (0.37 [0.20-0.69]) and 2022 (0.42 [0.23-0.79]). In no case was readmission more likely in the SDD group than in the longer stay group.

Conclusion: Over the past decade, same-day discharge rates have increased for laparoscopic appendectomy, laparoscopic cholecystectomy, gastrostomy closure, and hemithyroidectomy. Same-day discharge following these common, elective pediatric surgical procedures was not associated with an increased odds of readmission compared to discharge after greater than 24 hours length of stay and may be an important marker of quality and safety.

Abbreviations: Same-day discharge (SDD)

Length of stay (LOS)

Confidence interval (CI)

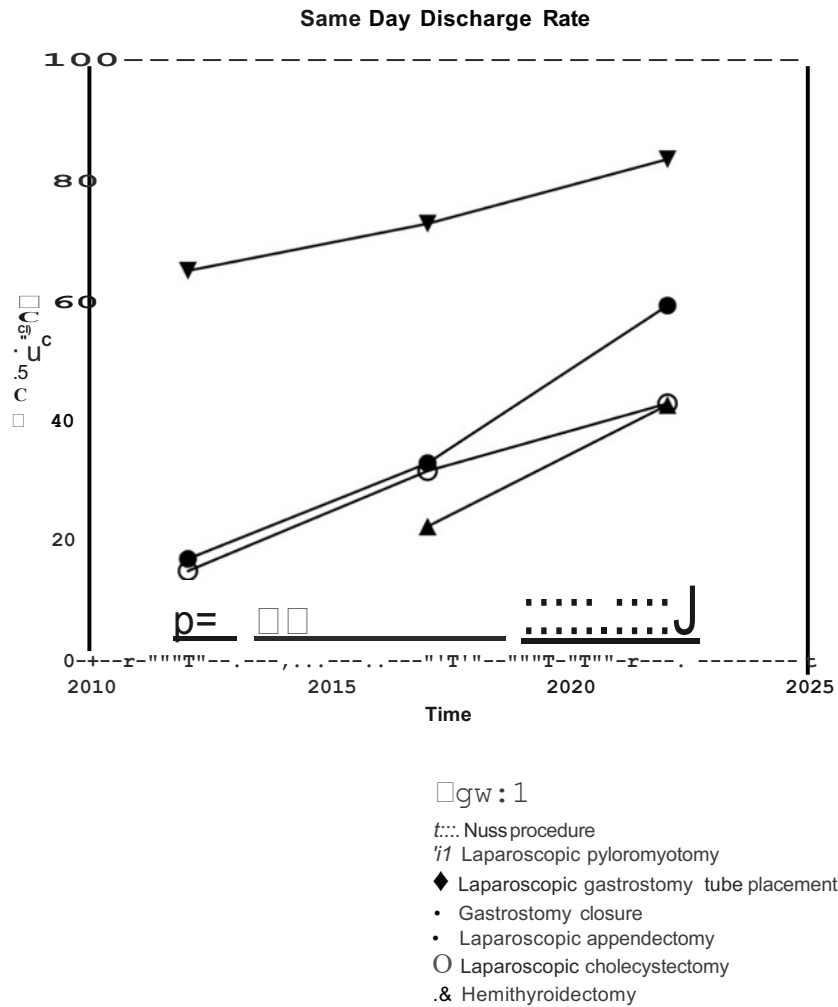


Figure 1 Incidence rates of same-day discharge (SOD) for seven common pediatric surgical procedures at three timepoints- 2012, 2017, and 2022.

S123

IMPACT OF AN INTERACTIVE ONLINE DASHBOARD ON COMPLIANCE WITH PEDIATRIC SURGICAL ANTIBIOTIC PROPHYLAXIS GUIDELINES

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Abstract: Purpose

Multiple infection-control organization have published consensus guidelines on proper antibiotic prophylaxis for multiple operations. However, awareness of and adherence to these guidelines is extremely variable amongst pediatric surgical specialists. Therefore, we set out to quantify our institutional rate of antibiotic misutilization prior to elective operations on children. Further, we aimed to reduce our rate of misutilization through an interactive dashboard for providers to learn about their specialty-specific outcomes and current antibiotic prophylaxis recommendations.

Methods

We used the Pediatric NSQIP Surgical Antibiotic Prophylaxis Semi-Annual Report (SAP-SAR) to quantify our institutional rate of antibiotic misutilization prior to elective operations on children. We then conducted focus groups with each surgical specialty included in the SAP-SARs to educate them about current antibiotic prophylaxis recommendations. Finally, we established an interactive, online dashboard for all pediatric surgical specialists. The dashboard allowed users to track their specialty-specific outcomes over time, while also containing a searchable database which listed the recommended antibiotic prophylaxis guidelines for a host of elective procedures. "Misutilization" was defined as an incorrect antibiotic prophylaxis of any kind. "Overutilization" was defined as using overly broad-spectrum prophylaxis, giving prophylaxis when none was indicated or unnecessarily using prophylaxis postoperatively. "Underutilization" was defined as giving inappropriately narrow-spectrum prophylaxis, omitting prophylaxis when it was indicated or giving antibiotics too remote from the time of incision.

Results

In comparing the SAP-SARs from May 2023 to August 2024, our institution markedly improved its outcomes with regards to prophylaxis misutilization (40.28% to 25.95%), prophylaxis overutilization (29.17% to 18.71%), prophylaxis underutilization (12.04% to 10.24%), non-compliance with timing (5.95% to 2.53%), non-compliance with spectrum (15.61% to 6.67%), inappropriately board spectrum prophylaxis (14.45% to 6.00%), prophylaxis use in low-risk clean procedures (77.78% to 42.11%) and any postoperative prophylaxis (42.05% to 35.00%). No antibiotics stewardship measures noted worsening outcomes during the study interval. During that same time interval, the SAP-SARs did not detect any significant changes pertaining to all SSIs, incisional SSIs, organ-space SSIs or *C. difficile* infections.

Conclusions

A digital, interactive dashboard, when coupled with direct provider education, can lead to significantly improvements towards antibiotic stewardship without compromising surgical outcomes in pediatric patients.

Abbreviations: SAP-SAR = surgical antibiotic prophylaxis semiannual report

NSQIP = National Surgical Quality Improvement Program

SSI = surgical-site infection

	May 2023	August 2023	February 2024	P+HH
Overall prophylaxis misutilization (%)	40.28	33.17	29.77	25.95
Overall prophylaxis overutilization (%)	29.17	29.95	26.50	18.71
Overall prophylaxis underutilization (%)	12.04	4.44	5.62	10.24
Non-compliance with timing (%)	5.95	1.27	1.10	2.53
Non-compliance with spectrum (%)	15.61	15.61	10.12	6.67
Prophylaxis use in low-risk clean procedures	77.78	86.36	76.67	42.11
On first day in clean-contaminated and high-risk clean procedures	11.29	3.45	5.56	10.00
Any postoperative prophylaxis	42.05	44.74	43.98	35.00
Postoperative prophylaxis > 24 hours	10.77	9.47	8.38	9.38

IMPLEMENTATION OF REMOTE PATIENT MONITORING TO REDUCE GASTROSTOMY TUBE RESOURCE UTILIZATION

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Abstract: Purpose: To reduce unnecessary healthcare utilization and improve the family experience, we implemented a remote patient monitoring (RPM) program providing automated high-touch support for families during the pre-, peri-, and post-operative stages of care.

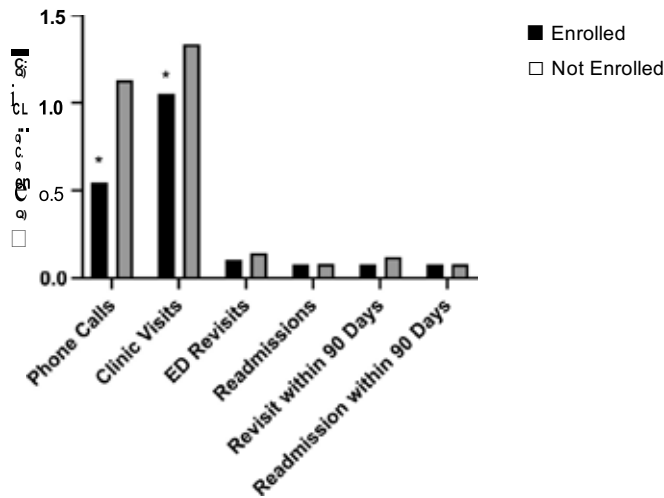
Methods: Electronic Medical Record data for pediatric patients who had GTs placed by general surgery at a single institution from January 2018 – July 2024 was retrospectively reviewed. Beginning in September 2023, all ambulatory patients scheduled for a GT were eligible to enroll in the RPM program and data was prospectively collected. In brief, this was a 6-month intervention providing support before and after surgery through just-in-time education, questionnaires, and check-ins. The SMARTIE aim was to reduce emergency department (ED), and urgent clinic visits related to new GTs by 50% during the first 90-days following surgery, regardless of race and ethnicity.

Results: A total of 1071 patients were included. Of these patients, 95 (80%) enrolled or completed the RPM program. On average, RPM education and questionnaire tasks were completed at a rate of 48% and 24%, respectively. Of the program participants who completed the satisfaction survey, 82% would accept earlier GT placement with their current knowledge and 69% found the support offered “Very Satisfactory” or “Satisfactory”. The average total number of phone calls related to GT concerns per patient in the enrolled group compared to the non-participating group within 6 months postop was 0.66 vs. 1.2 ($p < 0.001$). GT-related urgent clinic visits in patients with low profile GTs were significantly lower in the enrolled group compared to the nonparticipating group (0.56 vs. 1.37, $p = 0.03$). ED revisit rate was not statistically significantly different with intervention.

Conclusion: Early results demonstrate RPM programs are an effective method to proactively identify, support, and address education gaps; reinforce key components of care; increase care team engagement; and encourage early communication. Overall, family satisfaction and engagement with this early iteration of our RPM program was found to be high. Interestingly, despite introduction of high-touch RPM program, ED revisit rate remains high. This is currently being investigated.

Abbreviations: Remote Patient Monitoring (RPM)
Emergency Department (ED)

Gastrostomy Tube-Related Medical Resource Utilization 6 Months Postop



S125

SAME DAY DISCHARGE AFTER SURGICAL GASTROSTOMY TUBE PLACEMENT IN CHILDREN

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Abstract: Background: Gastrostomy tube (GT) placement is a common procedure performed by pediatric surgeons. Our institution has recently implemented a same day discharge (SDD) clinical practice guideline (CPG). This study evaluated SDD after GT placement for a select patient population with implementation of a CPG. We hypothesized that use of this CPG will provide a select patient population with the ability to discharge sooner after GT placement without increasing post-op emesis or complications.

Methods: A CPG was created by a multidisciplinary pediatric surgery QI team using best practice evidence while accounting for unique institutional workflow. The CPG directed scheduling parental training classes, consulting nutrition for recommendations, ordering home equipment immediately after surgery, and implementing a standardized protocol to start feeds via GT as soon as the feeding is available. This QI study retrospectively reviewed a pre-implementation cohort (pre-SDD) and the post-implementation (SDD) patients, comparing time to first feeding, length of stay (LOS), emesis events, and return to emergency department (ED) visits for GT issues within 30 days.

Results: The historical cohort prior to the implementation of the SDD CPG (3/2022-1/2023, N=84) showed median time to discharge of 27.1 hours (IQR: 4.3), with 20 patients returning to the ED visits for GT issues. The SDD GT cohort (12/23-9/24, N=5) showed average time to first feeding of 5.45 hours and average time to discharge as 6.29 hours with 0 patients with readmission or return ED visits for GT issues.

Conclusions: Implementation of a SDD protocol after GT placement through implementation of a CPG allowing for more expedited feed and discharge management is effective at significantly decreasing LOS by over 20 hours. In a small select patient population, SDD following GT placement does not appear to adversely affect frequency of emesis or likelihood of readmissions or ED visits related to GT issues. Impending studies involve the assessment of the impact the implementation of the SDD CPG has on LOS for the entire post GT population including patients who were not planned for SDD.

Abbreviations: Gastrostomy tube (GT)
Same day discharge (SDD)
Clinical practice guideline (CPG)

S126

CALCULATING CARBON EMISSION REDUCTION IN PEDIATRIC PATIENT VISITS AT OUTREACH CLINICS FROM A SURGICAL PATIENT COHORT

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Abstract: Introduction

Healthcare is a significant generator of greenhouse gases, with one source being created by patients traveling to access care. Outreach clinics present a potential solution to reduce this environmental impact. The objective of this study was to measure the reduction in carbon emissions via outreach clinics for pectus excavatum patients who underwent the Nuss procedure.

Methods

A retrospective cohort study was performed on pediatric patients that underwent a Nuss procedure for pectus excavatum (by a single surgeon) who reside in Northeast Wisconsin from 2012 – 2024. Patients were excluded if they lived locally near the Children's Hospital, had insurance limitations preventing them from being seen at the outreach clinic, or if there was insufficient documentation to abstract data. Four facilities were defined as outreach clinics located in two cities, Green Bay and Oshkosh, Wisconsin. Total outreach visits per patient were tabulated, and the reduction in miles traveled by not visiting the Children's Hospital clinic was calculated, along with the reduction in carbon emissions. The standard 400g of CO₂ emissions per mile, as defined by the United States Environmental Protection Agency, was used for the analysis.

Results

Of the 124 patients identified, 33 met the inclusion criteria. Total patient travel to the outreach clinics accounted for 1,172,560g CO₂ emissions. This would have been 7,559,400g CO₂ emissions if they traveled to the Children's Hospital. 142 appointments were recorded among the 33 patients, of which 87 had overlapping days. These 87 appointments were covered in 37 visits by the surgeon traveling to the outreach clinics with a resultant 2,156,000g CO₂ emissions. If these patients had to travel to the Children's Hospital for these appointments, then there would have been an additional 4,732,720g of CO₂ emissions generated. This is the CO₂ equivalent of supplying electricity to 212 homes for one year.

Discussion

Surgical outreach clinics reduce the carbon footprint, which can reduce the environmental impact of the healthcare system. Furthermore, outreach clinics substantially improve access to subspecialized pediatric surgical care and can improve patient experience by reducing their travel time and cost to commute to centralized regional centers.

Abbreviations: CO₂ - carbon dioxide

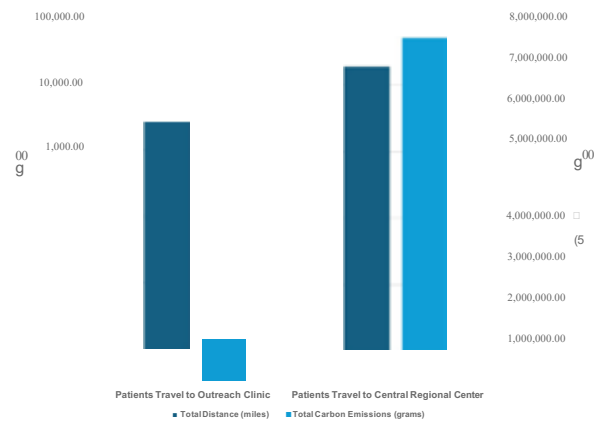


Figure 1: Bar graph depicting total miles traveled by patients to the outreach clinic versus the central regional center and resultant total carbon emissions. Axes are in a log-based scale.

S127

CROTALID ENVENOMATION SCORE IMPROVES MANAGEMENT OF PEDIATRIC SNAKEBITE PATIENTS

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Abstract: Purpose: Pediatric snakebite management is not well-defined, has the potential for serious morbidity, and involves costly intensive care unit (ICU) hospitalization and antivenom administration. We developed a pediatric-specific treatment guideline that utilizes the novel Crotalid Envenomation Score. We report the new guideline outcomes after three years of implementation.

Methods: A multidisciplinary team developed the novel Crotalid Envenomation Score utilizing retrospective data from pediatric crotalid snakebite patients cared for at a single pediatric hospital between January 2008 to December 2018. Physical exam and laboratory findings were used to determine the Crotalid Envenomation Score, which directed treatment along a pediatric-specific guideline (Table 1). After three years of guideline implementation, data was retrospectively collected from January 2019 to August 2022. Chart review for pre- and post-guideline patients included snake type, coagulation studies, physical exam findings, vials of antivenom administration, hospital length of stay (LOS), ICU LOS and readmission. Regression analysis was used to compare outcomes in pre- and post-guideline cohorts for hospital LOS, ICU LOS, and antivenom use. Additional stratification was performed by Crotalid Envenomation Score. A p-value < 0.05 was considered significant.

Results: 111 children with snakebites were identified; 76 in the pre-guideline and 35 in the post-guideline cohort. Crotalid Envenomation Score of 2 was more prevalent in the post-guideline group (40% vs 17.1%, p=0.02). Post-guideline patients had significantly fewer ICU admissions (63% vs 85%, p=0.012). Regression analysis controlling for Crotalid Envenomation Score demonstrated a 66% reduction in ICU LOS (p = 0.043) and that those with a Crotalid Envenomation Score of 0 received 77% less antivenom (P < 0.001) in the post-guideline group. Hospital LOS and rate of readmission were similar between groups.

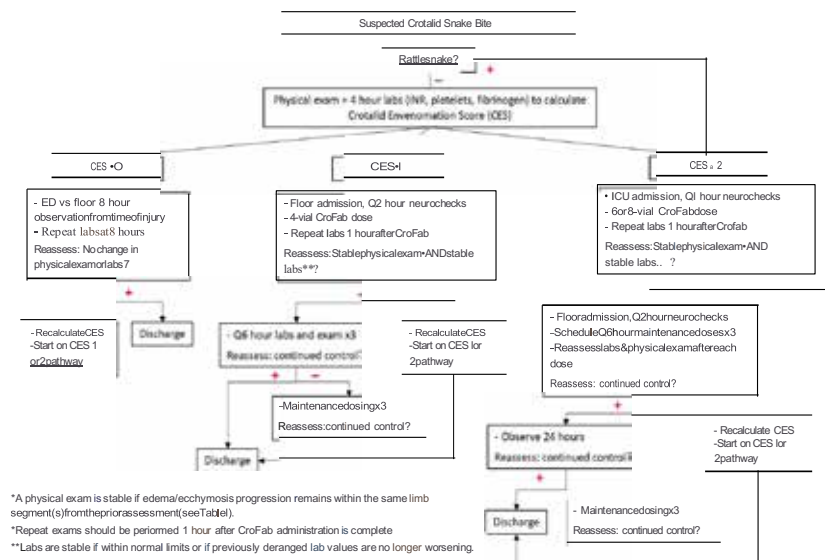
Regression analysis stratifying by Crotalid Envenomation Score demonstrated that those with a score of 0 experienced shorter hospital LOS and ICU LOS (1.5 vs 3 days and 0.97 vs 1.57 respectively, p < 0.01), and received less antivenom (p < 0.01) than those with a score of 2.

Conclusion: Utilization of a novel Crotalid Envenomation Score and pediatric-specific snakebite guideline conserves resources, maintains excellent outcomes, and is applicable across a broad range of hospital settings.

Abbreviations: Intensive care unit (ICU)
Length of stay (LOS)

Table 1: Severity of Crotalid Envenomation Score (CES)

	CES-0	CES-1	CES-2
Physical Exam and Lab Values	(-) Physical Exam AND (-) Coagulopathy	(+) Physical Exam OR (+) Coagulopathy	(+) Physical Exam AND (+) Coagulopathy OR (+) Rattlesnake Report



*A physical exam is stable if edema/ecchymosis progression remains within the same limb segment(s) from the prior assessment (see Table 1).

**Repeat exams should be performed 1 hour after CroFab administration is complete

***Labs are stable if within normal limits or if previously deranged lab values are no longer worsening.

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OPEN VERSUS MINIMALLY INVASIVE SURGERY FOR PEDIATRIC CHOLEDOCHAL CYST IN A PROPENSITY SCORE MATCHED COHORT

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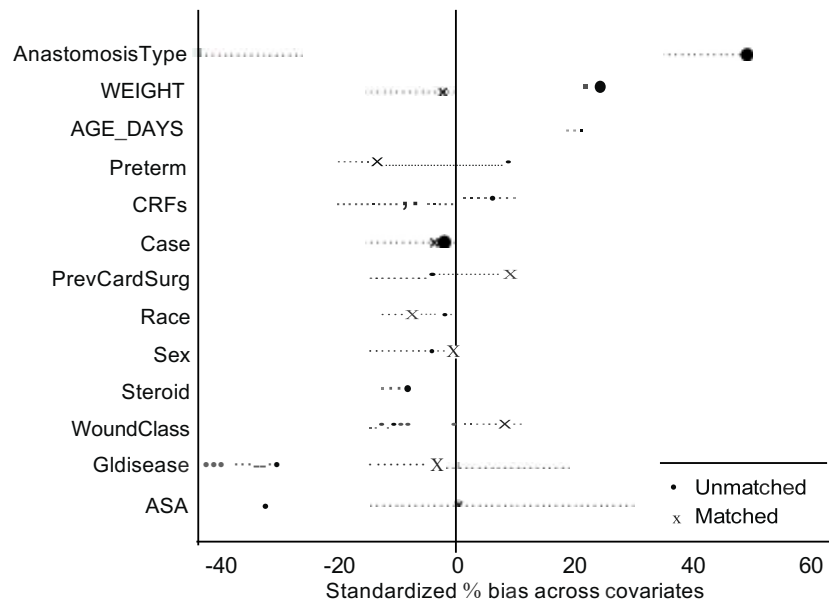
Abstract: Purpose: This study aims to evaluate outcomes for children undergoing open versus minimally invasive (MIS) choledochal cyst excision using a matched cohort created from a national database.

Methods: Children undergoing choledochal cyst excision from 2013-2022 were identified using the National Surgical Quality Improvement Program-Pediatric database. A propensity score-matched analysis using bile duct reconstruction technique and various other baseline characteristics was performed. Outcomes were then compared between operative approaches using an intention-to-treat analysis. Pearson's chi-square, Fisher's exact, and Mann-Whitney's U tests were used as appropriate.

Results: 596 children who underwent choledochal cyst excision were identified. Pre-match, children undergoing open excision were more likely to be younger, smaller, have Roux-en-Y hepaticojejunostomy performed, have a history of gastrointestinal disease, and have higher ASA class. Post-match, the groups were similar and included 62 children per group. MIS excision was associated with a longer median operative time (307 vs 232 minutes, $p=0.0001$). There were no differences in composite morbidity (Open 9.7% vs. MIS 12.9%, $p=0.57$), readmission (Open 6.5% vs. MIS 1.6%, $p=0.17$), reoperation (Open 3.2% vs. MIS 1.6%, $p=0.56$), or median total length of stay (Open 6 days vs. MIS 6 days $p=0.91$).

Conclusions: With the exception of operative time, there were no differences in postoperative outcomes after matching for baseline patient characteristics and type of bile duct reconstruction performed.

Abbreviations: MIS: minimally invasive surgery



Wednesday, May 7, 2025

Scientific Session 8 - General Pediatric Surgery 1

4:00 PM – 5:30 PM

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UNDER PRESSURE: HOW ACTIVITY RESTRICTIONS SHIFT THE PECTUS BAR PARADIGM - A WESTERN PEDIATRIC SURGERY RESEARCH CONSORTIUM STUDY

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Abstract: Introduction:

Activity restrictions following the minimally invasive repair of pectus excavatum (MIRPE) have historically been implemented to reduce the risk of pectus bar displacement (PBD). However, advancements in surgical techniques and bar fixation strategies have emerged to further minimize PBD postoperatively. We aimed to assess the impact of activity restrictions on PBD following MIPRE.

Methods:

A ten-center retrospective review was conducted among patients younger than 21 years of age undergoing MIRPE between July 2022 and October 2023. Patient demographics, intraoperative details, and postoperative outcomes were collected. Postoperative activity restrictions were categorized into two groups: no restrictions versus activity restrictions. PBD was defined as bar migration requiring return to the operating room within 90 days. We compared PBD and other postoperative outcomes between activity cohorts using Chi-Square analysis.

Results:

A total of 532 patients were included, with the mean age of 15.9 ± 2.0 years. The cohort was 86% male, had a median BMI of 18.4 [IQR:17.1-20.2] kg/m², and a Haller index 4.5 [IQR:3.8-5.8]. The following surgical techniques were commonly employed: use of sternal elevation (65%), securement of pectus bars with pericostal sutures (69%), pectus bar stabilizers (55%), subpectoral tunnel (53%), and cryoanalgesia (91%). Postoperatively, 24% of patients (127/532) were given no activity restrictions. There was no difference in patient demographic (age, sex, height, weight, Haller index) between study groups, $p > 0.05$. Patients with activity restriction had a higher proportion of pericostal suture use (78% vs 43%, $p < 0.001$) and subpectoral tunneling (58% vs 36%, $P < 0.001$), and a lower proportion of sternal elevation (63% vs 80%, $p < 0.001$) and cryoanalgesia (88% vs 100%, $p < 0.001$) during MIRPE. Overall, PBD occurred in 1.6% of patients, with no difference in the incidence of PBD between those patients with and without activity restrictions (1.8% vs 0.9%, $p = 0.468$). Additionally, there was no significant differences in other postoperative complications between these groups (Table 1).

Conclusion:

Ad libitum physical activity after MIRPE was not associated with an increased risk of pectus bar displacement. Activity restrictions may not need be as strict as previously thought and further study may allow surgeons to eliminate restrictions entirely.

Abbreviations: Pectus bar displacement - PBD

Minimally invasive repair of pectus excavatum - MIRPE

Body mass index - BMI

Table 1 – Patient perioperative outcomes between those with and without activity restrictions

Patient outcomes	Activity restrictions n=405	No activity restrictions n=127	p-value
Pectus bar displacement	7 (1.5%)	1 (0.8%)	0.45
Emergency department/ unscheduled visits	37 (9.1%)	13 (10.2%)	0.73
Readmission	29 (5.5%)	8 (6.3%)	0.66
Return to the operating room	16 (4.0%)	7 (5.5%)	0.45
Surgical site infection	10 (2.5%)	2 (1.6%)	0.55
Pectus bar infection	6 (1.4%)	3 (2.3%)	0.50
Wound hematoma	4 (1.0%)	1 (0.8%)	0.84
Wound dehiscence	1 (0.2%)	1 (0.8%)	0.42
Pneumonia	4 (1.0%)	0 (0.0%)	0.26

S130

HOME NG TUBE FEEDS ARE SAFE AND DO NOT LEAD TO ADDITIONAL MORBIDITY OR LATE GASTROSTOMY PLACEMENT IN PREMATURE INFANTS BORN AT A RURAL ACADEMIC HOSPITAL

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Abstract: Purpose: To determine the safety and feasibility of home NG tubes in a cohort of premature infants born in a rural center.

Methods:

We performed a retrospective chart review of one hundred patients enrolled in our hospital's Hope Grows at Home program from July 2020 to November 2023. The program involved remote patient monitoring and telehealth support for premature infants discharged with NG feeds. Demographics, length of stay, and clinical outcomes were recorded. The study was approved by the hospital's IRB. Statistical analyses included univariate and multivariate linear regression and Pearson's correlation coefficients, with significance defined at $p < 0.05$. Results are presented as mean (standard deviation SD).

Results:

One hundred patients (59% female) were included. Mean gestational age at birth was 32.99 weeks (SD 2.29). Nineteen patients were multiple gestations. Mean length of hospital stay was 26.2 days (SD 22.86). Mean NG feed duration was 17.2 days (SD 23.6) after discharge. There were 3 ED encounters and 3 readmissions during the program. There was one death after completion of the program unrelated to feeding issues. Only 3 patients required G tube placement after trialing home NG tube. Notably, none of these negative outcomes were related to NG tube placement or function.

Higher gestational age at birth was significantly correlated with reduced hospital length of stay ($p < 0.001$) and duration of NG tube feeding ($p=0.026$). Distance between the hospital and home zip code was not significantly correlated with length of stay or length of NG feeds.

Conclusion:

Our study demonstrates that most premature patients treated at this rural academic center can safely meet nutritional milestones from home with NG feeds and adequate clinical support, thereby decreasing the morbidity and costs associated with increased hospital length of stay and invasive interventions such as G tube placement. Importantly, this holds true even for patients who live further from the hospital, highlighting that home NG tube programs are safe for families that would likely benefit the most from avoiding the financial and emotional strain of additional time at the hospital.

Abbreviations: IRB: Institutional Review Board

SD: Standard Deviation

NG: Nasogastric

Table 1: Demographics and Clinical Outcomes for a Cohort of Premature Infants

Demographic Data (n=100)		
Sex,(female), n (%)	59(100)	59.0%
Gestational Age at Birth (week+day\$/7),mean (range)	32.99	25.86- 36.43
Multiple GestationM n(16)	19(100)	19.0%
Comorbidities (Y/N),n(%)	21(100)	21.0%
Clinical Outcomes (n=100)		
Hospital Length of Stay (day<), mean(range),(n=97)	26.2 (5.00-117.00)	
NG feed duration (days),mean(range),(n=97)	17.2 (1.00- 170.00)	
Required G-tub4' after discharge" (Mof patient</n)	3/100	
ED visits• (Mof patients/n)	3/100	
Readmissions• (Mof patients/n)	2/100	

• ED/Readmission Diagnoses

- Rhinovirus/enterovirus(N=1)
- COVID-19 +Rhino11irus/entero11irus (N::1)
- Forehead abrasion (N=1)
- Con::tipation (N=1). Same patient a□ abo11e.
- Note: 1 death occurred after program completion.

IMPLEMENTATION OF AN ENHANCED RECOVERY AFTER SURGERY PATHWAY FOR PEDIATRIC SURGICAL ONCOLOGY USING QUALITY IMPROVEMENT METHODOLOGY

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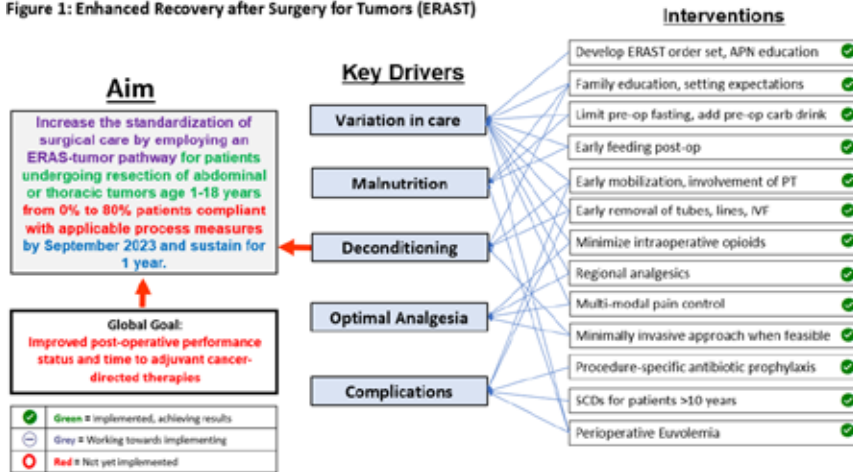
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Abstract: Purpose: Enhanced Recovery After Surgery (ERAS) pathways have demonstrated significant benefits but often face challenges in implementation due to the scope of process measures and multi-disciplinary buy-in required. This study aimed to standardize surgical care for children undergoing solid tumor resection by implementing an ERAS for Tumor (ERAST) pathway. Methods: Our ERAST pathway consisted of 20 process measures. We set a goal of achieving at least 80% of these per patient undergoing thoracic or abdominal tumor resection by one year. Plan-Do-Study-Act (PDSA) cycles were utilized and included implementing standardized pre- and post-operative orders, data-enabled electronic progress note template, and multidisciplinary preoperative team huddles. The primary outcome was 80% adherence to protocol process measures. Secondary outcomes included hospital length of stay (LOS). Balancing measures included readmission and/or emergency room visits within 90 days post-procedure. Results: Over 1 year, 48 patients with 52 unique surgical encounters were included and compared to data from 2015-2022. The median process measure adherence was 88.9% (IQR 84.2%, 94.4%). Intraoperative normothermia improved from 0% to 100% after introduction of a preoperative huddle. Intraoperative fluid administration decreased from a median of 12.19 cc/kg/hr to 5.97 cc/kg/hr in all cases (p-value: < 0.001). Intraoperative opioid use decreased in abdominal cases from a median of 0.37 OME (opioid milliequivalents)/kg pre-ERAST to 0.24 post-ERAST (p-value: 0.0008). There was no difference in intraoperative opioid use in thoracic cases. Post-operative opioid use in abdominal cases decreased from a median of 0.16 OME/kg/day to 0.04 (p-value: < 0.001), and thoracic cases from 0.30 OME/kg/day to 0.13 OME/kg/day (p-value: 0.0017). LOS decreased from a median of 5.3 to 2.9 days post-laparotomy, 3.4 to 2.5 days post-thoracotomy, and 2.1 to 1.2 days post-thoracoscopy (all p< 0.001). There was no difference in LOS post-laparoscopy. There was no difference in readmission and/or emergency room visits pre/post ERAST for all cases. Conclusion: Implementation of an ERAST pathway utilizing quality improvement methodology with targeted approaches to individual process measures demonstrated consistent compliance. These interventions contributed to a significant reduction in LOS and opioid utilization without worsening balancing measures, demonstrating the effectiveness of the ERAST pathway in optimizing recovery for children undergoing tumor resections.

Abbreviations: ERAS: Enhanced Recovery After Surgery
ERAST: Enhanced Recovery After Surgery for Tumor
PDSA: Plan-Do-Study-Act

LOS: Length of Stay
 IQR: Interquartile Range
 OME: Opioid Milliequivalents
 cc/kg/hr: Cubic Centimeters per Kilogram per Hour

Figure 1: Enhanced Recovery after Surgery for Tumors (ERAST)



S132

**PER ORAL ENDOSCOPIC MYOTOMY (POEM) FOR PEDIATRIC ACHALASIA:
INSTITUTIONAL EXPERIENCE WITH THE FIRST 100 CASES**

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Abstract: Background: Achalasia is a rare esophageal motility disorder that presents unique challenges in pediatric patients due to the rarity of this disease. Per Oral Endoscopic Myotomy (POEM) is an established, minimally invasive treatment for adult achalasia, but its application in children is not widely documented, with limited comprehensive studies available. This study aims to address this gap by evaluating 100 cases of pediatric achalasia treated with POEM at a single institution, providing insight into the safety, efficacy, and long-term outcomes to guide future clinical care.

Methods: An IRB approved retrospective analysis including all patients with esophageal achalasia who underwent POEM or laparoscopic Heller myotomy (LHM) at a tertiary children's hospital in the United States between 2015 and 2024 was performed. Patient demographics, surgical techniques, pre- and post-operative Eckardt scores, complications, outcomes, and follow-up data were analyzed.

Results: Of 100 patients who underwent surgical intervention, 93 received primary POEM, while 7 underwent primary LHM. Including redo POEM cases, a total of 100 POEM operations were performed during the study. High-resolution manometry confirmed achalasia in 96% of patients, classified as Type I (21.5%), Type II (62.4%), and Type III (4.3%). Thirty-five children (35%) had prior endoscopic treatment, and 28% had prior operative interventions. The mean age at surgery was 11.6 years, and the mean weight was 40.6 kg. The average operative time was 95.4 minutes, with a post-POEM hospital stay of 1.8 days. There were no deaths or conversions to LHM. Intraoperative complications included 35 "gas-related" events, primarily managed by needle decompression. Two major complications included a pneumothorax requiring a pigtail catheter and a submucosal tunnel leak requiring a chest tube and re-clipping. Median follow-up was 33.8 months. Late complications included recurrent dysphagia (10.8%), gastroesophageal reflux (14.3%), and failed POEM (8.6%). Post-POEM Eckardt scores showed significant improvement (0.5 ± 0.7), with most children (95.7%) experiencing complete symptomatic relief.

Conclusion: POEM is a safe and effective primary treatment for pediatric achalasia, with favorable long-term outcomes and low rates of reflux and reoperation. Children displayed adequate growth and development, supporting POEM as a reliable option to improve quality of life in children with achalasia.

Abbreviations: POEM-per oral endoscopic Myotomy

THE SCOPE OF VASCULAR SURGERY EXPERTISE IN PEDIATRIC SURGERY: A SURVEY OF DIVISION CHIEFS AT UNITED STATES CHILDREN'S HOSPITALS

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Abstract: Purpose: Pediatric vascular diseases comprise a wide spectrum of acquired and congenital diagnoses and are variably addressed, often based on local resources and practice patterns. Literature on pediatric vascular disease management is sparse and lacks consensus guidelines. We undertook a nationwide survey to illustrate the breadth of needs and practice patterns in pediatric vascular surgical management.

Methods: An IRB-approved 21-question survey about vascular surgery practice patterns and resource utilization in pediatric patient care was delivered to chiefs or heads of pediatric surgery divisions at children's hospitals throughout the United States.

Results: Survey completion rate was 72.3% (132/182). We received 46/54 (85.2%) replies from pediatric surgery fellowship programs and 85/114 (74.6%) from free-standing children's hospitals. Other institutional characteristics included: 87.9% with trauma centers and 85.6% within academic centers.

Within pediatric surgery divisions, 84.1% had a vascular surgery call schedule, 80.3% had a vascular surgeon available 24-hours/7-days-a-week, 76.5% provided ECMO cannulation, 66.7% provided trauma care, and 65.9% provided microsurgery. For ECMO cannulations, most divisions (90.1%) did not usually consult adult vascular surgeons. Microsurgery was performed by plastic surgery (98.9%), vascular surgery (29.9%), and/or pediatric surgery (4.6%). Regarding vascular surgeon hospital access, 78.8% had routine privileges, and 88.6% had EMR access for billing consultations.

On a 7-point Likert scale, most respondents at least slightly disagreed that pediatric vascular surgery should remain in the hands of pediatric surgeons only (78.8%); 59.1% were neutral to strongly dissatisfied with their division's ability to operate on pediatric vascular cases (Figure). Common indications for adult vascular surgery consultation were major vascular injury and reconstruction, endovascular techniques, and complex oncological cases. Availability, adult vascular surgeon willingness to operate on small children, and geography were common themes in cost-benefit decision-making. Being joined/adjacent to an adult hospital was seen as a facilitator to adequate access to vascular expertise. A recurrent belief was that the standard pediatric surgeon armamentarium lacks adequate vascular expertise.

Conclusion: Surgical management of pediatric vascular disease is an important and complex subject without evidence to ensure optimal and consistent outcomes. Vascular emergencies are generally covered though there remains diversity in practice patterns nationwide, which warrants further discussion.

Abbreviations: Institutional Review Board (IRB)
Extracorporeal membrane oxygenation (ECMO)
Electronic medical record (EMR)

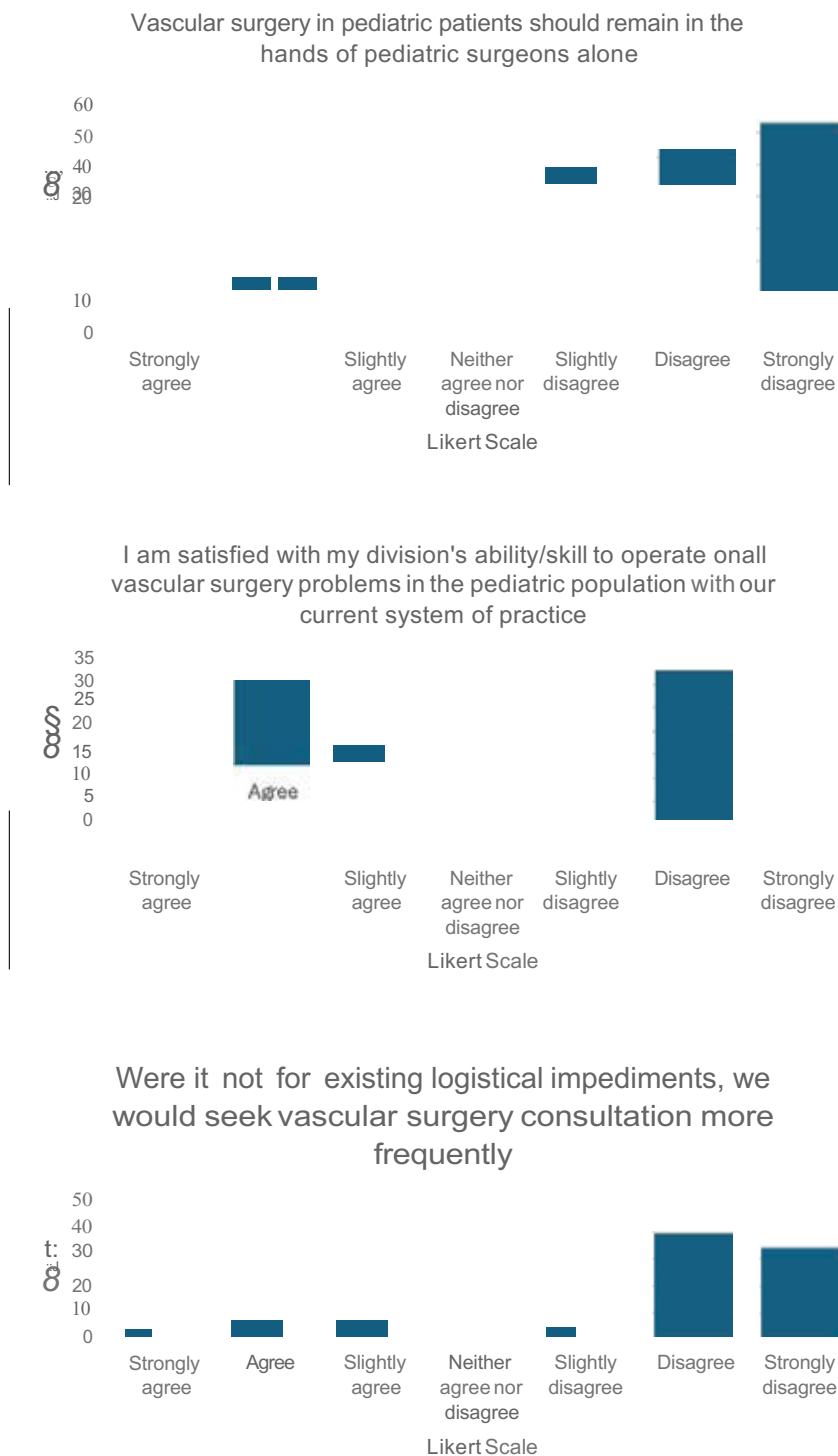


Figure I Pediatric vascular surgery perspectives on a 7-point Likert scale

NON-OPERATIVE MANAGEMENT OF PEDIATRIC, UNCOMPLICATED ACUTE APPENDICITIS: A SURVEY OF PEDIATRIC SURGEONS' PERCEPTIONS AND PRACTICE

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Abstract: Purpose: Despite evidence supporting selective use of non-operative management (NOM) for children with uncomplicated, acute appendicitis, there is no consensus regarding its application. This study aims to characterize surgeons' contemporary perceptions and utilization of NOM.

Methods: A 29-question electronic survey addressing NOM was distributed to attending pediatric surgeons through APSA, the AAP Section on Surgery, and the Pediatric Surgery Research Collaborative between 12/2023-6/2024.

Results: The survey achieved a response rate of 41.0% (433/1,056). Surgeons with ≥10 years in practice comprised 61.4% of respondents. 42.0% reported regularly discussing NOM as an alternative to surgery, and 32.2% of those who discuss NOM reported recommending against it (Table). Fewer reported regularly offering NOM to eligible patients (27.9%). Those that never offer NOM have been in practice longer than those that do offer NOM (median 17 [IQR=7-23] vs. 13 [9-25] years, p=0.005). The most common reasons for not offering NOM included the belief that recovery was faster after appendectomy (52.0%) and concern for higher recurrence rates (51.5%). In contrast, the most common reasons for offering NOM included the belief that patients appreciate having options (49.2%) and the potential to avoid surgery (48.5%). Only 54.7% of surgeons

considered absence of an appendicolith essential for attempting NOM, and a minority applied criteria of symptom duration (39.0%), age (27.2%) or WBC (25.4%) when determining NOM eligibility. Therefore, most did not apply the inclusion criteria used in clinical trials, and when applied, many deviated from those parameters, especially with increased present-day willingness to use NOM in younger patients (median lower age limit=5.0 [IQR=5.0-6.5] years). Significant variability existed in protocols for in-hospital observation, definitions of NOM success, and follow-up after NOM. Nonetheless, 58.9% indicated willingness to change their practice in response to new data.

Conclusions: NOM is infrequently discussed with or offered to eligible patients due to limited surgeon buy-in and different valuations of its risks and benefits. Wide variability in practice exists, and many surgeons who do offer NOM are comfortable applying it in a broader patient population than previously studied. These data suggest the need for further research on patient selection, standardization, patient perspectives, and clinical outcomes.

Abbreviations: Non-operative Management (NOM)

American Pediatric Surgical Association (APSA)

American Academy of Pediatrics (AAP)

How Would You Characterize Your Discussion of NOM?	
I don't bring it up at all, and if they ask, I recommend against it.	8.3% (33/398)
I don't bring it up, but if they ask, then I offer it as a reasonable alternative to surgery.	4.3% (17/398)
I don't bring it up, but if they ask, I present the advantages and disadvantages in as balanced a way as possible and encourage them to decide based on what is most important to them.	26.4% (105/398)
I bring it up and present the advantages and disadvantages in as balanced a way as possible and encourage them to decide based on what is most important to them.	31.4% (125/398)
I bring it up as an option but recommend against it.	20.6% (82/398)
I bring it up but explain it's still experimental.	3.3% (13/398)
I bring it up and recommend it as an alternative to surgery.	5.8% (23/398)
If they meet criteria, I automatically tell them the treatment is non-operative management, and I only offer surgery if they fail.	0.0% (0/398)

DOES SURGICAL TECHNIQUE PLAY A ROLE IN POSTOPERATIVE HYDROCELE FORMATION IN PEDIATRIC INGUINAL HERNIA REPAIR

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Abstract: Purpose:

Open and laparoscopic pediatric inguinal hernia repairs (IHR) are commonly performed and can result in postoperative hydrocele. The effect of surgical technique on hydrocele formation is poorly understood. This study aims to assess the impact of surgical technique on incidence of postoperative hydrocele requiring intervention.

Methods:

A retrospective chart review was conducted on pediatric patients less than 18 years old who underwent open or laparoscopic IHR from January 2017 to December 2019 at 20 children's hospitals in the United States. Demographic, operative, and post-operative data were collected. Exclusion criteria included female patients, males with cryptorchidism and patients with sliding hernias. Postoperative hydrocele was defined as any hydrocele that developed within 3 years of hernia repair that required intervention (aspiration or hydrocelectomy). Data was analyzed in SPSS using descriptive statistics, Chi-squared, and Mann-Whitney U tests with significance defined as $p < 0.05$. Multinomial logistic regression was performed to identify associations between patient/operative factors and hydrocele formation.

Results:

A total of 8,421 pediatric patients met inclusion criteria; 2,567(30.5%) underwent laparoscopic repair and 5,854(69.5%) underwent open repair. Patients who underwent laparoscopic repair were younger than the patients who underwent open repair (2.13 years vs. 2.95 years, $p < 0.001$). Infants (< 1 year) accounted for 59.2% of the laparoscopic cohort and 54.9% of the open cohort ($p < 0.001$). Postoperative hydrocele developed in 26(0.3%) of all patients with hydrocele intervention occurring at a mean of 5.96 months following hernia repair. There was no significant difference in postoperative hydrocele between the laparoscopic and open cohorts (10 (0.4%) vs 16 (0.3%), $p = 0.376$). Distal sac resection was performed in 77.8% of open repairs; postoperative hydrocele developed in 12 (0.3%) with distal sac resection versus 4(0.3%) without distal sac resection ($p = 0.785$). No patients in the laparoscopic group had distal sac resection and 0.6% had sac inversion and ligation. On multivariate regression, having a VP shunt was associated with increased risk of hydrocele formation ($p < 0.001$).

Conclusions:

Postoperative hydrocele requiring intervention after pediatric inguinal hernia repair is less than 1% irrespective of surgical technique. Leaving the hernia sac in place was not associated with an increase in post-operative hydrocele formation and may protect the vas deferens from injury.

Abbreviations: IHR: inguinal hernia repair

Table 1: Comparison of demographics, operative details and post-operative outcomes based on surgical approach to pediatric inguinal hernia repair

Demographics	Laparoscopic	Open	p-value
Age (years), median [Interquartile range]	0.50 [0.25-2.00]	0.58 [0.25-4.00]	<0.001
Weight (kg), median [Interquartile range]	6.90 [4.57-14.15]	7.58 [4.55-17.60]	<0.001
Prematurity*, n (%)	947 (62.3)	2117 (65.8)	0.003
Has VP shunt, n (%)	51 (2.0)	66 (1.1)	0.002
Has PD catheter, n (%)	9 (0.4)	16 (0.3)	0.548
Operative Details and Post-operative Outcomes			
Distal sac resection, n (%)	N/A	4556 (77.8)	N/A
Sac inversion and ligation, n (%)	15 (0.6)	N/A	N/A
Post-operative hydrocele intervention, n (%)	10 (0.4)	16 (0.3)	0.376

*Patients less than 1 year of age at time of inguinal hernia repair

DOES SURGEON YEARLY VOLUME AFFECT RECURRENCE RATES AFTER INGUINAL HERNIA REPAIR

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Abstract: Purpose: Adult literature demonstrated that high volume hernia surgeons have lower hernia recurrence rates. This study aimed to investigate the effect of surgeon case volume on pediatric inguinal hernia recurrence rates.

Methods: Surgeons' individual case volumes per year were calculated from a retrospective data set describing inguinal herniorrhaphy techniques and outcomes in children < 18 years old from 20 hospitals for 2017-2019. Quartiles were defined based on the number of inguinal hernia repairs the surgeon performed that year, which we classified as one surgeon year. Surgeons were categorized into High Volume (top quartile, Q4) and Lower Volume (bottom 3 quartiles, Q1-3) for each year. A χ^2 analysis and odds ratios were utilized to determine differences in recurrence rates with the High-Volume group as the reference, stratifying results by open and laparoscopic techniques. Results: For all repair techniques, there were 202 surgeons accounting for 480 surgeon years with 7,246 cases and 90 (1.2%) recurrences. For all repairs, Low-Volume surgeons performed ≤ 22 operations per year. Children receiving surgery from a low-volume surgeon were more likely to develop hernia recurrence compared to those receiving surgery from a High-Volume surgeon (OR 1.72; 95% CI 1.12-2.64, $p=0.014$). For open repairs, there were 186 surgeons, 418 surgeon years, and 4858 repairs with 42 (0.9%) recurrences. Low-Volume open repair surgeons performed ≤ 17 operations per year. Children receiving surgery from a Low-Volume open repair surgeon did not

have significantly increased recurrence compared to children receiving surgery from a High-Volume open surgeon (OR 1.37; 95% CI 0.74-2.51, $p=0.313$). For laparoscopic repairs, there were 186 group, 433 surgeon years, and 2671 repairs with 53 (2.0%) recurrences. Low-Volume laparoscopic repair surgeons performed ≤ 10 operations per year. Children repaired by a Low-Volume laparoscopic surgeon had increased hernia recurrence compared to children repaired by a High-Volume laparoscopic surgeon OR 1.77 (1.02-3.06, $p=0.040$).

Conclusions: Overall hernia recurrence rates were low, yet High-Volume surgeons had a lower hernia recurrence rate compared to Low-Volume surgeons. When separated by repair technique, surgeon volume was not associated with hernia recurrence for open operations, but High-Volume laparoscopic surgeons had lower hernia recurrence rates than Low-Volume laparoscopic surgeons.

Abbreviations: Q1-3 = quartile one through three
Q4 = quartile four

Table 1: Hernia Recurrence based on Surgeon Volume

	Surgeon Volume	Surgeries per Year	Surgery Count	Recurrence Rate (%)	Odds Ratio (95% CI)	P-value
All Repairs (n=7246)	Low-Volume	≤ 22	3558	56 (1.6)	1.719 (1.119-2.638)	$p=0.014^*$
	High-Volume	> 22	3654	34 (0.9)	Ref	Ref
Open Repairs (n=4858)	Low-Volume	≤ 17	2075	21 (1.0)	1.365 (0.744-2.507)	$p=0.313$
	High-Volume	> 17	2780	21 (0.7)	Ref	Ref
Laparoscopic Repairs (n=2671)	Low-Volume	≤ 10	1142	30 (2.6)	1.766 (1.021-3.058)	$p=0.040^*$
	High-Volume	> 10	1506	23 (1.5)	Ref	Ref

MANAGEMENT OF PEDIATRIC TRAUMATIC HemothORAX AND VOLUME THRESHOLD FOR CHEST TUBE PLACEMENT: MULTICENTER PEDIATRIC TRAUMA CENTER RETROSPECTIVE ANALYSIS

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Abstract: Purpose: Adult trauma literature indicates hemothorax volume > 300 ml requires thoracic drainage. There is a paucity in pediatric literature on the surgical management and volume analysis requiring chest tube placement. We aim to analyze the management of pediatric traumatic hemothorax and calculate volume threshold requiring chest tube placement.

Methods: Pediatric traumatic hemothorax cases from two level 1 trauma centers were analyzed from October 2015 to February 2024. Management was categorized into observation only (OO), chest tube placement (CT), and initial observation that failed requiring a chest tube (FO). Hemothorax volume was calculated using the Mergo's formula: $d \times l$. l = length on sagittal cuts. d = greatest depth on transverse cuts. Hospital course, postoperative and long-term outcomes were measured up to 1 year.

Results: A total of 383 traumatic thoracic cases were screened, with a total of 50 hemothorax cases analyzed: 22 OO (44%), 28 CT (56%), and 6 FO (12%). No statistical significance was found in demographics, GCS, and concurrent thoracic injuries. Significantly higher ISS and thoracic AIS scores were found in CT vs OO, (22 vs 15, $p=0.039$ and 3 vs 2, $p=0.006$). Presenting symptom of tachypnea was not associated with chest tube placement (50.5% vs 57.1%, $p=0.196$). Statistically higher hemothorax volume was found in CT vs OO (93.1 ml vs 7.0 ml, $p<0.001$). Utilizing ROC Curve analysis, ≥ 20 mL measured with Mergo's formula predicted chest tube placement ($p=0.001$). Volume difference adjusted for height ($p<0.001$) was statistically significant but adjusted for weight ($p=0.067$) was not. Chest tube placement was associated with increased intubation (68.9% vs 9.5%, $p<0.001$), hospital LOS (8 vs 2.5, $p<0.001$), and ICU LOS (4 vs 0, $p<0.001$). No patients developed delayed empyema from retained hemothorax or required VATS.

Conclusions: This is the largest cohort of pediatric traumatic hemothorax management and first in the literature to calculate volume threshold requiring chest tube placement. In contrast to adult trauma literature, delayed hemothorax complicated by empyema and surgical management are uncommon. Judicious application of hemothorax volume calculation and overall injury score may assist in the decision making of pediatric traumatic hemothorax management.

Abbreviations: OO= observation only

CT= chest tube placement

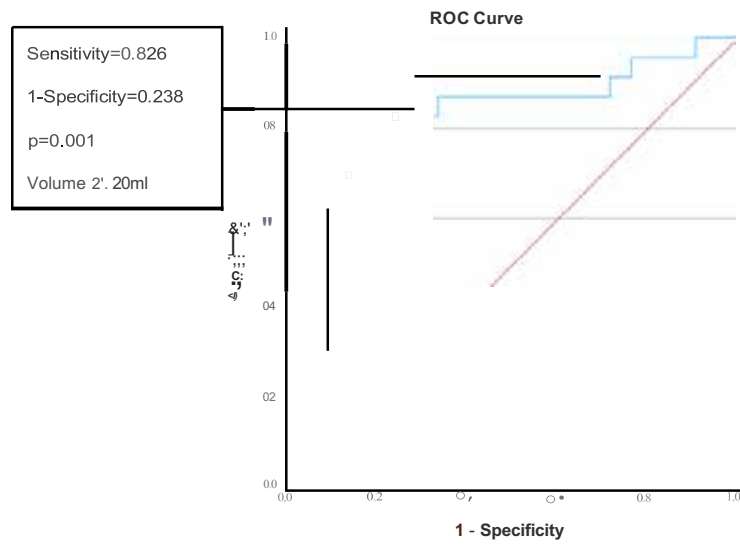
FO= failed observation

LOS= length of stay

VATS= video-assisted thoracoscopic surgery

ICU= intensive care unit

Figure 1: ROC curve analysis for chest tube requirement based on hemothorax Volume (ml) measured with Mergo's formula.



IDENTIFYING PREDICTORS OF RECURRENT PILONIDAL DISEASE IN ADOLESCENTS AND YOUNG ADULTS: SECONDARY ANALYSIS OF A RANDOMIZED CONTROLLED TRIAL

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Abstract: Purpose: Pilonidal disease is a common condition affecting adolescents and young adults with high recurrence rates and disease-associated morbidity. Identification of patient-specific factors and treatments associated with decreased disease recurrence can assist providers with treatment selection and patient counseling.

Methods: This is a planned secondary analysis of a single institution, randomized controlled trial which compared laser depilation as an adjunct to standard care versus standard care alone. Inclusion criteria were patients 11 to 21 years of age with a history of at least 1 episode of pilonidal disease, without active disease. Patients were randomized to receive laser depilation in conjunction with standard treatment versus standard treatment alone. Multivariable logistic regression modelling was performed to identify variables independently associated with disease recurrence including laser depilation, patient variables (biologic sex, body mass index (BMI), prior episodes of disease, prior surgical treatment, race and ethnicity, health insurance status), and annual family income.

Results: One-year follow-up data was available for a total of 200 patients in the trial. After adjusting for sex, BMI, prior episodes of disease, prior surgical treatment, race and ethnicity, type of health insurance, and household income, laser hair treatment was strongly associated with decreased odds of disease recurrence within one year (Odds ratio (OR), 0.26 [95% confidence interval (CI), 0.12-0.58]; $p = 0.001$). After adjusting for other co-variables, there was a significant interaction between laser hair treatment and health insurance type. Laser hair treatment was significantly associated with lower odds of disease recurrence in patients who were privately insured (OR, 0.29 [95% CI, 0.16-0.55], $p < 0.001$), but was not associated with lower disease recurrence in those who were publicly insured (OR, 1.20 [95% CI, 0.63-2.28], $p = 0.58$).

Conclusion: Laser depilation is associated with decreased pilonidal disease recurrence. However, there may be heterogeneity in treatment effect (HTE) based on insurance status with laser depilation decreasing recurrence in patients with private insurance and having less effectiveness in patients with public insurance. This HTE may be related to barriers to care and social determinants of health of patients who are publicly insured and warrants further investigation.

Abbreviations: BMI: body mass index
OR: odds ratio
CI: confidence interval
HTE: heterogeneity in treatment effect

Patient characteristic	Odds ratio of recurrence at 1-year (95% CI)	Pvalue ^a
Laser treatment in privately insured patients	0.29 (0.16-0.55)	<.001
Laser treatment in publicly insured patients	1.20 (0.63-2.28)	.58
Female sex	1.42 (0.67-3.02)	.35
Overweight or obese	1.68 (0.73-3.84)	.22
1 Prior episode of disease (vs 2)	0.71 (0.31-1.60)	.41
Prior surgical excision	0.86 (0.30-2.42)	.77
Non-Hispanic White	0.67 (0.27-1.67)	.39
Private health insurance	0.52 (0.11-1.55)	.24
Annual household income		.29
<\$50000	2.30 (0.76-6.94)	
\$50 000-\$99 999	1.15 (0.43-3.11)	
≥\$100000	(Reference)	

Thursday, May 8, 2025

Plenary 2 - Clinical/Societal

8:30 AM – 10:00 AM

11

CHANGES IN HEALTHCARE UTILIZATION AND SURGICAL NEEDS OF INFANTS IN TEXAS FOLLOWING EARLY ABORTION BAN (SENATE BILL 8, SB8)

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Abstract: Purpose: The landscape of surgical neonatal care in Texas has changed following ban on early abortions (SB8, 9/1/2021). We aim to evaluate how SB8 has impacted infant healthcare utilization and surgical care of congenital anomalies (CA) in Texas.

Method: Texas Inpatient Public Use Data File, a de-identified, statewide hospital discharge database was used to evaluate infant birth admissions (< 365 days) comparing pre-SB8[7/1/2020-6/30/2021] and post-SB8[7/1/2022-6/30/2023], where the entire gestation occurs following the abortion ban. CA were identified by international classification of disease(ICD-10) codes and groupings established by the Centers for Disease Control. Total costs, mortality and length of stay (LOS) were compared with descriptive statistics (median[IQR]).

Results: Overall admissions increased (9%, pre-SB8 333,440 vs post-SB8 364,016) with disproportionate increase in CA admissions (25%, pre-SB8 52,524 vs post-SB8 65,901) post-SB8. Overall admissions requiring OR increased (1.1%, pre-SB8 73,351 vs post-SB8 74,410) with overrepresentation from CA admissions (9.2%, pre-SB8 12,878 vs post-SB8 14,068). Total cost of operative admissions are greater than non-operative admissions with the difference increasing post-SB8 (overall: pre-SB8 non-OR\$4,483[\$3,144-\$6,945] vs pre-SB8 OR\$6,290[\$4,440-\$10,533], post-SB8 non-OR\$5,053[\$3,604-\$8,226] vs post-SB8 OR\$7,453[\$5,209-\$12,574]) and greatest increase in CA admissions (CA admissions: pre-SB8 non-OR\$5,394[\$3,570-\$11,609] vs pre-SB8 OR\$8,262[\$5,039-\$47,415], post-SB8 non-OR\$5,861[\$3,957-\$12,703] vs post-SB8 OR\$10,041[\$6,236-\$67,326]). Overall mortality is low with more deaths in operative admissions than non-operative admissions (overall: pre-SB8 non-OR 0.2%[648/260,089] vs pre-SB8 OR 0.3%[247/73,351], post-SB8 non-OR 0.1%[336/289,876] vs post-SB8 OR 0.3%[235/74,140]). While overall inpatient CA deaths decreased (pre-SB8 399 vs post-SB8 357), deaths in CA operative admissions increased 11% post-SB8 (CA admissions: pre-SB8 OR 157/12,878 vs post-SB8 OR 174/14,068). LOS was similar regardless of CA or OR across the study. Circulatory CA represent a significant proportion of anomalies throughout the study. Varied increases in CA were noted in every organ system post-SB8 (7-42%) with greatest increase in heart/circulatory (pre-SB8 11,289 vs post-SB8 13,512). Need for operative intervention varied across organ systems with increase OR needs across all systems except musculoskeletal CA post-SB8 (Table 1).

Conclusion: We conclude there is a disproportionate increase in healthcare utilization and surgical care in care of infants with CA following early abortion ban in Texas. Additional resources to care for infants with CA and their families will be needed as these patients survive past infancy.

Abbreviations: Senate Bill 8 (SB8)
 Congenital anomaly (CA)
 international classification of disease (ICD-10)
 length of stay (LOS)
 interquartile range (IQR)

Congenital Anomalies Admissions and OR Usage Pre- and Post-SB8 by System

Organ System	Overall CA Admissions			CA Admissions with OR		
	Pre-SB N	Post-SB, N	Change following SB8 (n,[%])	Pre OR N (% of overall)	Post OR N(% of overall)	Percent OR Population Change (n, [%])
Central Nervous System	1119	1309	190 (17%)	389 (35%)	446 (34%)	57 (15%)
Ear, Face and Neck	11064	13255	2191 (20%)	3263 (30%)	3433 (26%)	170 (5%)
Heart and Circulatory	11289	13512	2223 (20%)	3418 (30%)	3938 (29%)	250 (15%)
Respiratory	558	605	47 (8%)	250 (45%)	279 (45%)	20 (8%)
Gastrointestinal/Digestive	512	547	35 (7%)	272 (53%)	300 (55%)	28 (10%)
Genital	4979	7066	2087 (42%)	1049 (21%)	1296 (18%)	247 (24%)
Urinary	2574	3173	599 (23%)	864 (34%)	1045 (33%)	181 (21%)
Musculoskeletal	5303	5850	547 (10%)	1562 (30%)	1435 (25%)	-127 (-8%)
Chromosomal	1246	1353	107 (9%)	390 (31%)	429 (32%)	39 (10%)

PREOPERATIVE CONSIDERATIONS & EARLY OUTCOMES IN GASTROJEJUNOSTOMY TUBE PLACEMENT VS FUNDOPLICATION FOR TREATMENT OF GASTROESOPHAGEAL REFLUX: RESULTS FROM A MULTI-INSTITUTIONAL RESEARCH COLLABORATIVE

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Abstract: Background: Anti-reflux surgery is currently employed for children whose gastroesophageal reflux disease (GERD) symptoms do not respond to maximal medical management. Fundoplication and gastrojejunostomy tube (GJ) placement are common surgical options for children with medically refractory GERD, but there is a paucity of modern literature comparing these techniques. We aimed to examine preoperative characteristics and immediate postoperative outcomes in children with GERD undergoing fundoplication vs. gastrojejunostomy tube.

Methods: We performed a multicenter retrospective chart review from institutions participating in a

regional pediatric surgery consortium including 18 sites. We compared pre-existing conditions, preoperative symptoms, and 30-day postoperative complications in patients undergoing fundoplication or GJ tube from July 2010-June 2020. A univariable model was constructed with the odds ratio analyzed.

Results: 1322 patients < 3 years old were included in the study: 1142 funduplications and 180 GJs. Older children (OR 1.4) and those of a higher weight (OR 1.1) were more likely to undergo GJ. In addition, those with existing gastrostomy tube (OR 27.6), respiratory comorbidities (OR 1.6), GI conditions (OR 1.9) and genetic disorders (OR 2.1) were more likely to undergo GJ. Patients with preoperative vomiting (OR 3.6) and aspiration pneumonia (OR 1.7) were also more likely to undergo GJ whereas those with failure to thrive were more likely to have a fundoplication (OR 0.6). Hospital in which the surgery was performed was a significant factor in choice of operation. GJs had a significantly higher rate of bleeding, need for early postoperative sedated procedure, sepsis, and respiratory failure.

Conclusions: Our results demonstrate that several factors may contribute to choice of anti-reflux operation including preoperative comorbidities and symptoms such as vomiting, aspiration pneumonia and failure to thrive. We also found that GJs were associated with more early postoperative complications including bleeding, need for further procedures requiring sedation, sepsis, and respiratory failure. Further investigation into pre-operative workup prior to surgical management of GERD is needed to help stratify optimal treatment strategy for children and to elucidate whether certain comorbidities predispose to post-operative complications.

Abbreviations: gastroesophageal reflux disease (GERD)
gastrojejunostomy tube (GJ)

Table 1: Outcomes for Anti-reflux Operations

	Fundoplication (N=1142)	Gastrojejunostomy tube (N=180)	Total (N=1322)	p-value
Length of Stay	42 [8, 128]	12 [3, 54]	34 [7, 116]	<.0001
Complications (within 30 days)				
Bleeding	3 (0.3%)	5 (2.8%)	8 (0.6%)	<.0001
Peritonitis	4 (0.4%)	2 (1.1%)	6 (0.5%)	0.1581
Reoperation or need for sedated procedure	11 (1%)	20 (11.1%)	31 (2.3%)	<.0001
Shock/sepsis	1 (0.1%)	2 (1.1%)	3 (0.2%)	0.0073
Hematoma/seroma	0 (0%)	1 (0.6%)	1 (0.1%)	0.0117
Fever	9 (0.8%)	3 (1.7%)	12 (0.9%)	0.248
Infection	23 (2%)	5 (2.8%)	28 (2.1%)	0.5083
Wound dehiscence	2 (0.2%)	0 (0%)	2 (0.2%)	0.5742
Postoperative respiratory failure	20 (1.8%)	8 (4.4%)	28 (2.1%)	0.0197

TEENAGE APPENDICITIS: THE COST OF A TRANSFER

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Abstract: Purpose

Patients < 5 years old with appendicitis benefit from treatment at a pediatric hospital. There is no benefit in outcomes among those ≥ 15 years old. Transfers can be more expensive for families, and may mandate temporary caregiver relocation, time away from work, and/or arranging sibling childcare. We aim to determine how frequently transferring teenagers with appendicitis occurs and what the associated charges are.

Methods

The Wisconsin Health Organization Information claims database (including all submitted insurance claims in the state of Wisconsin from 2017 – 2023) was utilized to filter charges to any patient < 18 years old who had a CPT code for appendectomy. These claims were limited to 7 days prior to and 30 days after the appendectomy (7 days to capture initial presentation, including initial missed diagnosis, and 30 days as a standard metric to capture associated complication rates). Surgical facilities were defined as those centers having charged at least 10 patients (any age) for an appendectomy. Transfers were defined as those who had facility charges from at least two surgical facilities in different zip codes within two days before their surgery. Average total charges (unadjusted for inflation) were compared between patients 15-18 years old who were transferred vs not transferred; density maps were created.

Results

Out of the 5,707 children that underwent appendectomy, 1408 (15%) were 15-18 years old and included for analysis. Transferred teenagers (n=764, 54%) were charged a median \$39,326 (IQR 31,188-50,532); while those that were not transferred (n=644, 46%) were charged a median \$32,263 (IQR 24,191-42,181) (p< 0.001). The median difference charged was \$7,063/transferred teenager, for a total additional \$5,396,132 charged to this transferred teenage cohort. Density map of facilities which transferred 15-18-year-olds is depicted in Figure 1, compared to facilities which operated on patients 0–18 years old without a fellowship trained pediatric surgeon.

Conclusion

Using a comprehensive Wisconsin insurance claims database, among patients who had surgery for appendicitis from 2017 – 2023, we demonstrate significantly increased cost averages charged to transferred patients 15-18 years old. Each patient was charged an average additional \$7,063, for a total additional \$5,396,132 charged during the study period.

Abbreviations: CPT, current procedural terminology

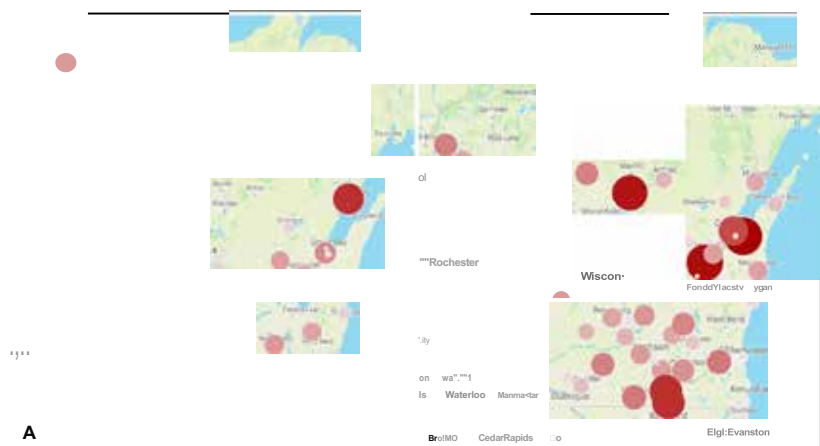


Figure 1. (A) Density map of 15-18-year-old teenagers who were transferred prior to appendectomy compared to (B) density map of 0-18-year-old children who were not transferred prior to appendectomy (excluding four zip codes in Wisconsin with fellowship trained pediatric surgeons).

PRACTICE PATTERNS IN ESOPHAGEAL ATRESIA SURVEILLANCE- A MULTI-CENTER, RETROSPECTIVE REVIEW FROM A REGIONAL CONSORTIUM

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Abstract: Purpose:

Population-based epidemiology and surveillance of children with esophageal atresia (EA) is largely based on expert opinion and varies widely. We aim to study patterns of endoscopic esophageal surveillance in EA patients to support evidence-based strategies.

Methods:

Patient records were retrospectively reviewed from 15 academic institutions. Patient demographics and upper endoscopy variables were abstracted (IRB 22-121). Data was analyzed using descriptive statistics.

Results:

EA patients (n=526) were reviewed with most having Gross Type C (76%) followed by Type A (10%) and a slight male predominance (56%). Surgical repair was mostly primary anastomosis (75%), then 2-stage or delayed repair (11%). Half (50%) had a surgically placed feeding tube and

10% underwent fundoplication.

Acid reflux/GERD was clinically diagnosed in half (52%) of patients. Most were discharged from index hospitalization on anti-acid medication (79%), with reduced use over time (71.7%, 62%, 54.5%, 54.8%, and 53.3% at 1, 2, 3, 5, and 10 years of age, respectively). Only 11% (n=57) of patients underwent pH-impedance testing with nearly half (54%) detecting increased acid exposure.

Of all patients, 80% (n=418) underwent upper endoscopy (n=2017). Indications included symptoms (60%), stricture management/dilation (41%) and uncommonly surveillance in asymptomatic patients (10%). Of the 20% who did not undergo endoscopy, 97% were ≥ 1 year old.

Endoscopy details are reported (Table1). Most surveillance endoscopies occurred beyond age one, and over a quarter did not obtain biopsies. Surveillance endoscopies were significantly more likely to have multiple esophageal biopsy sites/locations compared to non-surveillance. We found no malignancies and a low prevalence ($\sim 1\%$) of Barrett's, with surveillance detecting 40% of cases.

Conclusions:

This multi-institutional review of esophageal surveillance in children with EA is the largest of its kind. While a majority of children had at least one upper endoscopy, a minority were for surveillance. The technique of surveillance endoscopy was inconsistent and did not always include biopsy, which is pivotal. Thus, our results show a discrepancy between esophageal surveillance practice and current guidelines. Further work is needed to develop evidence-based standardization of care for the management of children with EA and encourage implementation of esophageal surveillance.

Abbreviations: EA: esophageal atresia
IRB: institutional review board
GERD: gastroesophageal reflux disease

Table 1: Characteristics of upper endoscopies & pathology in EA children.

		Non-Surveillance Endoscopies (n=1822)	Surveillance Endoscopies (n=195)	Pathology Results (any location)	Non-Surveillance Endoscopies with Biopsy (n=444)	Surveillance Endoscopies with Biopsy (n=145)
Unique Patients (% of total EA patients)		354 (67.3%)	64 (12.2%)	Normal	254 (58%)	87 (60%)
Median Age at Endoscopy (years)		1.7 [range 0-31, IQR3.7]	4.9 [range 0-20, IQR6.3]	Esophagitis	100 (25.3%)	31 (21.4%)
On Anti-acid at time of Endoscopy		74.3%	71.8%	EoE	87 (22%)	25 (17.2%)
Any Biopsy Performed (2:1)		21.7%	74.4%	Barrett's ^Δ	3 (0.76%)	2 (1.4%)
If Biopsy Performed, Multiple Biopsies Obtained		89.3%	89%	Any Malignancy	0(0%)	0(0%)
Biopsy site#	Upper Esophagus	17.7%	38%	# median number of biopsies per site ranged from 1-2 • Significant with p-values <0.05 Δ 5 cases of Barrett's were reported in the distal esophagus (median age 12, range 1-25, IQR 16) -EoE (Eosinophilic Esophagitis) defined as >15 eosinophils per high powered field -Anti-acid medication includes proton pump inhibitor (PPI) or histamine-2 receptor antagonist (H2RA)		
	Anastomosis	5.7%	7.2%			
	Lower Esophagus*	20.6%	57.9%			
	GEJ*	0.66%	5.6%			

BALANCING SUSTAINABILITY AND SAFETY: REDUCING HVAC CYCLING IN OPERATING ROOMS WITHOUT INCREASING INFECTION RISK

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Abstract: Introduction: Compared to other industries, the healthcare sector disproportionately contributes to negative environmental burdens. Operating rooms (ORs) are the most energy-intensive and waste-producing areas within a hospital. Heating, ventilation, and air conditioning (HVAC) systems in ORs are energy intensive and designed to maintain a high rate of air exchanges. The purpose of this study was to reduce HVAC cycling rates while balancing surgical site infections (SSI) rates as a key patient safety metric.

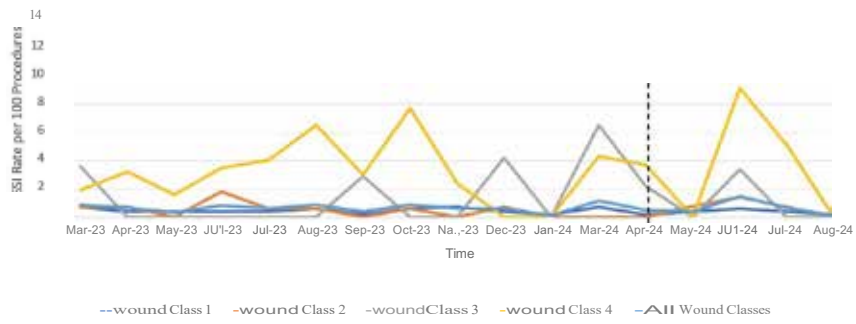
Methods: A quality/process improvement intervention was conducted at a large, urban, free-standing single-center children's hospital with multidisciplinary team collaboration including surgery, infection prevention, and engineering. The intervention involved implementing reduction of HVAC cycling rates to acceptable industry standard ranges in April 2024. SSI rates were monitored using standard infection surveillance protocols including longitudinal run-charts. Using negative binomial regression analysis, we compared the level and trend of SSIs between the pre-intervention and intervention periods. Energy usage as well as cost savings were calculated to assess annual environmental and economic impact.

Results: Across all 22 ORs, the HVAC cycling rates were decreased from a baseline of 22.9 to 33.5 air changes per hour (ACH) to 20.1 to 21.2 ACH (median 32.8 to 20.7 ACH, $p < 0.01$). There was a decrease in energy consumption, with a projected annual savings of approximately 500,158 kWh. This is equivalent to saving 893,628 gallons of gasoline annually. This translates to projected \$40,013 in energy costs annually. There was no significant difference in the level ($p=0.8$) or trend ($p=0.72$) of SSIs incidence rate between the pre-intervention and intervention periods (Figure).

Conclusion: Reducing HVAC cycling rates in ORs can significantly decrease energy consumption and generate cost savings without compromising patient safety, as demonstrated by stable SSI rates.

Abbreviations: OR=operating room
HVAC=heating, ventilation, and air conditioning
SSI=surgical site infection
ACH=air changes per hour

551 Rates Per 100 Procedures Pre and Post HVAC Cycling Reduction



POSTOPERATIVE PROPHYLAXIS USE AND OUTCOMES IN CHILDREN UNDERGOING NON-EMERGENT COLORECTAL SURGERY

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Abstract: Introduction: Use of postoperative antimicrobial prophylaxis (PAP) is common in children undergoing colorectal surgery; however, comparative effectiveness data exploring the benefit of this practice is lacking. The purpose of this study was to compare SSI rates in children undergoing non-emergent colorectal surgery who did and did not receive PAP.

Methods: The five most common colorectal procedure groups as categorized by diagnoses were identified from the 2021 and 2022 ACS NSQIP-Pediatric General Participant Use Files (PUF). Exclusion criteria included preoperative antibiotic administration other than for prophylaxis, emergent procedures, medications and comorbidities associated with immunosuppression, contaminated and dirty wound class procedures, and inadequate prophylaxis coverage for colorectal organisms. Outcomes (30-day postoperative incisional and organ space SSI) were obtained from the General Participant Use PUF and merged with prophylaxis utilization data from the NSQIP-Pediatric Surgical Antibiotic Prophylaxis PUF. Outcomes were compared between groups that did (PAP+) and did not (PAP-) receive postoperative prophylaxis after propensity matching on patient and procedural characteristics associated with increased SSI risk (based on historical NSQIP-Pediatric models).

Results: 952 patients met inclusion for matching with a median age of 6.6 months at operation (IQR 2.6-35.7). The overall SSI rate was 3.9% (incisional: 1.9% organ space: 2.0%). Overall, 60.8% of patients received PAP (median postoperative duration: 23.2 hours, IQR: 20.2-37.7), with the most common antibiotics including cefoxitin (55.9%), cefazolin/metronidazole (17.3%) and ampicillin/sulbactam (11.2%). Following matching, no differences remained between groups in any patient or procedural characteristics (figure). Rates of SSI were similar between groups in both the unmatched (PAP+ 3.8% vs PAP- 4.0%; RR, 1.0; 95% CI, 0.97-1.02; P = 0.87) and matched cohorts (PAP+ 3.1% vs PAP- 3.8%; RR, 0.99; 95% CI, 0.96-1.02; P = 0.81). No benefit was found with extended postoperative use > 24 hours in a propensity-matched subgroup analysis of 312 patients (Extended PAP+ 2.6% vs PAP- 3.8%; RR, 0.99; 95% CI, 0.95-1.03; P = 0.75).

Conclusion: Postoperative antibiotic utilization was not associated with SSI reduction in children undergoing non-emergent colorectal surgery. These data support abandoning the routine use of postoperative antibiotics in this cohort of children.

Abbreviations: PAP - Postoperative Antimicrobial Prophylaxis

SSI - Surgical Site Infection

ARM - Anorectal Malformation

HD - Hirschsprung's Disease

IC - Idiopathic Constipation

	Unmatched Cohort			Matched Cohort		
	Antibiotics(-)	Postoperative Antibiotics(+)		Postoperative Antibiotics(-)	Postoperative Antibiotics(+)	
	Prevalence	Prevalence		Prevalence	Prevalence	
	13.1(3.1-42.1)	5.5(1.6-12.1)		7.0(2.1-43.2)	6.1(2.2-36.1)	
Age, median (months, IQR)	13.1(3.1-42.1)	5.5(1.6-12.1)	<0.001	7.0(2.1-43.2)	6.1(2.2-36.1)	0.12
Female, N(%)	142(38.1)	228(39.4)	0.73	103(39.5)	107(41.0)	0.79
8MI, median(IQR)	16.6(14.5-18.6)	16.4(14.8-18.2)	0.46	16.6(11.0-18.3)	16.1(14.6-18.2)	0.3
Race/Ethnicity, N(%)			0.02			0.99
White	70(11.1)	11(13.5)		46(17.6)	45(17.2)	
Hispanic	6(17.2)	100(17.3)		49(18.8)	49(18.8)	
White	17(3.0)	22(31.7)		106(40.6)	106(40.6)	
Other/Unknown	92(27.7)	60(30.8)		60(23.0)	59(22.6)	
ASA Class, N(%)			<0.001			0.80
1-2	255(81.4)	372(81.1)		167(61.0)	172(65.9)	
3-4	106(28.6)	228(31.1)		87(33.3)	84(32.2)	
5-6	12(3.2)	11(1.1)		7(2.1)	5(1.9)	
Neonate, N(%)	70(18.8)	94(16.2)	0.33	57(21.8)	53(20.3)	0.75
Nutritional Support, N(%)	49(11.0)	61(10.5)	0.25	36(13.8)	32(12.3)	0.70
Open Abdomen/Complexity			<0.001			0.97
Primary Repair of Abdomen	92(24.1)	228(39.4)		77(29.5)	74(28.4)	
Diverting Ostomy or ARM or HO	70(11.1)	66(11.4)		56(21.5)	53(20.3)	
Perforation of Intestine	67(11.0)	115(21.0)		51(19.5)	57(21.8)	
Diverting Ostomy, IC	52(21.0)	37(6.4)		31(11.9)	30(11.5)	
Colostomy Closure, any diagnosis	62(16.5)	93(16.1)		46(17.6)	47(18.0)	
Outpatient, N(%)	29(7.8)	20(3.4)	0.004	15(5.7)	12(4.6)	0.69
Urgent Case, N(%)	27(7.2)	36(6.2)	0.004	23(8.8)	24(9.2)	0.99
Laparoscopic, N(%)	140(37.5)	129(29.7)	0.004	83(31.8)	91(33.9)	0.75
Total ORRVUs, median(IQR)	19.9(19.4-27.9)	26.4(17.5-33.2)	0.04	19.9(17.5-30.7)	19.9(17.5-31.7)	0.39
Operative Time, median(IQR)	101.0(57.0-154.0)	132.0(70.0-199.0)	<0.001	111.0(65.0-166.0)	113.0(76.0-174.0)	0.44

*Characteristics were included in the propensity model. †On their respective risk models. ‡INSQIP-Pediatric models. §Procedure groups defined using colorctal procedure CPT codes cross-referenced with p, inc, lap, IKD-10 diagnosis codes. ARM anorectal malformation; HD-filth spr; S-disease; C-idiopathic constipa, OOn.

HOMICIDE AT HOME: AN ANALYSIS OF NATIONAL CHILD FIREARM-RELATED DEATHS

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Abstract: Purpose:

Firearm-related injury is the leading cause of pediatric death in the United States with homicides accounting for most cases. While mass shootings and community gun violence draw significant media attention, little research focuses on domestic child homicide. Our purpose was to analyze pediatric firearm homicides by location and sociodemographic characteristics. We hypothesized that young children are most likely to die by firearm homicide in their homes.

Methods:

We utilized the 2020-2021 Centers for Disease Control and Prevention National Violent Death Reporting System. We included children aged 0-17 years and excluded 12.1% of cases for missing data regarding injury mechanism and location. Our primary outcome was homicide within a victim's home versus elsewhere. We assessed trends by victim age and used multivariable logistic regression to assess the association of sociodemographic characteristics with homicide location.

Results:

Of 2,160 pediatric firearm-related homicides, in-home homicides accounted for 24.3% (n=524). However, for younger children (0-12 years), over half of firearm-related homicides occurred at home (Figure 1). Of the 524 overall homicides, 343 (59.5%) had one child victim and 181 (34.5%) had multiple victims. Of 298 incidents that identified the assailant, a parent was reported in 43.3% (n=129), a sibling in 13.4% (n=40), and a parent's intimate partner in 10.1% (n=30). Males comprised 82.6% of assailants. Among child victims, girls were more likely than boys to be killed at home versus elsewhere (AOR=1.8; 95%CI=1.4-2.4; p< 0.001). Black (AOR=0.3; 95%CI=0.2-0.4; p< 0.001) and Hispanic children (AOR=0.4; 95%CI=0.3-0.6; p< 0.001) were less likely to be killed at home than non-Hispanic White children. Each one-year increase in age was associated with 17% lower odds of homicide occurring at home versus elsewhere (AOR 95%CI=0.8-0.9; p< 0.001).

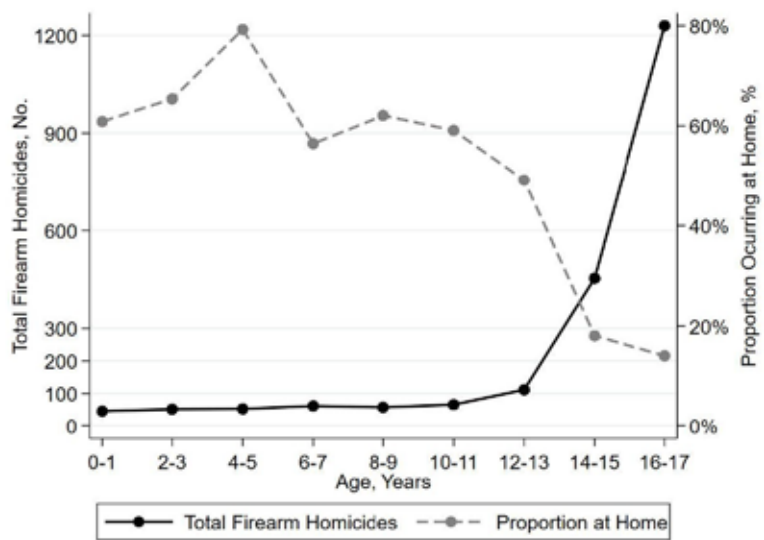
Conclusions:

A quarter of pediatric firearm-related homicides occur at home, most commonly by a child's parent. Young children are more often affected. These data point to domestic violence and non-accidental trauma as significant risk factors for homicide and provide evidence to support policies such as

extreme risk protection orders and domestic violence-related relinquishment requirements as tools to protect children. Traditional home-based firearm injury prevention through safe storage laws may be inadequate to address these tragic cases.

Abbreviations: AOR: Adjusted Odds Ratio; CI: Confidence Interval

Figure 1: Total Firearm-Related Homicides Among Children Ages 0-17 Years and the Proportion Occurring at Home, 2020-2021



OUTCOMES OF PEDIATRIC GANGLIONEUROMA: A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE (PSORC) STUDY

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Abstract: Purpose:

Current management of pediatric ganglioneuromas ranges from observation to gross total resection, with existing retrospective data demonstrating complications of up to 30%. We aimed to characterize differences in clinical outcomes of observation compared to resection of pediatric ganglioneuromas.

Methods:

A multicenter, retrospective study of patients 0-18 years old with a histologic diagnosis of ganglioneuroma from 2012-2022 was performed at 26 institutions. Data were collected and compared between groups using chi-square and Fisher's exact test (categorical variables) and Kruskal-Wallis test (continuous variables). Time to event analysis was performed via Kaplan-Meier analysis.

Results:

275 patients were identified with median (IQR) age at diagnosis of 10.5 (5.9-14.4) years. Of these, 68% (188) were symptomatic on presentation with the most common presenting symptom being abdominal mass 9.5% (26). 27.6% (76) were incidentally found with location varying between the thorax, abdomen, and other (41.1 % (113), 42.2% (116), and 16.7% (46), respectively). Initial treatment plan included resection for 77.8% (214) patients with observation in 22.2% (61) patients (Figure). Observation patients were more likely to have vascular encasement on imaging (26.2% vs 10.7%, $p=.006$) whereas resection patients were more likely to have no image defined risk factors (61.2% vs 42.6%, $p=.01$). Final treatment plan changed from observation to resection in 11 patients, most commonly for worsening symptoms (45.5%, $n=5$). A postoperative complication occurred in 29.1% (65) of patients, with Horner syndrome (21) being most common. Resection led to a change in the final diagnosis in 24 patients, with 69.6% (16) of these patients reclassified as ganglioneuroblastoma. At last follow-up (median 37.1 (17.1-66.4) months), no difference in disease progression, long term disability, or recurrence at the original site was found between groups ($p>.05$).

Conclusion:

Resection in pediatric ganglioneuroma remains a hallmark of therapy with complication rates near 30%. Comparing observation versus resection, no difference between disease progression, long term disability, or recurrence at the original site was found; however, an upgrade in pathology occurred in a subset of resection patients. Patient factors for upgrading versus clinically safe observation require further investigation.

Abbreviations: PSORC = Pediatric Surgical Oncology Research Collaborative

IQR = interquartile range

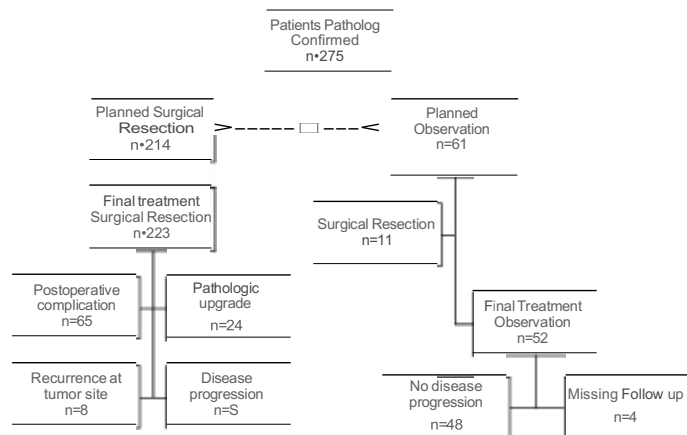


Figure. 275 patients with confirmed Urogenital neoplasia on pathology. Initial treatment plan included surgical resection for 214 patients and observation for 61 patients. 52 patients underwent observation, while 223 underwent surgical resection as final treatment plan.

IMPACT OF TIMING OF INGUINAL HERNIA REPAIR ON NEUROCOGNITIVE OUTCOMES IN PRETERM NEONATES

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Abstract: Purpose: General anesthesia in infants may worsen neurocognitive outcomes. Determining the appropriate timing for surgical procedures involves balancing anesthetic-exposure risks while addressing surgical needs. The HIP trial (NCT 01678638) concluded that inguinal hernia (IH) repair after neonatal intensive care unit (NICU) discharge results in fewer serious adverse events. A secondary objective of the HIP trial was to examine the impact of timing of anesthetic exposure on neurocognitive outcomes.

Methods: Preterm infants from this 39-center randomized clinical trial were assigned to early (prior to NICU discharge) or late (post-NICU discharge and > 55-weeks postmenstrual age [PMA]) repair between September 2013 and April 2021. Neurocognitive status was evaluated using the Bayley Scales of Infant Development III (BSIDIII) cognitive composite score at 22-months corrected age. A secondary hypothesis of the trial was that later repair (and exposure to general anesthesia) would be associated with a 6-point improvement in the BSIDIII cognitive scores. Infants in the study who had this assessment as routine care were included. Among 338 randomized infants, 320 had an IH repair, and 83 patients (39 early, 44 late) had follow-up with BSIDIII cognitive assessment. Demographics and BSIDIII cognitive scores were compared between treatment groups using descriptive statistics and Wilcoxon rank-sum test.

Results: Patients with BSIDIII assessment had similar gestational age, gender, race/ethnicity, and PMA at enrollment compared to those without BSIDIII assessment. Among those with BSIDIII assessment, the early repair groups had significantly lower median birthweight, weight at IH repair, and PMA at IH repair compared to the late repair group (Table 1). Median BSIDIII cognitive composite scores were in the normal range for both treatment groups and did not differ significantly between the early and late repair groups (85.0 [IQR:75,95] vs. 85.0 [IQR:68.5,95.0]).

Conclusion: High-risk preterm infants randomly assigned to IH repair with general anesthesia at approximately 41-weeks PMA versus approximately 59-weeks PMA had similar BSIDIII cognitive scores. However, the low capture rate of infants with BSIDIII assessment limits the generalizability of these findings. This is the only study evaluating neurocognitive outcomes of preterm infants exposed to general anesthesia at different vulnerability periods, and it suggests limited impact.

Abbreviations: IH – Inguinal hernia
NICU – Neonatal intensive care unit
PMA – Postmenstrual age
BSIDIII – Bayley Scales of Infant Development (third edition)

Table 1. Median birthweight, weight at time of inguinal hernia (IH) repair, and postmenstrual age (PMA) at time of IH repair.

	Early	Late
Birthweight, grams	690 [IQR:545,898]	810 [IQR:638,940]
Weight at IH repair, grams	2800 [IQR:2380,3255]	5290 [IQR:4975,7250]
PMA at IH repair, weeks	40.9 [IQR:38.71,44.57]	58.9 [IQR:55.07,62.71]

NOT LIKE OUR NEIGHBOR: CROSS-NATIONAL COMPARISON OF PEDIATRIC FIREARM INJURY IN THE U.S. AND CANADA

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Abstract: Purpose: Firearm injury is the leading cause of pediatric death in the United States (US) but not in Canada, despite both countries leading firearm ownership in high-income countries globally (42% US vs 26% Canada). We aim to contrast the burden and outcomes of pediatric firearm injury to highlight the impact that policy can make in injury prevention.

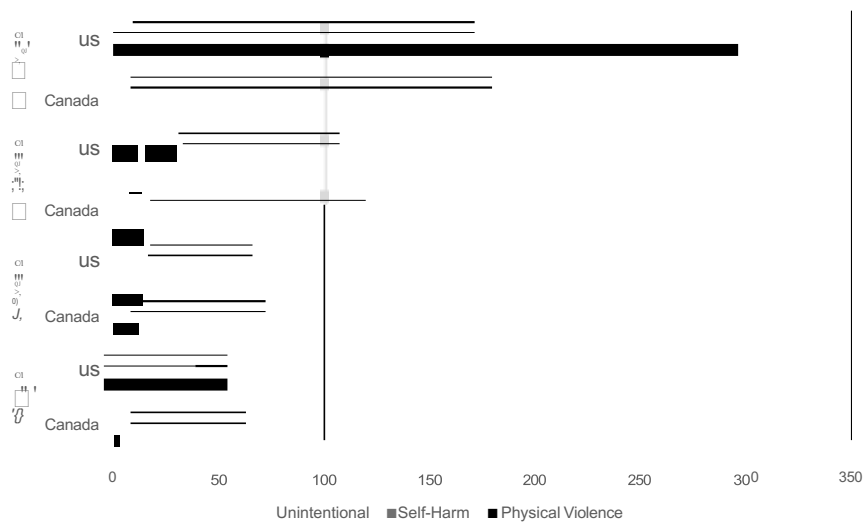
Methods: The Global Burden of Disease database was queried for firearm-related injuries in individuals < 20 years old in the US and Canada between 2017-2021. Annual population data was used to calculate standardized incidence, deaths, and mortality rates stratified by sex, age, and etiology (physical violence, self-harm, unintentional). Proportional z-tests, chi-square analysis, Fisher's exact tests, and linear regression were utilized for comparisons.

Results: Of 180,102 pediatric firearm victims (average from aggregate data), 171,492 (94%) were from US and 10,778 (6%) from Canada. Majority were male (76% US, 68% Canada). 16,720 of the injuries were fatal (Canada 2.6% vs US 9.6%). Canada had down-trending annual incidence (-0.19789/100,000, $p=0.001$), while US incidence remained stable. US population-standardized annual incidence averaged 158% higher than in Canada, with 580% higher mean standardized mortality due to these injuries in the US. Canada had higher proportion of unintentional injuries (82% vs 49%), while US had higher physical violence (49% vs 17%). When stratified by age group, < 5year, 5-9year, and 15-19year groups had significantly higher firearm injury incidence in the US ($p < 0.0001$), while the 10-14year groups were similar. Unintentional etiology was highest in all Canadian age groups (Figure). Death by physical violence was more common in the US in the < 5year (Canada 75% vs US 86%, $p < 0.0001$) and 15-19year groups (Canada 45% vs US 58%, $p < 0.0001$).

Conclusion: Despite being neighbors with many cultural similarities, the burden of pediatric firearm injuries differs between US and Canada, with US having 1.5x the incidence and 5.8x higher mortality due to firearm injuries when standardized for relative populations, and US injuries primarily attributed to violence. Implementing policy changes and safety efforts regarding firearms in the US to more closely align with those of Canada may greatly reduce the prevalence of pediatric firearm injuries and mortality.

Abbreviations: US - United States

Pediatric Firearm Injury by Shooting Type Standardized Incidence Rates Per 100,000



Thursday, May 8, 2025

Quickshot 1 - Potpourri

3:00 PM – 3:45 PM

Q1

THE MYTH OF TACHYPHYLAXIS WITH LONG-TERM USE OF SENNA-BASED LAXATIVES: A SINGLE-CENTER RETROSPECTIVE REVIEW

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Abstract: Purpose:

Chronic constipation impacts patients of all ages, particularly those with anorectal malformations and idiopathic constipation. Effective treatment is crucial to prevent long-term medical, financial, and psychosocial complications. Pediatric colorectal centers address these issues through bowel management programs utilizing tailored laxatives. However, many families express hesitation in starting stimulant laxatives, such as senna, due to concerns about their potential negative effects. A common myth is that patients develop tolerance to senna, requiring increasingly higher doses—a phenomenon known as tachyphylaxis. This study investigates the validity of this claim regarding tachyphylaxis after the long-term use of senna-based laxatives.

Methods:

A single-center retrospective review of patients participating in our bowel management program between May 2016 and September 2023 was performed. Patients included were those utilizing senna-based laxatives, without other concomitant modalities. Fecal incontinent patients or patients on enemas, were excluded from the study. IRB approval was obtained.

Results:

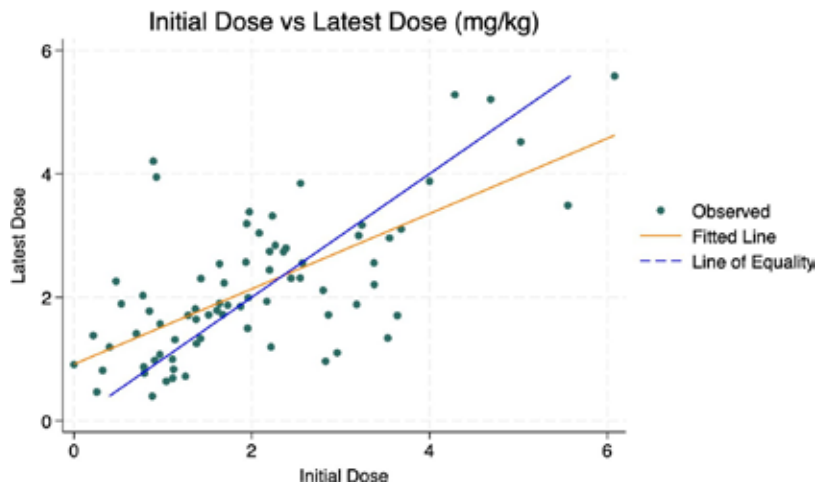
A total of 75 patients were successfully managed for constipation using senna-based laxative therapy. The mean age at the first consult was 8.79 years (SD 3.89), with a median follow-up period of 40.37 months (IQR: 25.62–59.69). Diagnoses were idiopathic constipation (65.33%) and anorectal malformation (34.67%). During long-term follow-up, 42 patients (56%) either reduced their initial dosage or maintained the same dose, while 33 patients (44%) increased their dosage. The median initial senna dosage was 1.89 mg/kg (IQR: 1.31–2.80), while the median dose at the last follow-up was 1.88 mg/kg (IQR: 1.04–2.80). No statistically significant difference was observed between the initial and latest doses ($p = 0.192$). A matched pairs rank biserial correlation between the initial and the most recent dosages indicated a weak negative relationship, but this was not statistically significant (-0.174 , 95% CI: -0.430 to 0.082 , $p = 0.183$).

Conclusions:

This study found no evidence of tachyphylaxis with long-term use of senna laxatives. Although

many patients increased their senna dosage as they aged, when adjusted for their weight, this increase was proportional, suggesting against tachyphylaxis. This evidence can help combat the propagation of this myth within the medical community, promoting better-informed treatment decisions for pediatric patients.

Abbreviations:



Q2

TWIST AND SHOUT, BUT DON'T TAKE IT OUT: A NSQIP-P ANALYSIS OF PEDIATRIC SURGEONS' PRACTICES FOR OVARIAN TORSION FROM 2016-2022

John M. Woodward, MD¹, Katherine Foote, n/a², Melanie Y. Tacher Otero¹, Krystle Bittner, MPH³, Andrew Nordin⁴, Peter Kim⁵, Carroll M. Harmon, MD PhD⁶, Phillip Benson Ham, MD, MS⁷

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Abstract: Purpose:

Ovarian salvage for ovarian torsion has become the standard of care, based on the 2018 APSA outcomes and evidence-based practice committee recommendations; however, the literature reviewing pediatric surgeons and ovarian salvage is still limited. We hypothesized that ovarian salvage performed by pediatric general surgeons has increased over time with equivalent or improved outcomes compared to oophorectomy.

Methods:

The National Surgical Quality Improvement Program-Pediatric (NSQIP-P) database was used to identify patients from 2016 – 2022 who were < 18 years old, diagnosed with ovarian torsion (ICD-10 = N83.5X), and operated on by Pediatric Surgeons. Patients were categorized into ovarian salvage [surgery on ovary without oophorectomy] and ovarian excision [oophorectomy] based on CPT codes. Exclusion criteria included: fallopian tube torsion alone (ICD-10 = N83.52X) and surgical excision of ovary as part of oncologic resection (CPT 58943). Cohorts were compared utilizing X2, Fisher's exact, and T-tests, with significance was defined at $p < 0.05$.

Results:

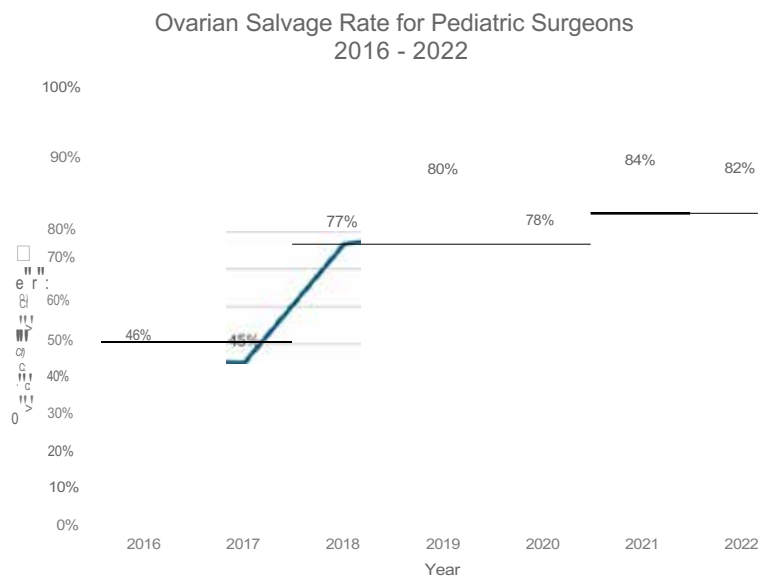
A total of 1993 pediatric patients met criteria for analysis. In 2016, pediatric general surgeons salvaged the ovary 46% of the time, increasing to 77% in 2018, and to 82% by 2022 (Figure 1). Patients who underwent salvage compared to excision were older (11.97 yr vs 9.60 yr, $p < 0.001$) and more likely to have a lower ASA class (ASA 1: 42.1% vs 40.0%, $p = 0.005$). Ovarian salvage procedures were shorter than oophorectomies (59.45 min vs. 73.90 min, $p < 0.001$). Both cohorts had equivalent outcomes of post-operative wound infection rates ($p > 0.4$), readmission (1.6% vs. 1.1%, $p = 0.516$), and reoperation (1.4% vs 1.1%, $p = 0.817$). There was no 30-day mortality.

Conclusion:

Pediatric surgeons have increased their rate of ovarian salvage over time for confirmed ovarian torsion in over 80% of cases, with lower operative times and equivalent outcomes compared to oophorectomy. These findings highlight the importance and impact of associated publications, presentations, and organizational evidence-based guidelines demonstrating the need for improvement, including by APSA committees.

Abbreviations: NSQIP-P - National Surgical Quality Improvement Program-Pediatric; ICD - 10 - International Classification of Diseases, Tenth Revision; CPT - Current Procedural Terminology; ASA Class - American Society of Anesthesiologists Classification;

Figure 1:



Q3

PERIOPERATIVE OPIOID USE IN NEURODIVERGENT VS. NEUROTYPICAL PATIENTS: A COMPARATIVE ANALYSIS

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Abstract: Purpose:

Assessing and managing postoperative pain in neurodivergent (ND) patients with communication delays is challenging, and data on this topic is limited.

This study evaluates patterns of opiate use in ND patients compared to neurotypical (NT) patients after common abdominal operations.

Methods:

A retrospective cohort of children aged 2-18 years undergoing common abdominal operations at a tertiary urban hospital from 2014 – 2024 was reviewed, and ND patients (n=707) were compared with NT patients (n=3202). Procedures included open and laparoscopic inguinal hernia repair, diagnostic laparoscopy, laparoscopic appendectomy, laparoscopic cecostomy tube placement, laparoscopic Chait tube placement, laparoscopic gastrostomy tube placement, and open epigastric and umbilical hernia repair. Patients undergoing more than one procedure were excluded, as were ND patients without a communication delay. Cohorts were compared using chi-square and Mann-Whitney U tests, with significance set at $p < 0.05$. Opiate use was recorded in morphine milligram equivalents per kilogram (MME/kg), postoperative duration of use (time from incision to final dose), and number of administrations.

Results:

A total of 3909 children were included. The ND cohort was younger (median 6 vs 10 years, $p < 0.001$) and had a higher proportion of males (67% vs 59%, $p < 0.001$). The most common operation for ND patients was laparoscopic gastrostomy (47%), while the most common operation for NT patients was laparoscopic appendectomy (67%).

ND patients were administered 11% more postoperative opioid in total (0.20 vs 0.18 MME/kg, IQR [0.15-0.25] vs [0.14-0.23]; $p < 0.001$). Opioid exposure time was similar (median 102 vs 106 min, IQR [46-1136] vs [33-961], $p=0.20$). ND patients were administered fewer opioid doses (median 4 vs 5, IQR [2-7] vs [3-8], $p < 0.001$).

Subgroup analysis of ND and NT patients undergoing only laparoscopic inguinal hernia revealed shorter opioid duration for ND patients (median 40 vs 90 min, $p < 0.001$) and a trend toward fewer administrations in ND patients (median 3 doses vs 4, $p=0.06$).

Conclusions: There is significant variation in opioid use between neurodivergent and neurotypical patients undergoing common abdominal procedures at our institution. Further research is needed to understand the impact of this difference on post-operative outcomes and to optimize pain management strategies for neurodivergent populations.

Abbreviations:

Q4

SOCIAL DETERMINANTS OF HEALTH SCREENING RESPONSES AND PEDIATRIC SURGICAL OUTCOMES

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Abstract: Purpose: Differential perioperative outcomes have been identified across racial groups, language preferences, and socioeconomic measures within the pediatric surgical literature. Such studies utilize various SDOH indices (including Area Deprivation Index, Social Vulnerability Index and Childhood Opportunity Index) to estimate relationships between SDOH and surgical outcomes. However, impact of a positive response from now-required SDOH screening tools and surgical outcomes has not been well-studied. We sought to assess the association between a positive response from SDOH screening tools and pediatric surgical outcomes [30-day post-operative mortality and serious adverse events (SAE)].

Methods: A retrospective analysis of pediatric surgical patients ages 0–21 years was performed at our quaternary pediatric hospital from 11/9/2019 (the initiation of SDOH screening) to 7/9/2024. Logistic regression was used to assess the relationship between a positive response on the SDOH screening tool utilized at our institution with 30-day post-operative mortality and serious adverse events.

Results: Among 28,130 patients included in the analysis, the incidence of 30-day mortality and SAE were 0.1% and 10% respectively. Logistic regression modeling found that patients with a positive SDOH screen experienced 44% higher odds of 30-day post-operative mortality (OR 1.44, 95% CI: 0.65-3.11) and a statistically significant 34% increased odds of SAE (OR 1.34, 95% CI: 1.20-1.49). Given the limited event size for mortality (n=35) it was not possible to model mortality outcomes based on each of the 4 SDOH screening domains (Housing, Food Insecurity, Transportation, and Cost) included in our screening tool. However, of the 4 domains, positive responses to Housing and Cost needs demonstrated statistical significant increased odds of SAE (Housing OR 1.38, 95% CI: 1.05-1.83 and Cost OR 1.32, 95% CI: 1.14-1.52).

Conclusion: Positive responses on SDOH screening for pediatric surgical patients were associated with statistically significant increased odds of 30-day post-operative SAE and a trend towards increased odds of post-operative mortality. These screening tools provide granular details about social needs that are not available through indices. Responding to needs identified on SDOH screening tools may improve equitable and optimal outcomes in surgical care for children.

Abbreviations: SDOH: social determinants of health

Table 1: Association between SDOH screening tool responses and 30-day post-operative mortality and serious adverse events

Characteristic	Mortality OR	95%CI	SAE OR	95%CI
Positive SOOH Screen	1.44	0.65,3.11	1.34	1.20, 1.49
SOOH Screen Categories				
<i>Housing</i>				
Stable Housing Today			1.11	0.86, 1.41
Stable Housing for the next 2 months			1.38	1.05, 1.83
<i>Food</i>				
Food (last 12months worried about running out of food)			1.01	0.78, 1.29
Food (Last 12months run out of food)			0.98	0.79, 1.21
<i>Cost</i>				
Pay for Necessities(housing, food, heating)			1.32	1.14, 1.52
Pay for Nutritious Foods over last 12 months (vegetables & fruit)			0.82	0.66, 1.01
<i>Transportation</i>				
Lack of Transport for medical needs			1.21	0.89, 1.66
Lack of Transport over past 12 months			1.18	0.87, 1.57

Bolded Tu,- p;<0.05

Q5

DECREASING BURN CARE BURDEN: REDUCING DRESSING FREQUENCY AND OPIOID PRESCRIPTIONS WITH ADVANCED THERAPIES IN PARTIAL THICKNESS PEDIATRIC BURNS

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Abstract: Purpose: Traditional pediatric burn care requires multiple daily dressing changes, often augmented by opioid medication. Advanced therapies and dressings for partial thickness burns, including epidermal autografting (EA), epidermal skin substitutes (ESS), and silver dressings, remain in place longer and have changed burn management. As a quality improvement initiative, we aimed to study the impact of the adopted utilization of advanced burn therapies in pediatric burn care.

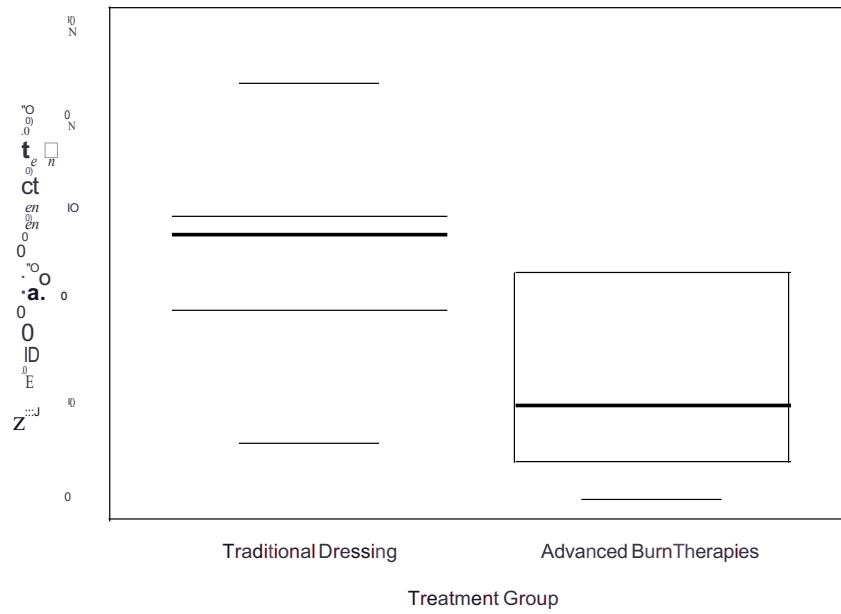
Methods: A retrospective cohort study of pediatric patients (age < 16 years) admitted to a tertiary children's hospital with an isolated burn injury (Total Body Surface Area (TBSA) < 30%) from May 2021-July 2024 was performed. Patients requiring surgical excision/grafting were excluded. Demographics, burn characteristics (mechanism, depth, TBSA), and treatment were collected. Patients were grouped by care strategy into traditional dressings (twice daily with antibiotic ointment/impregnated gauze) or advanced burn therapies (EA, ESS, and/or silver). Overall, 606 patients were included, 441 traditional and 165 advanced therapies. Descriptive statistics and Mann-Whitney U test were used to compare groups.

Results: Median age was 2.6 years (IQR 1.3, 6.6), with 56% male and 72% governmental insurance. The most common injury mechanisms were hot liquid (70%), hot surface (13%), and fire/explosive (13%). Median TBSA was 4% (IQR 2,7), with no difference between groups ($p=0.87$). In the traditional group, 97% of patients were discharged with twice daily dressing changes. With advanced therapies, only 16% performed any dressing changes prior to follow-up after discharge with only 3% twice a day. Opioids were prescribed at discharge for 76% of patients, with no difference between groups ($p=0.83$). However, the advanced therapies cohort was discharged with a median of 5 doses (IQR 2,12) compared to 14 (IQR 10,15) in the traditional group, a mean difference of 6 doses less (95% CI 5.00-8.00, $p<.001$) (FIGURE).

Conclusion: Treating partial thickness burns with advanced therapies utilizing long-term dressings, significantly minimizes the need for twice-daily dressing changes, with most patients requiring no home dressing changes. Subsequently, this strategy resulted in a 64% reduction in the median number of opioid doses prescribed. Pediatric burn research is needed to optimize patient-centered care and investigate the quality of life for families.

Abbreviations: EA: Epidermal autografting
ESS: Epidermal skin substitutes
TBSA: Total Body Surface Area

Opioid Doses at Discharge



Q6

GUT CHECK: DOES A SUBJECTIVE TRIGGER FOR CHILD ABUSE SCREENING RESULT IN DISCRIMINATION?

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Abstract: Purpose: The American Academy of Pediatrics recommends collection of skeletal surveys when abuse is suspected during an assessment of children two years of age and younger. A skull fracture in this population might raise suspicion in one provider but not in another. Affinity and projection biases influence the decision to screen and are unavoidable when subjective triggers are utilized. The purpose of this study is to determine if provider subjectivity in the decision to screen for child abuse results in unintended bias and discrimination.

Methods: This study was conducted using a retrospective, descriptive correlational design. The setting was a tertiary children's hospital within an academic medical center. In 2020, the institution transitioned to an electronic medical record. This allowed for isolation of all children ≤ 3 years of age with skull fractures. In total, 231 patients were identified. Of these patients, 36 were excluded. Exclusion criteria included fracture during the birthing process, motor vehicle collision, dog bites, and those limited to facial bones. This resulted in 195 patients with calvaria fractures being included in statistical analysis. Of these, 118 (60.5%) were white and 77 (39.5%) were people of color (POC). The POC breakdown was 74.0% black or African American, 16.9% Hispanic, 3.9% Asian, 2.6% Arab, and 2.6% biracial. Fisher's exact test was applied using GraphPad Prism version 10.3.1 for Windows.

Results: Our hypothesis that POCs are subjectively routed for more skeletal surveys was affirmed, with a two-tailed p-value of 0.028. Significance was defined as $p < 0.05$. There was no difference in the rate of ophthalmology consultation when an associated intracranial hemorrhage was present ($p = 0.230$), nor was there a difference in Child Protective Services (CPS) referrals when the skeletal survey and ophthalmology exams were negative ($p = 0.829$).

Conclusion: We conclude that, without objective triggers, POCs are subjected to increased scrutiny in the form of skeletal survey collection. Discrimination is eliminated when objective measures, such as presence of intracranial hemorrhage as a trigger for ophthalmology consultation or positive skeletal surveys and/or presence of retinal hemorrhages as a trigger for CPS referral, are utilized.

Abbreviations: CPS: Child Protective Services

POC: People of Color

Q7

EFFECTS OF BODY MASS INDEX ON PEDIATRIC KIDNEY TRANSPLANT OUTCOMES

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Abstract: Purpose:

Obesity is an increasingly prevalent issue amongst children. Within adult transplantation, high Body Mass Index (BMI) is associated with poor outcomes in kidney transplantation (KT) recipients. Although BMI is routinely used to evaluate transplant candidacy in adults, its use in children is less common given ethical concerns and limited data. Our aim was to evaluate the impact of pre-transplant obesity on outcomes of pediatric KT recipients.

Methods:

Pediatric (< 18 years) KT data were obtained from the Scientific Registry of Transplant Recipients (SRTR) database from 2002-2022. Recipient demographic data, reasons for waitlist removal, and graft/recipient outcomes were analyzed. BMI and weight-for-length (WFL) Z-scores were calculated for patients aged 2-17 and < 2 years, respectively, according to CDC and WHO criteria.

Results:

In total, 15417 patients met study criteria. Of these, 736 (4.8%) children were underweight, 9757 (63.3%) were normal weight, 3737 (24.2%) were overweight, and 1187 (7.7%) were obese. In comparison to normal weight recipients, obese recipients were younger at KT (8.8 years vs 13.3 years; $p < 0.001$) and had a higher degree of functional impairment pre-transplant. Additional demographic data is shown in Table 1. Post-operatively, obese patients were noted to have longer lengths of stay (9 days vs 8 days, $p < 0.001$). Obese recipients were also more likely to have a trend towards significantly delayed graft function (8.3% vs. 6.5%, $p = 0.07$) and acute rejection post KT (2.7% vs. 1.6%, $p = 0.145$). There was no observed difference in rates of graft failure across weight classes. Obese patients demonstrated significantly higher mortality rates (6.9%) as compared to normal weight recipients (3.5%), with leading causes of death including infection ($p = 0.012$), cardio/cerebrovascular ($p = 0.039$), and respiratory failure ($p < 0.001$).

Conclusions:

Obesity is increasingly prevalent in pediatric KT recipients. While no difference in graft function was observed, obese children were found to have significantly higher risk of all-cause mortality than normal weight recipients, highlighting the importance of optimization of comorbid conditions and functional status both pre- and post-transplantation.

Abbreviations: BMI- Body Mass Index; KT- Kidney Transplantation; WFL - Weight-For-Length; CDC- Centers for Disease Control and Prevention; WHO- World Health Organization

Pediatric Kidney Transplant Patient Demographics				Outcomes		
Variable	All Patients	Underweight	Normal weight	Overweight	Obese	P value
Age at transplantation (years)	12.8 (7.1, 15.9)	14.7 (11.1, 16.8)	13.3 (8.5, 16)	11.5 (5, 15.5)	8.8 (2.9, 15.3)	<0.001*
Gender						<0.001*
Female	6321 (41%)	280 (38%)	4193 (43%)	1408 (37.7%)	440 (37.1%)	
Male	9096 (59%)	456 (62%)	5564 (57%)	2329 (63.3%)	747 (62.9%)	
Ethnicity						0.001*
Hispanic or Latino	3948 (25.6%)	157 (21.3%)	2474 (25.4%)	1031 (27.6%)	286 (24.1%)	
Not Hispanic or Latino	11469 (74.4%)	579 (78.7%)	7283 (74.6%)	2706 (72.4%)	901 (75.9%)	
Race						0.023*
White	11629 (75.4%)	528 (71.7%)	7426 (76.1%)	2786 (74.6%)	889 (74.9%)	
Non-White	3788 (24.6%)	208 (28.3%)	2331 (23.9%)	951 (25.5%)	298 (25.1%)	

Data are presented as n (%) or median (IQR).

P values were calculated using the Kruskal-Wallis, the Chi-square test or Fisher's exact test, as appropriate.

*statistically significant.

Q8

COMPARING LAPAROSCOPIC VERSUS OPEN LADD'S PROCEDURE IN PEDIATRIC PATIENTS: A 10-YEAR REVIEW OF THE PEDIATRIC NSQIP DATABASE

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Abstract: Purpose: As expertise with laparoscopic surgery increases, more surgeons have been trained to perform the Ladd's procedure laparoscopically. This study investigates changes in the proportion of Ladd's procedures being performed laparoscopically over time and compares 30-day outcomes between laparoscopic and open Ladd's.

Methods: The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) - Pediatric Database was queried to identify patients < 18 years of age who underwent an elective Ladd's procedure between 2013-2022. Children undergoing other major procedures that may have affected the operative approach were excluded. Changes in the proportion of patients undergoing a laparoscopic approach over time were evaluated overall and in subgroups based on age < 1 and ≥1 year using Cochran-Armitage tests. Comparison of 30-day outcomes between laparoscopic and open Ladd's were performed using propensity score matched cohorts.

Results: 1563 patients underwent an elective Ladd's procedure between 2013-2022 with 66% having an open procedure and 34% a laparoscopic procedure. The median age was significantly lower in patients undergoing open vs. laparoscopic Ladd's (0.5 years (IQR 0.1-4.2 years) vs. 4.0 years (IQR 0.5-11.9 years), $p < 0.0001$). The proportion of patients undergoing laparoscopic Ladd's has significantly increased from 24% in 2013 to 40% in 2022 ($p < 0.0001$) with significant increases in patients ≥1 year of age (37% to 48%, $p < 0.0001$) and those < 1 year of age (13% to 32%; $p = 0.008$). After propensity score matching, median post-operative length of stay in the open cohort ($n = 384$) was 5 days (IQR 3-10) and 3 days (IQR 2-6) in the laparoscopic group ($n = 384$) ($p < 0.0001$). The percentage of any post-operative complication was 19.5% in the open cohort and 14.3% in the laparoscopic cohort ($p = 0.054$).

Conclusions: The proportion of elective Ladd's procedures being performed laparoscopically has increased over time across all children, with the largest increase in children < 1 year of age. Laparoscopic Ladd's is associated with decreased length of stay but has similar frequencies of post-operative complication when compared to matched patients undergoing open Ladd's. The increased use of laparoscopic Ladd's warrants additional rigorous investigation to compare longer term outcomes between laparoscopic and open Ladd's.

Abbreviations: NSQIP: National Surgical Quality Improvement Program
IQR: Interquartile Range



Q9

WHAT FACTORS DRIVE FEMALE PEDIATRIC GENERAL AND SUBSPECIALTY SURGEONS TO CHANGE JOBS OR LEAVE MEDICINE ALTOGETHER?

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1Phoenix Children's Hospital, Phoenix, AZ, USA, 2Phoenix Childrens Hospital, Department of Surgery, Phoenix, AZ, USA, 3Mayo Clinic Arizona, Phoenix, AZ, USA

Abstract: Purpose:

Only 28% of general pediatric surgeons in the United States are female and even fewer advance to leadership roles compared to their male counterparts. Previous studies highlighted insufficient protected time as a barrier to success and poor practice conditions as the most frequent reason for changing jobs. This study aims to identify factors that drive female pediatric surgical sub-specialists to either change jobs or leave the field of medicine.

Methods:

An anonymous survey was distributed via private female physician social media groups and email lists from February to May 2024. Physician credentials are required for membership to these groups. Basic demographics and responses to multiple choice and free-text questions evaluating female physicians' experiences in medicine were collected. Descriptive and inferential statistics were used to describe responses. Pediatric surgeons were defined as pediatric general surgeons and pediatric surgical subspecialists.

Results:

176 female surgeons completed the survey; 22 were pediatric surgeons. Of the pediatric surgeons, 1 left medicine entirely and 21 changed jobs within the field. Pediatric surgeons were in practice for a mean of 7 years prior to changing jobs. Compared to female adult surgeons, pediatric surgeons less frequently worked in private practice. All other demographics were the same across both groups, Table 1. Pediatric surgeons identified lack of opportunities for professional development and advancement (20%) and harassment/bullying/discrimination (20%) as the primary reasons for their job changes, while the main driver for job changes among adult female surgeons was an uncomfortable work environment (23%). 91% of female pediatric surgeons felt that their professional development needs weren't met in their previous roles, and over a quarter indicated that an improved work environment/culture could have prevented their job change. In their free-text responses, many expressed that they felt unsupported, including having inadequate coverage assistance, inadequate income, and limited opportunities for career growth.

Conclusions:

Lack of opportunities for professional development and advancement, along with issues of harassment, bullying, and discrimination emerged as primary factors driving female pediatric surgeons to change jobs. To better support our female surgeons and foster their professional growth, pediatric surgical professional organizations should lead efforts to address these concerns.

Abbreviations:

Table 1: Comparison of demographics and factors that influenced job changes between pediatric surgical subspecialists and adult surgeons and sampling of free-text responses by pediatric surgical subspecialists

Demographics and factors influencing job changes	Pediatric surgical subspecialists, n=22	Adult surgeons, n=154	P-value
Age in years, mean(SD)	47 (8.5)	46 (6.7)	0.423
Previous job, n(%)			
Academic/university	13 (59)	69 (45)	0.256
Private practice	5 (23)	71 (46)	0.041
Other	4 (18)	14 (9)	0.249
Years in practice when changed jobs or left medicine, mean(SD)	7 (5.6)	7 (5.3)	0.753
Professional development needs were met at previous job, n(%)	2 (9)	42 (27)	0.072
Top primary reasons for changing jobs or leaving medicine*, n(%)			
Harassment, bullying and discrimination	4 (20)	22 (14)	0.507
Uncomfortable work environment	2 (10)	35 (23)	0.253
Lack of opportunities for promotion, advancement and professional development	4 (20)	9 (6)	0.046
Other	4 (20)	33 (21)	1.000
Top responses to nothing that could have prevented the job change*, n(%)			
Better income	4 (18)	14 (9)	0.249
Improved work environment/culture	6 (27)	74 (48)	0.072
Shorter hour,	1 (5)	18 (12)	0.474
Sampling of pediatric surgical subspecialists' free-text responses			
Were there any particular processes or systems in place that contributed to your decision to leave?	"No salary increases, increasing RVU to be more difficult to obtain" "Hidden pay inequity" "Pregnancy related disability discrimination" "The promotion process:" "Lack of opportunities to advance" "Lack of support" "Partners unable to imagine different work models"		
How could your previous organization have better supported you?	"Hired locums so that I didn't have to cover my partners' excessive vacations, more admin/clinical support staff" "Provided opportunities for dynamic growth over time" "Improve leadership" "Providing support and guidance in the promotion process. Providing equal opportunities in areas that count towards promotion" "Get locums" "Made changes to leave policies, ability to obtain a raise hindered by current pay structure"		

*: Not all multiple-choice options from the survey are shown. Percentages indicate the proportion of respondents who chose each option, relative to all the available options for that survey prompt, including those not displayed in the table.

Q10

PERCUTANEOUS CHOLECYSTOCHOLANGIOGRAPHY FOR DIAGNOSING BILIARY ATRESIA AT A HIGH-VOLUME CENTER

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1Columbia University- New York Presbyterian- Morgan Stanley Children's Hospital, Wayne, NJ, USA, 2Columbia University- New York Presbyterian- Morgan Stanley Children's Hospital, New York, NY, USA, 3Columbia University Irving Medical Center, New York, NY, USA, 4New York Presbyterian Morgan Stanley Children's Hospital, New York, NY, USA, 5Rutgers RWJMS - Bristol Myers Squibb Children's Hospital RWJBH, New Brunswick, NJ, USA

Abstract: Purpose: Percutaneous cholecystocholangiography (PCC) is a minimally invasive tool that helps diagnose biliary atresia (BA). We evaluated PCC as an adjunctive diagnostic tool by comparing outcomes of Kasai portoenterostomy (KP) before and after incorporation of PCC in our diagnostic algorithm for BA evaluation.

Methods: A single-institution retrospective review was performed for BA patients who underwent KP between January 2014 and July 2023 (n=59). PCC was implemented in January 2019 and patients who underwent KP after implementation (post-PCC group) were compared to those who underwent KP in the previous 5 years (Pre-PCC group). Patient demographics, preoperative, and 3-month postoperative laboratory values were obtained in patients with their native liver to evaluate for adequate biliary drainage. A Mann-Whitney U-test was used to evaluate statistical significance with a 95% confidence interval between the two groups. Outcome was survival with native liver (SNL) at one year and biliary drainage was assessed by postoperative total bilirubin.

Results: Of the 59 patients included in the study, 32 were male (54%). Baseline preoperative laboratory values were the same between groups (Table 1). Age at procedure was significantly less in the post-PCC group (51 vs. 60, p=0.0056). SNL at one year was 18/26 (69%) in the pre-PCC group. In the post-PCC group, 22/33 (67%) were referred for PCC and SNL at one year was 20/33 (61%). Of the 22 patients referred for PCC, SNL at one year was 15 (68%). The median total bilirubin at 3 months post KP in the pre and post PCC groups was 1.9mg/dL and 2.1mg/dL respectively, (p= 0.87). and the median days to surgery from initial hepatology referral was 7 days in the pre-PCC group and 11 days in the post-PCC group. (p=0.20)

Conclusion: Biliary drainage based on total bilirubin and time to surgery from initial hepatology referral were not significantly different before and after PCC implementation. Age at procedure was significantly less in the post-PCC group. This data suggests the safety of PCC in the diagnostic algorithm of BA without delaying surgery or affecting SNL. Lower age at surgery in the PCC group may suggest an added benefit in the algorithm.

Abbreviations: Percutaneous cholecystocholangiography (PCC)
biliary atresia (BA)
Kasai Portoenterostomy (KP)
survival with native liver (SNL)

PCC Abstract Table

Table 1. Baseline Characteristics and Pre-Operative Variables Of Pre and Post PCC Groups

Variable	Pre-PCC	Post-PCC	z score	p-value
Age at Procedure	60 [54-71]	51 [37 -62]	-2.77	0.0056
GGTP	437 [395 -761]	498 [293- 883]	-0.10	0.92
AST	170 (126 - 279]	154 (102-277]	-0.40	0.69
ALT	139 (107 -204]	113 (60 -233]	-1.21	0.23
ALP	454 (389 - 659]	504 (403 - 624]	0.45	0.65
Total Bilirubin	8.7 (6.5- 10.1]	7.4 (5.6- 8.9]	-1.63	0.10
Direct Bilirubin	5.4 [4.2- 7.8]	5.3 (4.4- 7.4]	-0.25	0.80
Albumin	4 [3.8-4.1]	4 [3.7-4.1]	0.04	0.97

PCC= Percutaneous

GGTP= gamma glutamyl transpeptidase

AST= aspartate aminotransferase

ALT= alanine aminotransferase

ALP= alkaline phosphatase

Q11

OUTCOMES FOLLOWING ADOPTION AND INTEGRATION OF ROBOTIC-ASSISTED CHOLECYSTECTOMY FOR BILIARY TRACT DISEASE: A SEVEN-YEAR, SINGLE-CENTER EXPERIENCE WITH 395 PATIENTS

Joyce J. L. H McRae, MD¹, Steven L. Raymond, MD², Mark Kashtan, MD, MPH¹, Georgi Mladenov, MD¹, Rosemary Vannix, MSN¹, Vinicius Silva³, Alexandra Vacaru, BS³, Ali Mejaddam, MD¹, Faraz Ali Khan, MD⁴, Andrei Radulescu, MD, PhD¹, Donald Moores, MD¹, Edward P. Tagge, MD, MS, MBA¹

1Loma Linda University Health, Loma Linda, CA, USA, 2University of Florida Health, Gainesville, FL, USA, 3Loma Linda University School of Medicine, Loma Linda, CA, USA, 4Stanford University, Palo Alto, CA, USA

Abstract: Purpose:

Obesity and concomitant biliary disease are a growing problem in children. Despite increased utilization of robotic-assisted cholecystectomy (RAC) in adults, adoption in pediatrics is limited due to availability, surgeon experience, outcomes and cost. Our center-initiated RAC in 2017 and it has become our primary approach. This review aims to compare our outcomes of laparoscopic (LC) versus RAC.

Methods:

After IRB approval, all cholecystectomies in children under age 18 at our academic children's hospital from January 1, 2017, to July 31, 2024, were reviewed. During this period, 395 cholecystectomies were performed: 185 as LC and 210 as RAC. Statistical analysis included the use of the Wilcoxon rank sum, Chi square and Spearman correlation with p value < 0.05 denoting significance.

Results:

Total cohort median age was 15.5, median Body Mass Index was 27.9 kg/m², and 77% were female. Two hundred thirteen (54%) patients had obesity (107) or severe obesity (106). The most common biliary pathologies were choledocholithiasis (165) and symptomatic cholelithiasis (131). RAC was launched in 2017 after appropriate proctoring sequentially equipped five pediatric surgeons with robotic certification. Overall, yearly cholecystectomies increased from 36 in 2017 to maximum of 91 in 2022. The proportion of RAC gradually increased from 13% to 74%. LC was performed more often for urgent inpatient cases (66.5% vs 49.5%; p = 0.0007) and RAC was utilized more often in severely obese patients (Odds Ratio 3.09). Median operative time in minutes differed between LC and RAC [93 vs 102; p < 0.0328]. Conversion to open cholecystectomy occurred in only one patient (LC). Retained common duct stones occurred in 2 (0.95%) RAC and 6 (3.2%) LC. There were no common bile duct injuries, no mortalities and no difference in rates of emergent revisits or readmissions (p 0.72).

Conclusion:

This is the largest reported cohort of pediatric robotic cholecystectomies, demonstrating that implementation of a robust robotic program is possible without compromising patient safety. It appears to be a particularly helpful modality for children with severe obesity. Further research evaluating educational and ergonomic advantage of robotic surgery in pediatrics as well as its fiscal impact is needed.

Abbreviations: LC: Laparoscopic Cholecystectomy

RAC: Robotic-Assisted Cholecystectomy

IRB: Institution Review Board

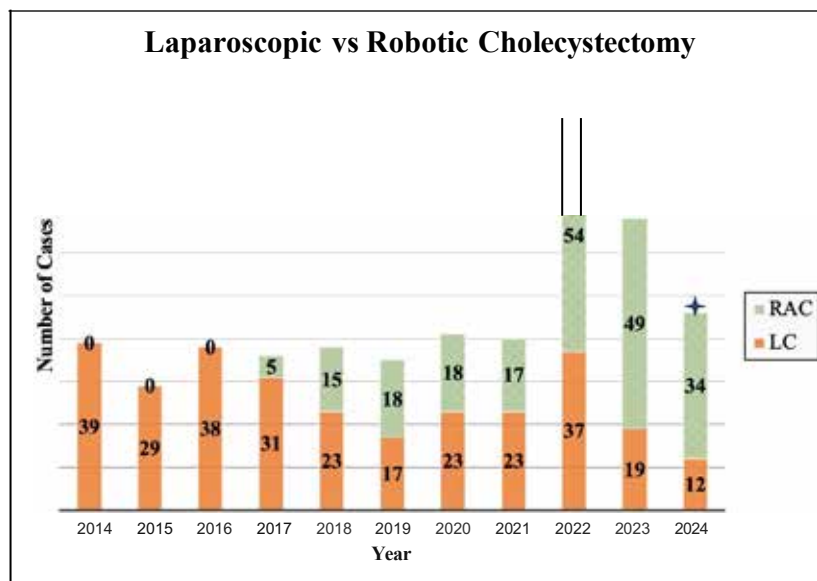


Figure 1: Trends in Number of Operations from January 2014 to July 2024
 (+ denoting total of cases through July 31, 2024)

Q12

LAPAROSCOPIC VS OPEN INGUINAL HERNIA REPAIR IN OLDER CHILDREN: A NSQIP-PEDIATRIC ANALYSIS

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1Aga Khan University, Karachi, Sindh, Pakistan, 2Stanford University, Palo Alto, CA, USA, 3Aga Khan University, Karachi City, Sindh, Pakistan

Abstract: Purpose: There is still no consensus on the preferred mode of surgery of inguinal hernia repair in pediatric patients. While there have been a lot of studies looking at inguinal hernia (majority on neonates), very few have specifically talked about the older children. Thus, with this study, we aimed to compare the outcomes of laparoscopic vs open surgery in children greater than one years old.

Methods: We utilized the National Surgical Quality Improvement Program-Pediatric (NSQIP-P) dataset to review all patients >365 days old were admitted for surgery with the diagnosis of inguinal hernia (ICD-10: K40.0-K40.91) from 2016-2022. Data extracted for analysis included the patient demographics, type of hernia and the 30 day post operative outcomes. Median and interquartile ranges (IQR) are used to describe the continuous variables while number (percentages) are used for the categorical variables. Wilcoxon rank-sum (Mann-Whitney) test and Chi Square test were used for the continuous and categorical variables respectively. For categorical variables with very low frequencies Fisher's Exact Test was used instead. A p value of < 0.05 was considered significant.

Results: We included a total of 1680 children who underwent either laparoscopic (73.2%) or open (26.8%) inguinal hernia repair. The patients were predominantly male (80%) with a mean age of 5.44±4.26 years. Laparoscopic and open procedures were used equally for bilateral hernias (16.4% vs 16.2%, p=0.922) and obstructed hernias (3.98% vs 4.67%, p=0.232). The duration of the operation was significantly longer in open surgeries compared to the laparoscopic surgeries (83 vs 74, p=< 0.001). There was no significant difference between laparoscopic and open surgeries in the post operative outcomes like surgical site infection (0.41% vs 0.44%, p=0.915), bleeding/transfusion episodes (0% vs 0.20%, p=0.268), the need for unplanned readmission (1.06% vs 0.89%, p=0.761) and reoperation (0.24% vs 0.67%, p=0.194). The length of stay was significantly higher (p=0.018) in open surgeries (1.04±1.72) than laparoscopic surgeries (0.43±1.04).

Conclusion: We conclude that there is no significant difference between laparoscopic and open inguinal hernia repair apart from increased operative duration and length of stay in the latter.

Abbreviations: National Surgical Quality Improvement Program-Pediatric (NSQIP-P)
Interquartile ranges (IQR)

Table 1:

	Laparoscopic N=1230	Open N=450	p value
Anesthesia Duration (minutes), median (IQR)	74 (60-96)	83 (67-112)	<0.001
Operation Duration (minutes), median (IQR)	37 (25-54)	45.5 (32-69)	<0.001
Surgical Site Infection, number (percentage)	5 (0.41%)	2 (0.44%)	0.915
Length of stay (days), mean+SD	0.43+1.04	1.04+1.72	0.018
Bleeding, number (percentage)	0(0%)	1 (0.20%)	0.268
Reoperation, number (percentage)	3 (0.24%)	3 (0.67%)	0.194
Unplanned Readmission, number (percentage)	13(1.06%)	4 (0.89%)	0.761
Post operative ventilator need, number (percentage)	0(0%)	2 (0.45%)	0.072
Reintubation, number (percentage)	0(0%)	1 (0.20%)	0.268

N: Total number of patients, IQR: Interquartile range, SD: standard deviation

Thursday, May 8, 2025

Quickshot 2 - Basic Science and Appendicitis

3:00 PM – 3:45 PM

Q13

PENETRATION OF EVIDENCE-BASED PRACTICES INTO PEDIATRIC APPENDECTOMY CARE

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Abstract: Purpose:

Many children's hospitals have implemented evidence-based practice (EBP) for diagnosis and management of appendicitis using clinical pathways. These include imaging pathways to preferentially use ultrasound (US) and minimize computer tomography (CT) and standardized postoperative pathways to decrease imaging, drain placement, and antibiotic use for complicated appendicitis and promote same day discharge for uncomplicated appendicitis. As successful implementation of evidence into practice can take years, this study evaluated the penetration of EBPs for pediatric appendicitis over time.

Methods: The ACS NSQIP Pediatric (2015-2022) was queried for patients undergoing appendectomy for acute appendicitis. Patient demographics, preoperative and postoperative care were reviewed. Outcomes included use of US, CT, magnetic resonance imaging (MRI) at any institution, parenteral and oral antibiotics use at discharge, peripherally inserted central catheter (PICC) line use, postoperative drain use, and same day discharge. Cochran- Armitage tests were performed.

Results: 135,412 children undergoing appendectomy for acute appendicitis (72.2 % simple; 27.8% complicated) were included. 60.5% were male and 39.5% were female. The median age was 11.3 (8.5-14.2). 42.11% underwent a preoperative CT and 71.6% underwent a preoperative US. From 2015 to 2022, for children with uncomplicated appendicitis, the use of oral antibiotics at discharge decreased from 10% to 7.1% ($p < 0.001$), while same day discharges increased from 69.4% to 77.5% ($p < 0.001$). Decreases over this time in children with complicated appendicitis occurred for the postoperative practices of percutaneous drain placement (12.5% to 9.9%, $p < 0.001$), PICC use (10.0% to 6.9%, $p < 0.001$) and parenteral antibiotics at discharge (3.0% to 2.1%, $p < 0.001$), while the use of oral antibiotics at discharge increased from 50.9% to 64.3% ($p < 0.001$). The use of postoperative CT in complicated appendicitis remained unchanged, but the use of MRI increased from 0.77% to 1.1% and US increased from 9.1% to 12.5% ($p < 0.001$; Figure).

Conclusion: EBPs are increasingly utilized in pediatric appendicitis care for both uncomplicated appendicitis, as reflected by decreased utilization of oral antibiotics at discharge and increasing same day discharge, and complicated appendicitis with decreasing rates of drain placement, PICC use, and parenteral antibiotics at discharge and increasing use of US and MRI.

Abbreviations: Evidence-based practices (EBP)
Ultrasound (US)
Computer tomography (CT)
Magnetic resonance imaging (MRI)
Peripherally inserted central catheter (PICC)

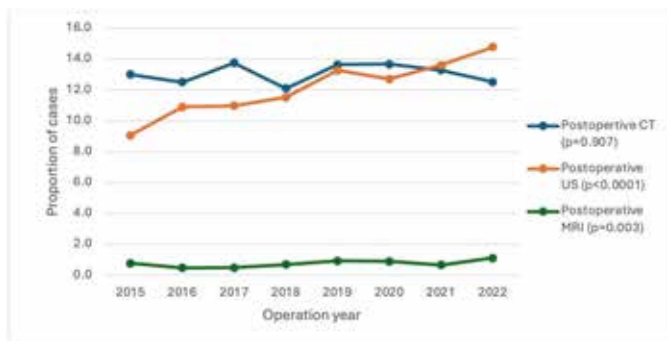


Figure: Frequency of post-operative imaging in patients with complicated appendicitis.

Q14

PROTEOMICS-BASED ANALYSIS OF WILMS TUMOR PATIENT-DERIVED XENOGRRAFT TUMOR CELL CONDITIONS IDENTIFIES INTACT TUMOR MICROENVIRONMENT IS CRITICAL TO TUMOR GROWTH

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Abstract: Purpose: We previously observed that intact tumor chunks exhibited a high Wilms tumor patient-derived xenograft (WTPDX) engraftment rate (>70%), while single cells and tumor-derived spheroids from identical tumor chunks did not reliably engraft. This observation suggests that cell-cell/cell-extracellular matrix (ECM) contacts are critical to WTPDX cell survival and targeting critical mediators of cell contacts may be a novel therapeutic strategy. This analysis characterized differential protein expression between WTPDX tumor cell conditions to identify critical proteins and pathways altered by mechanical disruption.

Methods: Six different WTPDX were studied (3 diffuse anaplastic, 3 favorable histology). Triplicates of each xenograft in different conditions (whole tumor chunk, single cells (SC) after mechanical dissociation, and tumor-derived spheroids) underwent tandem mass tag (TMT)-based quantitative proteomic analysis (Figure 1A). Principal component analysis (PCA) and differential expression analyses were performed. Enrichment analysis was performed using top 100 differential proteins between conditions for each WTPDX (using false discovery rate $q < 0.05$) using Gene Ontology (GO) Biological Process 2023 pathways.

Results: A total of 8,067 common proteins were identified and quantified across all WTPDX/condition samples. Log2 intensities were normally distributed and triplicates within each WTPDX-condition group were highly correlated. On PCA, samples clustered together by WTPDX. APOC3 and acute phase reactants albumin (ALB), serotransferrin (TF), and hemopexin (HPX) were enriched in SC after mechanical dissociation and again in formation of spheroids. CADPS2, BCR/ABL, MYH4, RASS43 were increased in tumor chunks over SC and spheroids (Figure 1B-C). Upon enrichment analysis, collagen fibril organization and ECM organization were the most frequently changed pathways between chunks to SC, with small leucine-rich proteoglycans DPT and LUM frequently implicated. Cytoplasmic translation (i.e. RPS/RPL family proteins), negative regulation of blood coagulation (i.e. PLAUI, F2, PLG, KNG1), and chromatin/chromosomal organization (i.e. histone H1 family proteins) were the most frequently altered pathways between SC and spheroids.

Conclusions: This proteomic approach identified collagen fibril and extracellular matrix organization, leucine-rich proteoglycans, cytoplasmic translation, and chromatin organization as candidate pathways supporting Wilms tumor cell survival that are disrupted by tumor dissociation. These pathways may represent new therapeutic targets and avenues to further optimize in vivo model generation capabilities.

Abbreviations: WTPDX: Wilms tumor patient-derived xenograft
ECM: extracellular matrix

SC: single cells
TMT: tandem mass tag
PCA: principal component analysis
GO: gene ontology

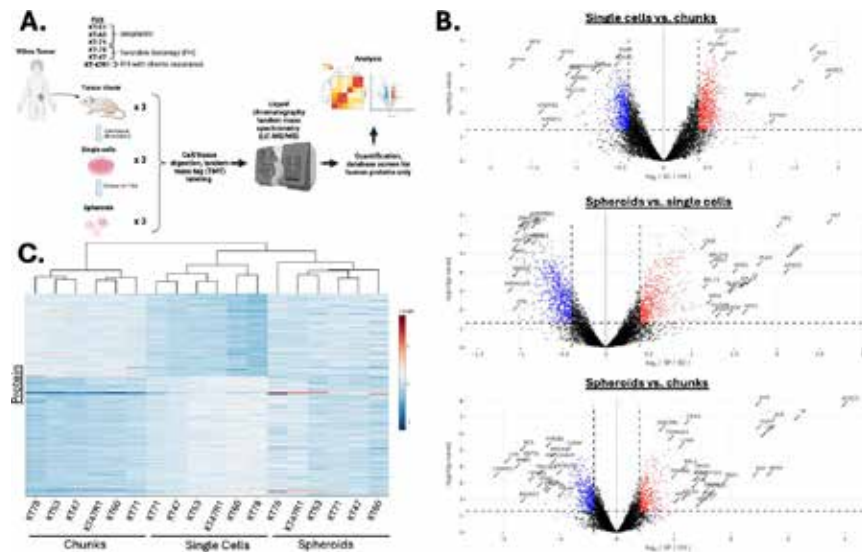


Figure 1. A: Experimental design flowchart, three conditions of 6 different Wilms Tumor patient-derived xenografts (WTPDX) were analyzed via liquid chromatography tandem mass spectrometry (LC-MS/MS) with technical triplicates for each condition of each WTPDX (image created with Biorender.com). B: Volcano plots of aggregate differential proteins (\log_2 fold change ≥ 0.4 and $p < 0.05$) between single cells and chunks (SC/CH, top), spheroids and single cells (SP/SC, middle), and spheroids and chunks (SP/CH, bottom), with key proteins labeled. C: Heatmap of all differential proteins (\log_2 fold change ≥ 0.4 and $q < 0.05$) between chunks and single cells with hierarchical clustering dendrogram by samples.

Q15

TRANSCRIPTOMICS WITHIN SILICO CELL MAPPING HIGHLIGHTS TRANSCRIPTION FACTOR AP-2 (TFAP2A/C) ABERRATIONS IN PEDIATRIC CROHN'S BOWEL

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Abstract: Purpose:

Some children with Crohn's disease develop severe fibrostenotic disease requiring surgery, and the etiology and pathophysiology of Crohn's disease is not yet understood. Using a pan-Canadian surgical biobank for pediatric Crohn's disease, we analyzed gene expression in bowel, fat, and lymph nodes to compare and characterize genes and Reactome pathways upregulated in severe pediatric Crohn's inflammation.

Methods:

Full thickness inflamed and non-inflamed bowel, inflamed/creeping and non-inflamed fat, and lymph nodes were collected intraoperatively from children undergoing elective resection for non-perforated Crohn's disease at 10 children's hospitals in Canada. RNA was extracted and sequenced from 10 patients and then analyzed using a random forest model for unsupervised hierarchical clustering and Reactome pathway analysis via Enrichr. Identified differentially expressed gene sets were then mapped onto cell types using the Crohn's disease single cell RNA sequencing component of the pediatric Human Gut Cell Atlas.

Results:

Bulk RNA sequencing comparing tissues from each patient demonstrated significant differences in gene expression between inflamed and non-inflamed bowel but no differences between inflamed and non-inflamed fat. While the majority of differentially expressed genes in inflamed bowel vs non-inflamed bowel were found in the enterocytes, the subset of genes identified via Reactome pathway analysis were predominantly expressed in non-enterocyte cells.

The most significant Reactome pathway we identified in the inflamed bowel was "TFAP2 (AP-2) Family Regulates Transcription of Cell Cycle Factors R-HSA-8866911." Other significant pathways involved cell cycle modulation, chondroitin sulfate homeostasis, and antiviral/antimicrobial responses. Each pathway tended to involve at least one gene strongly expressed in fibroblasts.

Conclusion:

We conclude that differential gene expression in pediatric Crohn's bowel inflammation may be driven primarily by dysregulation of anti-inflammatory pathways in non-enterocyte cells. We found no differences in gene expression between inflamed and non-inflamed fat, which suggests that the changes leading to the formation of creeping fat may be secondary to pathophysiological changes in the adjacent bowel rather than in the fat itself.

Abbreviations: TFAP2: Transcription Factor Activating enhancer binding Protein 2

Q16

A NOVEL VIRTUAL GUT MODEL: ANTICIPATING GLUCOSE ABSORPTION RATE WITH CHANGING SMALL BOWEL ANATOMY

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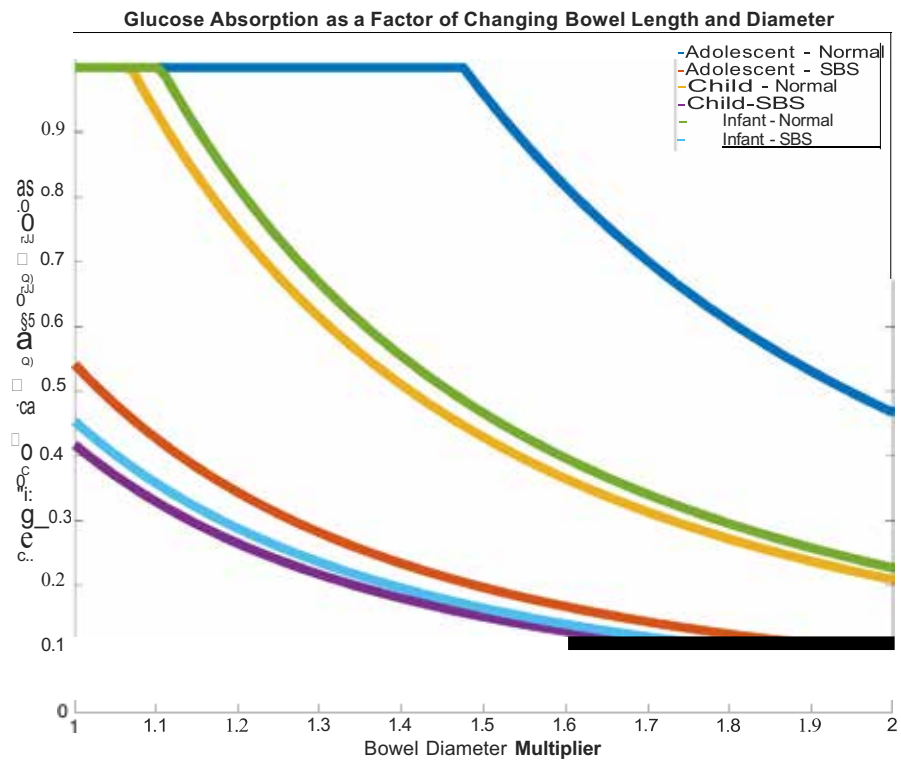
Abstract: Purpose: Studying the impact of surgical intervention on nutrient absorption in short bowel syndrome (SBS) is challenging due to disease rarity. Animal models are expensive, time consuming, and don't truly mimic SBS physiology in humans. Our goal was to create a virtual gut model using known physiologic parameters to predict nutrient absorption with changing bowel length and diameter.

Methods: We began with extensive literature review, gathering data on age-specific bowel diameter, length, glucose absorption, transit time, villi function, and peristalsis. We created n-section and analytic models in Matlab. Bolus movement is modeled using the Darcy-Weisbach equation. Using standardized small bowel dimensions, glucose absorption was calculated in the average adolescent, 2-year-old, and neonate. Bowel length was decreased to model SBS and bowel diameter adjusted up to 2-times normal to model maladaptive dilation. Our analytic model predicts the absorption(abs) in terms of bowel diameter(Db) and bowel length(Lb) as $abs \propto (Lb^{(3/2)})(Db^{(5/2)})$.

Results: Based on literature review, bowel diameter, length, and SBS length were set at the following for an adolescent, 2-year-old, and neonate, respectively: 23mm,575cm,200cm; 21mm,350cm,175cm; 12mm,250cm,125cm. Absorption was estimated at 80 mmol/hour/25cm with a 140mM glucose bolus. Bolus size for age was based on the volume of an average supplement drink, juice box, and bottle respectively. Glucose absorption was 100% in all age categories with normal bowel dimensions. At full length, adolescent absorption remained 100% until 1.5x normal bowel diameter. Child and neonate absorption declined between 1.05-1.1x diameter(Figure 1). In SBS and no dilation, absorption was 54%(adolescent), 42%(child), and 45%(neonate). This drops off rapidly with dilation following a negative exponential curve. Unlike full-length bowel, SBS bowel showed no plateau of maintained absorption percentage with dilation.

Conclusion: We have created a reasonable virtual gut model to predict changes in nutrient absorption as bowel diameter and length change. Our model suggests that neonates and children with SBS are highly susceptible to malabsorption with even a low degree of dilation. Autologous reconstruction may be of benefit sooner than it is typically offered. We hope this platform will allow future testing of differing surgical interventions to help optimize both the procedure and intervention timing.

Abbreviations: SBS: Short bowel syndrome



Q17

UNBIASED PLASMA PROTEOMICS AND PRINCIPAL COMPONENT ANALYSIS IDENTIFIES CANDIDATE BIOMARKERS TO DISTINGUISH INJURY SEVERITY AND TYPE IN CHILDREN

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Abstract: Purpose

Avoiding undertriage and missed injuries in pediatric blunt trauma while minimizing unnecessary transfers and imaging studies remains challenging. We aimed to determine if there are differences in circulating proteins following blunt trauma in children which can be further investigated as biomarkers of injury for rapid triage and diagnosis, hypothesizing that protein expression would be different by injury severity and type.

Methods

An IRB-approved, single-institution prospective study was performed 6/2023–1/2024. Blood samples obtained during trauma resuscitation from children < 18 years old were processed to plasma. Age- and sex-matched uninjured control plasma was obtained and follow-up samples obtained from enrolled patients when possible. The Olink Explore HT panel quantitatively assayed 5420 proteins. Principal component analysis (PCA) revealed separation between study groups. Volcano plot identified candidate biomarkers associated with injury overall and by injury severity and type using injury severity score (ISS) and abbreviated injury scale (AIS). ANOVA testing with Benjamini-Hochberg correction and Tukey's method for multiple comparisons tested protein expression for the top six altered proteins among injured patients overall and for each subgroup against control groups.

Results

We enrolled 21 patients with median (IQR) age of 14 (12-16) years including 3 infants, 36% female, and median ISS 11 (5-17). Polytrauma occurred in 9 patients (41%). All survived to discharge. Volcano plot identified 795 proteins altered among injured patients vs controls (all $p < .05$). PCA found distinct circulating protein signatures by injury type and severity. HNMT, AHNAK2, TPPP3, BDH2, CRIP2 had elevated expression in all injured patients vs controls and returned to baseline when follow-up levels assessed (all $p < .05$). This persisted for ENAH and CRIP2 in patients with $ISS \geq 10$ vs controls and vs those with $ISS < 10$. Candidate biomarkers for specific injury types were elevated in affected patients vs controls and vs those with other injuries (all $p < .05$; Figure – abdomen).

Conclusion

These data identify candidate circulating protein biomarkers for injury in pediatric blunt trauma which require further investigation in larger studies as triage tools. Candidate biomarkers for abdominal and other types of injuries require further investigation as diagnostic tools to direct subsequent imaging and care.

Abbreviations: ANOVA = analysis of variance
HNMT = Histamine N-methyltransferase

AHNAK2 = Protein AHNAK2

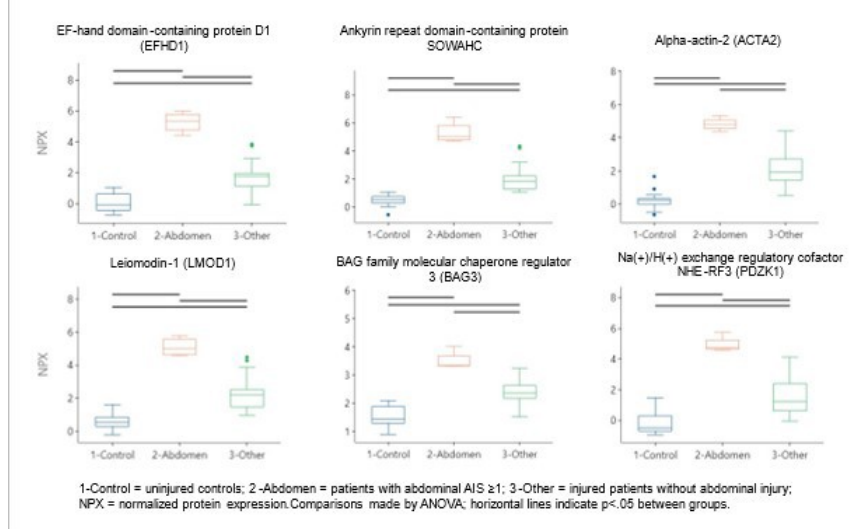
TPPP3 = Tubulin polymerization-promoting protein family member 3

BDH2 = Dehydrogenase/reductase SDR family member 6

CRIP2 = Cysteine-rich protein 2

ENAH = Protein enabled homolog

Figure: Top significantly altered proteins in children with blunt abdominal injuries



Q18

IMPACT OF HYPERGLYCEMIA ON SKELETAL MYOBLASTS: IMPLICATIONS FOR NEURAL TUBE DEFECTS ASSOCIATED WITH MATERNAL DIABETES

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Abstract: Purpose: Neural tube defects (NTDs) are the second most common congenital anomaly, with sacral agenesis – a disruption of the caudal neural tube and hypoplastic gluteal muscles – occurring 200 times more frequently in infants of diabetic mothers. Previous research has identified a population of neural tube-derived myogenic cells and highlighted the role of neural crest signaling in myogenic differentiation, suggesting shared regulatory networks between the two lineages. However, the role of skeletal myoblasts in NTDs has not been previously studied. We hypothesize that maternal hyperglycemia impacts neural tube development by upregulating retinoic acid pathway and interfering with myoblast maturation.

Methods: Female CD1 mice were injected intraperitoneally with streptozotocin (75 mg/kg) for three consecutive days, and mating occurred when fasting blood glucose reached ≥ 300 mg/dL. Murine myoblasts, C2C12 cells, were cultured in high (25 mM), moderate (15 mM), low (5 mM) glucose to measure the rate of proliferation. Gene expression in the retinoic acid signaling pathway was analyzed using RT-qPCR. Similarly, murine neural crest cells, O9-1 cells, were cultured under high and low glucose conditions, and their migration rate was assessed using a wound-scratch assay.

Results: The incidence of NTDs was increased in offspring born to diabetic mothers (12%), compared to 0% in non-diabetic mothers. Myoblasts cultured in high glucose showed higher rate of proliferation (30-fold increase in cell number), compared to only a 5-fold increase in low glucose condition ($p < 0.05$). Hyperglycemia led to increased level of RXR α mRNA, an important retinoic acid receptor in myoblasts (3-fold). Downstream effector molecules including Hoxa1 (1.5-fold), and Hoxb1 (7-fold) were also increased. Wnt5a, a molecule usually repressed by retinoic acid signaling, decreased by 2-fold ($p < 0.05$). In contrast, hyperglycemia had no effect on neural crest cell migration in vitro as evidenced by 95- and 97% re-population of wound in low and high glucose conditions respectively.

Conclusion: Hyperglycemia increases proliferation and retinoic acid signaling in skeletal myoblasts both of which may lead to reduced myoblast differentiation. Hyperglycemia has no effect on neural crest cell migration in vitro, suggesting that skeletal progenitors may be the target cells involved in maternal diabetes-related neural tube defects.

Abbreviations: NTDs - Neural tube defects

Q19

THE ROLE OF PHARMACOGENOMICS AND OPIOID PRESCRIBING FOR INFANTS WITH SURGICAL CONGENITAL HEART DISEASE: A SINGLE-CENTER PILOT STUDY

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Abstract: Purpose: Pharmacogenomic variants influence opioid metabolism and reward pathways and may contribute to pain response and risk of opioid dependence. Infants undergoing surgery receive opioids as part of routine care, and prolonged exposure can impact short-term health outcomes and long-term neurodevelopment. Therefore, pharmacogenomic variation could significantly impact early childhood neurodevelopment and may be key to understanding gene-opioid-brain interactions. In this pilot study, we evaluated the relationship between pharmacogenomic variants and cumulative opioid utilization in infants undergoing surgery for congenital heart disease (CHD).

Methods: This retrospective cohort study was conducted at a quaternary children's hospital from 2009-2020. We identified infants < 1y who underwent CHD surgery who had exome sequencing as part of their routine clinical care. Pharmacogenomic variants in genes associated with opioid metabolism and altered reward/pain pathways were evaluated (COMT, DRD2/ANKK1, ABCB1, OPRM1, CYP2B6 and CYP2D6). For each hospitalization, total cumulative morphine milliequivalents (MMEs) prescribed were calculated and median MMEs corresponding with each pharmacogenomic variant were analyzed. Kruskal-Wallis tests were utilized.

Results: Overall, 48 infants were identified (54.2% male, 47.9% Hispanic/Latino, 6.3% preterm). A majority (n=34, 70.8%) underwent open CHD surgery, with the remaining undergoing a minimally invasive CHD procedure. Forty infants (83%) were homozygous for at least one pharmacogenomic variant impacting opioid metabolism and/or pain response. Infants who underwent open CHD surgery and were homozygous for pharmacogenomic variants in OPRM1: rs1799971, COMT: rs4633, rs4680, and ABCB1:rs1045642 required increased cumulative MMEs compared with wild type (Table). Infants who underwent minimally invasive CHD surgery and were homozygous for variants in ABCB1: rs1045642 also required increasing cumulative MMEs compared with wild type. When examining CYP2B6 and CYP2D6 metabolizer phenotypes, no clear relationship with cumulative MMEs was observed.

Conclusion: A majority of infants undergoing CHD surgery who had clinical exome sequencing were homozygous for pharmacogenomic variants that affect opioid metabolism and pain/reward pathways. Additionally, a unidirectional trend based on genotype was observed, with homozygous variants receiving increased morphine milliequivalents during hospitalization. Routine reporting of pharmacogenomic variations could inform future innovation to leverage precision medicine to bolster opioid stewardship efforts.

Abbreviations: CHD: Congenital Heart Disease
MME: Morphine Milliequivalents

Table: Pharmacogenomic variant prevalence for infants undergoing open CHD surgery and median cumulative morphine milliequivalents (MMEs) during hospitalization

Pharmacogenomic Variants	Alleles	Open CHD surgery (n = 34)	MMEs median, (IQR)	p-value
CO/1FT: rs1633	wild type	10 (29.4%)	192.1 (71.8-516.3)	0.383
	heterozygous	18 (52.9%)	357.4 (25.0-3559.7)	
	homozygous variant	6 (17.6%)	843.4 (386.8-1251.0)	
CO/1FT: rs1680	wild type	9 (26.4%)	218.6 (159.3-516.3)	0.311
	heterozygous	18 (52.9%)	219.4 (25.0-2034.2)	
	homozygous variant	7 (20.5%)	998.3 (386.8-7042.9)	
ABCB1: rs104562	wild type	8 (23.5%)	151.4 (11.7-703.1)	0.184
	heterozygous	10 (29.4%)	307.3 (21.8-958.3)	
	homozygous variant	16 (47.1%)	690 (153.8-8022.9)	

Q20

DISPARITIES IN OUTCOMES AFTER PRESENTATION FOR COMPLICATED APPENDICITIS IN PEDIATRIC PATIENTS

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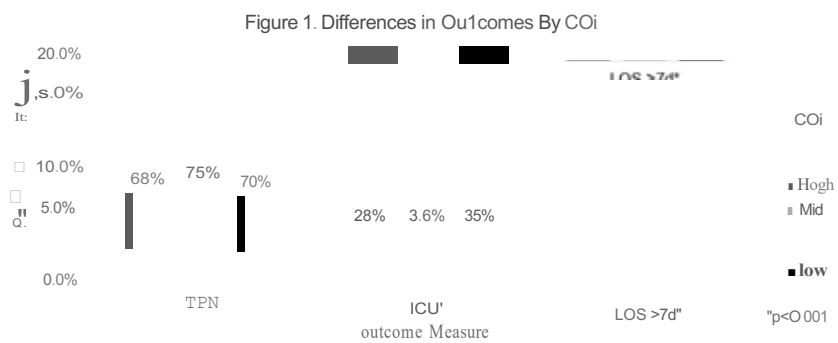
Abstract: Background: Previous reports demonstrate social determinants of health (SDoH) contribute to delayed presentation of appendicitis in children. Child Opportunity Index (COI), a composite marker of SDoH, integrates economic, social, environmental, educational, and health factors associated with a child's neighborhood. Characterization of inpatient outcomes for complicated appendicitis and their relationship to COI is not understood. The aim of this study is to characterize pediatric patient outcomes following complicated appendicitis admission by COI.

Methods: Using the Pediatric Health Information System and COI, we identified patients less than 18 years old with complicated appendicitis admitted between 2017-2022. COI was categorized into low, mid and high and inpatient outcomes including length of stay (LOS), total parental nutrition (TPN) use, and intensive care unit (ICU) admission were compared using chi-squared analysis. Inpatient outcomes were additionally analyzed with a multivariable logistic regression adjusted for age, race, payor, complex chronic condition, COI, and urban-rural classification.

Results: A total of 40,965 patients were identified with complicated appendicitis. A majority were male (60%), White (61%), and lived in urban settings (88%). The average age was 9.7 years old (SD 4.1). Most patients had low COI (n=19,709; 48%), followed by high COI (n=14,064; 34%), and least often mid COI (n=7,192; 18%). Patients from low and mid COI were more likely to have a longer average LOS in days (High: 4.9±6.9, Mid: 5.2±5.6, Low: 5.4±7.2, p< 0.001), utilize TPN (High 6.8%, Mid: 7.5%, Low: 7.0%, p=0.11) and ICU admission (High: 2.8%, Mid: 3.6%, Low: 3.5%, p< 0.001) than patients from high COI (Figure 1). On adjusted analysis, low COI was a predictor of longer LOS (≥7days) (aOR 1.011 95% CI 1.002-1.019, p=0.02) and ICU admission (aOR 1.005, 95% CI 1.001-1.009, p=0.02) when compared to patients with high COI. Utilization of TPN was not different across COI on adjusted analysis.

Conclusions: For children with complicated appendicitis, those with lower COI have longer LOS and more ICU admissions. SDoH have an impact on both prehospital and inpatient outcomes. Efforts in both inpatient and outpatient contexts are needed to reduce healthcare utilization and improve outcomes for vulnerable populations with complicated appendicitis.

Abbreviations: COI - Child Opportunity index; SDoH - Social Determinants of Health; ICU - Intensive care unit; LOS - Length of stay; TPN - total parental nutrition



Q21

CHILDREN TRANSFERRED FROM NON-NATIONAL SURGICAL QUALITY IMPROVEMENT PROGRAM-PEDIATRIC HOSPITALS REQUIRE HIGH RATES OF CROSS-SECTIONAL IMAGING TO DIAGNOSE APPENDICITIS

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Abstract: Purpose: Despite ultrasound (US) and magnetic resonance imaging (MRI) based protocols at many centers, our experience with transfers from outside hospitals (OSH) is that there is a high rate of failure to identify the appendix on US, which leads to additional cross-sectional imaging (computed tomography [CT] and MRI). We hypothesize that this is due to inexperience among OSH ultrasound technicians due to the low volume of pediatric patients seen at these hospitals. To address this issue, we are developing a novel tool to improve identification of the pediatric appendix on US by less experienced technicians, but first we aim to quantify the nationwide variation in additional imaging requirements between high and low volume centers during the evaluation of pediatric appendicitis using National Surgical Quality Improvement Program-Pediatric (NSQIP-P) verification as a proxy.

Methods: This is comparative analysis included children aged 4-17 years who underwent an ultrasound as part of an evaluation for appendicitis in the American College of Surgeons NSQIP-P database from 2015-2022. Children were grouped based on whether their initial ultrasound was at an outside hospital (OSH) or a NSQIP-P hospital. Rates of additional imaging between groups were compared. Logistic regression modeling was performed to account for age, sex, body mass index, and severity of disease (white blood cell count).

Results: Of the 79,995 children who met criteria, 20,746 (25.9%) were initially evaluated at an OSH. Children who underwent an ultrasound at an OSH were significantly more likely to undergo additional cross-sectional imaging than those receiving all of their imaging at a NSQIP-P center (52.2% vs 20.7%, $p < 0.001$). Furthermore, 50.2% of this additional imaging was performed prior to transfer. After adjustment, patients evaluated initially at an OSH were still significantly more likely to receive additional imaging (adjusted odds ratio: 4.46, 95% confidence interval: 4.31-4.62).

Conclusion: Children evaluated for appendicitis at non-NSQIP-P hospitals were over 4 times more likely to require additional imaging, leading to increased exposure to ionizing radiation and increased costs. Tools to improve the US identification of the pediatric appendix at lower-volume centers are needed.

Abbreviations: US - ultrasound. MRI - magnetic resonance imaging. CT - computed tomography. NSQIP-P- National Surgical Quality Improvement Program-Pediatric. OSH - outside hospital.

Figure: Breakdown of children 4-17 years old who underwent an ultrasound during the diagnosis of appendicitis at either a National Surgical Quality Improvement Project-Pediatric(NSQIP-P) Hospital or prior to transfer based on type of additional imaging obtained. OSH-outside hospital. CT-computed tomography. MRI-magnetic resonance imaging. US-ultrasound.

<u>Total Cohort: 79,995</u>		
Work-Up Location		
<u>OSH: 20,746 (25.9%)</u>		<u>NSQIP-P: 59,249 (74.1%)</u>
Imaging Before Transfer	Imaging After Transfer	Imaging in Addition to US
<u>CT: 5,246 (25.3%)</u>	US: 4,471 (21.6%)	<u>CT: 10,766 (18.2%)</u>
<u>MRI: 193 (0.9%)</u>	CT: 1,146 (5.5%)	<u>MRI: 1,550 (2.6%)</u>
	MRI: 503 (2.4%)	

Q22

PRE-OPERATIVE FACTORS INFLUENCING NEGATIVE APPENDECTOMY: A RETROSPECTIVE ANALYSIS OF CLINICAL CHARACTERISTICS, IMAGING AND ADMISSION PATHWAYS USING A NATIONAL DATABASE

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Abstract: Purpose:

A normal appendix on pathology after appendectomy for suspected appendicitis, known as a 'negative appendectomy' is a potential outcome of surgical management of acute appendicitis. While the overall incidence has decreased with increasing usage of preoperative scoring systems and imaging, the risk is not completely avoidable. Therefore, we utilized national data to identify preoperative risk factors for a negative appendectomy to aid in clinical decision making.

Methods:

We used National Surgical Quality Improvement Program-Pediatrics (NSQIP-P) to identify patients < 18 years who underwent an appendectomy for suspected acute appendicitis from 2016 to 2022. Patient with other indications for appendectomy or missing pathology were excluded. Patients with 'normal' pathology (negative appendectomy) were compared to patients with positive pathology. Differences were assessed with X2, Fisher's exact, and T-tests. Regression analysis identified risk factors for negative appendectomy.

Results:

A total of 126,631 appendectomies were performed for suspected acute appendicitis with 2,971 (2.3%) confirmed as negative appendectomies on pathology. Negative appendectomy patients, compared to positive, were slightly younger (10.6 yr vs 11.2 yr, $p < 0.001$), more often female (48.5% vs 39.5%, $p < 0.001$), more likely to undergo surgery without imaging (5.1% vs. 2.2%, $p < 0.001$) or be directly admitted from home/clinic (6.5% vs. 4.8%, $p < 0.001$), and were less likely to exhibit SIRS/Sepsis (34.2% vs 51.9%, $p < 0.001$) and have a lower WBC (11.5 vs 15.1, $p < 0.001$). On regression analysis, female sex (OR 1.42), no imaging versus ultrasound (OR 1.96) and direct admission from home/clinic versus through the Emergency Department (OR 1.37) all increased the odds of negative appendectomy. Increasing age and WBC, preoperative SIRS/Sepsis, and CT compared to US decreased odds of negative appendectomy (Table 1).

Conclusion:

Our analysis interrogates the influence of patient characteristics and preoperative evaluation pathways on negative appendectomy. Younger patients and female patients have increased odds; however these variables are non-modifiable. Modifiable factors included direct admission from home/clinic, bypassing emergency providers, who may have a wider differential, and more clinical experience with non-surgical abdominal pain; and forgoing ultrasound which doubled the odds of negative appendectomy. These findings suggest opportunities to minimize potential surgical morbidity through optimizing the preoperative workup of suspected appendicitis.

Abbreviations: National Surgical Quality Improvement Program-Pediatrics (NSQIP-P); Systemic Inflammatory Response Syndrome (SIRS); White Blood Cell (WBC); Computed Tomography (CT);

Ultrasound (US)

Table 1: Linear Regression of Factors Influencing Negative Appendectomy

Negative Appendectomy	Odds Ratio (95% CI)	p-value
Age in Years	0.945 (0.930 – 0.961)	<0.001
Female Sex	1.424 (1.271 – 1.597)	<0.001
Preoperative SIRS, Sepsis, Shock	0.715 (0.629 – 0.813)	<0.001
WBC	0.875 (0.863 – 0.887)	<0.001
Imaging		<0.001
Ultrasound	1 (Reference)	
CT	0.775 (0.686 – 0.874)	<0.001
MRI	0.773 (0.544 – 1.091)	0.143
No imaging	1.955 (1.365 – 2.799)	<0.001
Admission Location*		<0.001
ER	1 (Reference)	
Home/Clinic	1.374 (1.168 – 1.615)	<0.001
Outside Hospital Admission	0.757 (0.552 – 1.037)	0.083

*Admission categories changed in 2022: Regression data for Admission was 2016-2021

Q24

WHAT'S BREWING IN PERFORATED APPENDICITIS? A 7-YEAR SINGLE-CENTER RETROSPECTIVE STUDY

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Abstract: Background: Complicated appendicitis is the leading cause of intra-abdominal contamination in children, but the contribution of individual microbes to postoperative organ-space infections (OSI) remains unclear. Our purpose was to examine the bacteriology and antibiotic susceptibility of pediatric perforated appendicitis, with focus on patients who develop OSI post-appendectomy. We hypothesized that organisms with antibiotic resistance would confer an increased risk of OSI after surgery.

Methods: After IRB approval, we performed a retrospective cohort study including all pediatric patients (age < 18y) who underwent appendectomy for perforated appendicitis (1/2016-12/2023). Patients were identified using our institutional NSQIP-Pediatric dataset; gram stain, culture, and antibiotic sensitivity data were extracted from the electronic medical record. Chi-square was used to understand contributions from each microbe to OSI development. Results are presented as odds ratios (OR [95% confidence interval], Number Needed to Treat (NNT).

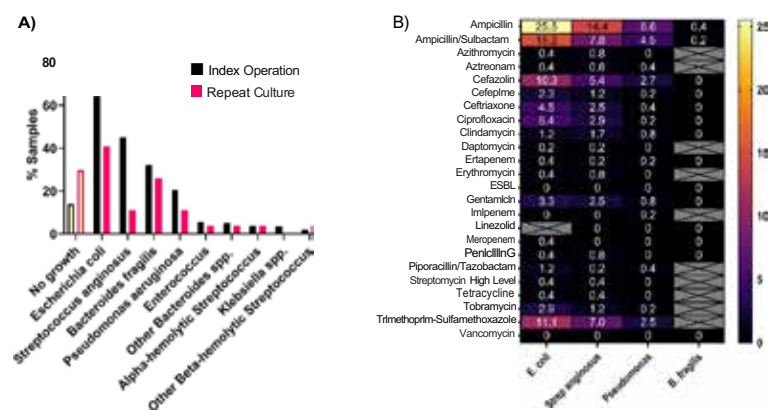
Results: Culture data were available for 35.8% (239) of the 667 patients who underwent appendectomy for complicated appendicitis. *Escherichia coli*, *Streptococcus anginosus*, *Bacteroides fragilis*, and *Pseudomonas* species were most commonly identified on index cultures (Figure 1A) and 13.8% (33) had neither bacteria on gram stain, nor culture growth. *E. coli* and *Strep. anginosus* exhibited frequent antibiotic resistance, most commonly to ampicillin, ampicillin-sulbactam, trimethoprim-sulfamethoxazole, and cefazolin (Figure 1B). In contrast, 6.6% of *Pseudomonas* species and < 1% of *B. fragilis* had documented antibiotic resistance (Figure 1B).

Patients with *B. fragilis* (2.15 [0.95-4.71]; NNT 12.1, p=0.030) and those with antibiotic resistant *E. coli* (2.38 [1.08-5.33]; NNT 10.7, p=0.016) were significantly more likely to develop an OSI. The presence of *E. coli* (2.12 [0.87-5.26]; NNT 14.8, p=0.057), *Strep. anginosus* (1.60 [0.75-3.66]; NNT 21.2, p=0.125) or *Pseudomonas* species (1.12 [0.44-2.84]; NNT 83.9, p=0.407) on index cultures did not increase the odds of developing an OSI.

Conclusions: Resistance to commonly prescribed antibiotics is frequent. This study demonstrates that *B. fragilis* and antibiotic-resistant *E. coli* strains in pediatric complicated appendicitis are associated with postoperative OSI, while *Strep. anginosus* and *Pseudomonas* species did not confer increased risk. These findings support more targeted antimicrobial strategies, reducing overtreatment while ensuring infection control.

Abbreviations: OSI (organ space infections), NNT (number needed to treat).

Figure 1. A) Percent of samples positive for each microbe. Index cultures are shown with black bars and repeat cultures from a second procedure are shown in pink. B) Percent of isolated bacteria with antibiotic resistance from the index operation.



Thursday, May 8, 2025

Quickshot 3 - Neonatal

3:00 PM – 3:45 PM

Q25

EARLY CARDIOPULMONARY RESUSCITATION AMONG INFANTS WITH CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose

Congenital diaphragmatic hernia (CDH) often presents as hypoxemia, hypercarbia, and acidosis after birth, indicated by low Apgar scores, potentially requiring early cardiopulmonary resuscitation (CPR). There is a paucity of data about the patient characteristics, risks, and outcomes associated with early resuscitative efforts for infants with CDH. This study aims to review morbidity and mortality outcomes among CDH patients who receive early postnatal CPR.

Methods

Using the CDH study group registry, patients born between 2007-2020 were selected. Demographics, early resuscitative events, and postnatal variables were prospectively collected and retrospectively analyzed. Non-parametric tests of comparisons, multivariable, and survival analyses were performed to analyze for outcomes of morbidity and mortality.

Results

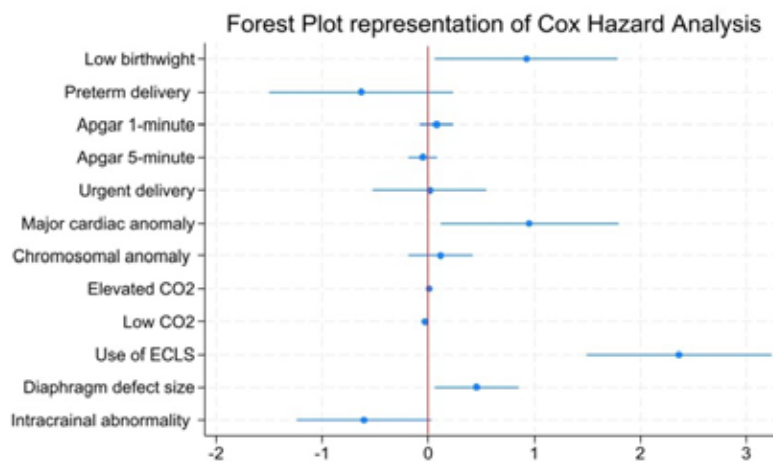
Of 7,164 patients included, 987 (13.8%) received CPR (CPR+) in the delivery room. Comparing CPR+ with CPR-, the median birth weight was 2.9 kg vs 3.0 kg ($p \leq 0.001$), 35.2% were delivered < 37 weeks gestational age vs 21.9% ($p \leq 0.001$), and both Apgar 1- and 5-minute scores were lower (2.5 and 5 vs 5 and 7, $p \leq 0.001$, respectively). The CPR+ cohort had more major cardiac anomalies (11.1% vs 7.1%, $p = 0.001$) and utilized ELCS more often (32.8% vs 28.3%, $p = 0.004$). There was no difference in chromosomal anomalies (8.7% vs 7.1%, $p = 0.16$). Only 68.4% CPR+ underwent diaphragm repair, compared to 87.3% CPR- ($p \leq 0.001$), and CPR+ had a higher proportion of larger defect sizes (60.0% C/D vs 46.3%, $p \leq 0.001$). Additionally, those who received CPR had higher rates of abnormal brain imaging (27.4% vs 23.4%, $p = 0.03$). The overall survival was lower for CPR+ (53.3% vs 76.1%, $p \leq 0.001$), with median time to death 3 vs 14 days ($p \leq 0.001$). In a multivariable regression, preterm delivery, low Apgar score, prenatal CDH diagnosis, and urgent delivery (induced vaginal delivery or non-elective cesarean section) were all associated with CPR+. For the CPR+ cohort, mortality can then be anticipated by a few key variables (Figure).

Conclusion

CDH patients requiring CPR shortly after delivery are at risk for significantly higher morbidity and mortality. These findings underscore the challenges faced by this vulnerable population yet highlight the potential for survival and offers opportunities for improved counseling strategies for caregivers and families.

Abbreviations: Congenital diaphragmatic hernia = CDH
cardiopulmonary resuscitation = CPR
received CPR = CPR+
did not receive CPR = CPR-
extracorporeal life support = ELCS

Forest Plot represents the Cox Hazard Analysis for survival among those who received CPR shortly after delivery. Mortality was associated with lower birthweight, major cardiac anomaly, ECLS treatment, and larger defect sizes.



Q26

DISPARITIES IN ACCESS TO NEONATAL AND PEDIATRIC ECMO SERVICES IN THE UNITED STATES

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Abstract: Purpose: This study investigates disparities in access to neonatal and pediatric extracorporeal membrane oxygenation (ECMO) across the United States.

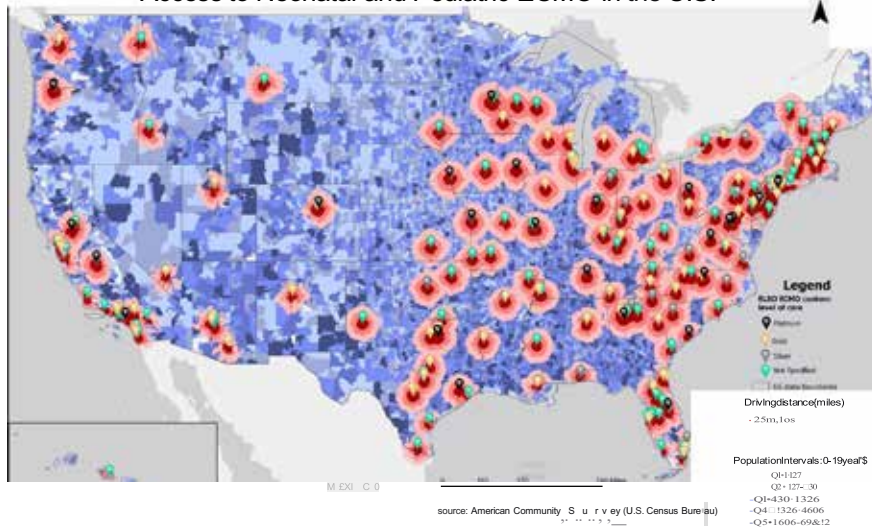
Methods: Data was extracted from the American Community Survey, a database managed by the U.S. Census Bureau. Extracorporeal Life Support Organization (ELSO) ECMO centers were stratified by 1) neonatal and pediatric capability and 2) platinum, gold, and silver ELSO Award of Excellence. Using ArcGIS, a secure mapping and spatial analysis platform, population densities of children aged 0-19 years were heat-mapped by ZIP code against locations of ECMO centers to identify coverage gaps. Driving radii (0-25 miles; 26-50 miles; 51-75 miles) and, separately, flying radii (0-25 miles; 26-50 miles; 51-75 miles; 76-100 miles; 100-125 miles) were calculated for each ECMO center and surrounding ZIP codes. Descriptive statistics and Chi-square tests examined differences in demographic and socioeconomic factors for ZIP codes with driving distance ≤50 vs. >50 miles to the closest ECMO center. Area Deprivation Index (ADI) for each ZIP code was calculated and compared for those ≤50 miles vs. >50 miles using the Wilcoxon rank-sum test.

Results: 224,234,017 people representing 68.1% of the U.S. pediatric population reside >50 miles from the nearest neonatal or pediatric ECMO center. The racial distribution of those living >50 vs. ≤50 miles is different with a lower proportion of Whites and African Americans residing >50 miles away ($p < .0001$). ZIP codes >50 miles have a lower median income (\$59,767 vs. \$62,066, $p < .0001$), higher proportion of "no education" (1.19% vs. 1.03%, $p < .0001$), higher poverty rate (12.90% vs. 12.41%, $p < .0001$), higher unemployment (2.90% vs. 2.70%, $p < .0001$), and are more likely to be rural (7180 vs. 650, $p < .0001$). ADI worsens with increasing distance from ECMO centers (60 vs. 56, $p < .0001$). Mapping shows more ZIP codes without proximity to ECMO services in western U.S.

Conclusion: Disparities exist in access to neonatal and pediatric ECMO in the U.S., predominantly affecting the rural population. For many, the obstacle of geographic distance may be compounded by additional disadvantages in income, education, and insurance. This suggests a need for strategic development of new ECMO centers and transport improvements to ensure equitable access to this life-saving treatment.

Abbreviations: ECMO=extracorporeal membrane oxygenation
ELSO=Extracorporeal Life Support Organization
ADI=Area Deprivation Index

Access to Neonatal and Pediatric ECMO in the U.S.



Q27

EARLY AND OFTEN: HEALTHCARE UTILIZATION IN CHILDREN WITH SURGICALLY TREATABLE CONGENITAL ANOMALIES

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Abstract: Purpose

Surgically treatable congenital anomalies (STCA) confer significant morbidity including high healthcare utilization, symptom burden, psychosocial difficulties, and numerous decision-making points for early, high-risk operative and procedural interventions. Pediatric palliative care (PPC) can facilitate goals of care/decision-making conversations and as such has great potential to improve the experiences of and outcomes for children with STCA and their families. We therefore examined the healthcare utilization of children with STCA and how this differed by sociodemographic and clinical factors as well as whether PPC was consulted and involved in the children's care.

Methods

We performed a retrospective review of infants with one of five STCA (congenital diaphragmatic hernia [CDH], tracheoesophageal fistula [TEF], gastroschisis, biliary atresia [BA], and intestinal atresias [IA]) enrolled from birth to 2 years old between 2016 and 2020 in Medicaid in 12 U.S. states participating in the Merative MarketScan database from Medicaid. Healthcare utilization included inpatient stays, outpatient and emergency visits, pharmacy encounters, and surgical interventions (SI), and were summed to determine total healthcare days (HD). PPC consultation was also assessed. Multivariable log-normal models assessed patient factors (including complex chronic conditions [CCC]) associated with total HD.

Results

The cohort included 925 children (30% non-White, 45% female, and 79% with at least two other CCC) who underwent a median of 6 SI and had 77 HD during the two-year follow up period. Patients with BA and TEF had the highest utilization burden (median 93 HD and 85 HD, respectively; $p=0.003$). Those with TEF, gastroschisis, and IA had the highest intervention burden (median 7 SI) ($p=0.009$). More CCC (≥ 3) was associated with greater HD for all conditions ($p<.001$). PPC consultation was rare (1.8%), but greatest in CDH (4%). Figure 1 demonstrates the distribution of HD over time by STCA type.

Conclusion

We conclude that children with STCA, especially those conditions with greater medical complexity, have significant healthcare utilization including numerous surgical interventions. PPC consultation occurs for few patients. Given the clinical and psychosocial implications of frequent decision making and medicalization for these patients, greater PPC engagement should be investigated.

Abbreviations: BA: biliary atresia

CCC: complex chronic conditions

CDH: congenital diaphragmatic hernia

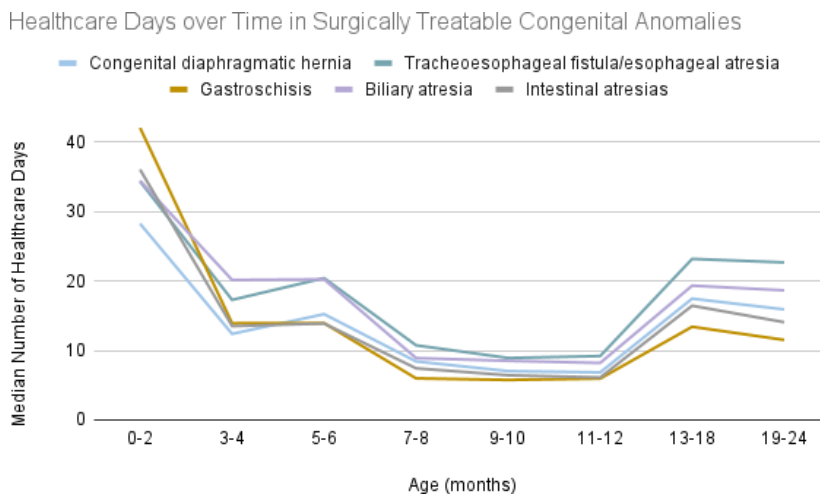
HD: healthcare days

IA: intestinal atresias

PPC: pediatric palliative care

SI: surgical interventions

STCA: surgically treatable congenital anomalies
TEF: tracheoesophageal fistula



Q28

SOCIAL INEQUITIES IN PEDIATRIC ECMO OUTCOMES: ROLE OF THE CHILD OPPORTUNITY INDEX

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Abstract: Purpose: To investigate if social determinants of health (SDoH) as measured by the Child Opportunity Index (COI) are associated with one-year pediatric extracorporeal membrane oxygenation (ECMO) outcomes.

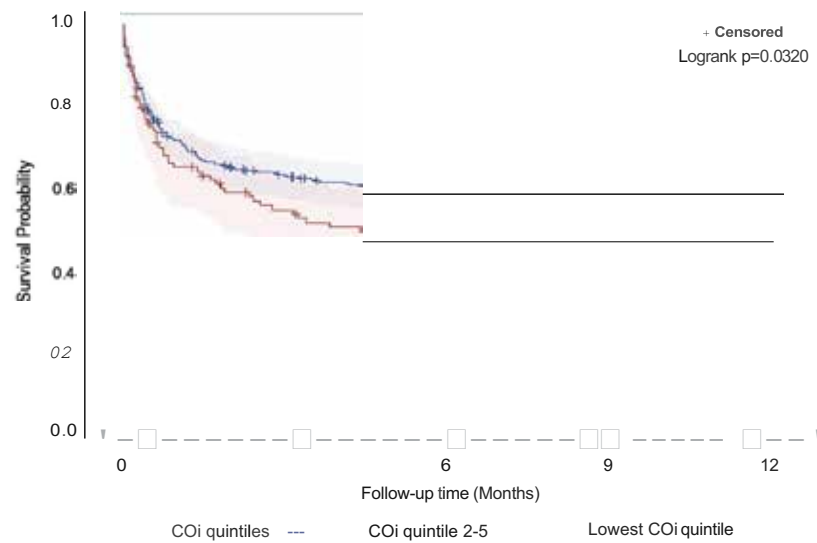
Methods: We performed a retrospective cohort study of all pediatric patients (n=472) supported on ECMO at our institution (2009 – 2023). Demographic and clinical variables, including significant comorbidities, were summarized using descriptive statistics and compared across COI quintiles. Logistic regression models were used to compare patients' outcomes (including survival, tracheostomy, gastrostomy tube, and residing in a facility) at one year post cannulation between COI quintiles. Linear regression models were used to evaluate continuous outcome variables, including ECMO hours and length of stay (LOS). A survival analysis was performed to evaluate the cumulative survival rate at one year. Cox regression models were built to assess associations between mortality and COI quintiles. Analyses were stratified by indications for ECMO.

Results: Of 472 patients, indications for ECMO included: 173 (36.7%) cardiac, 131 (27.8%) extracorporeal CPR (ECPR), 168 (35.6%) respiratory. The median number of comorbidities was 2 (IQR:1-3). The median survival time was 2200 days post-cannulation. One-year survival was 54.50% (95% CI: 49.74-59.01%). Patients with very low COI had increased mortality compared with all other groups (HR=1.39, 95% CI: 1.03-1.88). Among patients with a cardiac indication for ECMO, high or very high COI versus low COI had triple the odds of being alive at one year (high COI: OR=3.89, 95% CI: 1.26-11.96; very high COI: OR=3.60, 95% CI: 1.30-9.98). Respiratory and ECPR ECMO patients did not differ in 1-year survival based on COI. There were no differences in ECMO hours or LOS based on COI. At one year, patients with very high COI vs. very low COI were less likely to have a gastrostomy tube (OR=0.26, 95% CI: 0.1-0.66) or live in a facility (OR=0.06, 95% CI: 0.01-0.52); there was no difference in odds of tracheostomy.

Conclusion: Higher COI is associated with improved survival in pediatric ECMO, particularly for cardiac patients, and reduced need for long-term supportive care, highlighting the influence of SDoH on recovery and the need to address drivers of inequitable outcomes.

Abbreviations: COI - child opportunity index
ECMO - extracorporeal membrane oxygenation
LOS- length of stay
IQR - interquartile range
OR - odds ratio
CI - confidence interval

Figure 1. Product limit survival estimates based on COi quintile: 2-5 correspond to low, moderate, high, and very high; lowest COi quintile corresponds to very low COi



Q29

PERIOPERATIVE FACTORS ASSOCIATED WITH SURGICAL SITE INFECTION FOLLOWING LAPAROTOMY IN NEONATES

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Abstract: Purpose:

Surgical site infections (SSI) are one of the most common causes of postoperative morbidity, affecting length of hospital stay and postoperative recovery. With immature immune systems, neonates comprise a particularly vulnerable population. Therefore, we sought to identify pre-, intra-, and post-operative factors associated with an increased risk of SSI following laparotomy in neonatal patients.

Methods:

We retrospectively reviewed the records of all NICU patients undergoing laparotomy between 2013-2021. Patients were excluded if they passed away within 5 days of surgery. Specifically, information regarding sex, maternal age at birth, race, age at birth, age at surgery, weight at surgery, diagnosis, ASA class, case urgency, surgical details, wound classification, type/duration of antibiotic prophylaxis, and blood product transfusion utilization were recorded. Clinical outcomes were evaluated, and multivariate analysis was performed to evaluate for any association between these variables and the outcome of an SSI. Chi squared analysis was used to evaluate the distribution of diagnoses requiring laparotomy.

Results:

A total of 212 patients were identified, 57.5% of which were male. 74 laparotomies were performed for necrotizing enterocolitis (34.9%), 24 for spontaneous intestinal perforation (11.3%), 97 for other bowel pathologies (45.8%), and 17 for congenital diaphragmatic hernia (8%). There were a total of 63 (29.7%) surgical site infections. Multivariate analysis demonstrated that neonates undergoing laparotomy for necrotizing enterocolitis had a significantly higher risk of SSI compared to other singular diagnoses ($p < .05$). The odds of SSI were higher with use of nonabsorbable fascial sutures ($OR = 5.14$, $P = .021$) and without use of liquid topical skin adhesive dressings ($OR = 3.22$, $p = .0026$). Postoperative antibiotic prophylaxis, regardless of duration, was not associated with decreased odds of wound complication ($OR = .26$, $p = .22$).

Conclusions:

Laparotomies performed for necrotizing enterocolitis in neonates were significantly more likely to develop SSIs, as were cases in which non-absorbable sutures were used for fascial closure. Postoperative antibiotic prophylaxis, regardless of duration, does not mitigate the risk of developing SSIs.

Abbreviations: SSI: surgical site infection

NICU: neonatal intensive care unit

ASA: American Society of Anesthesiologists

OR: odds ratio

Q30

PREMO: A NOVEL MULTIPARAMETER PROBE FOR PREMATURE INFANT MONITORING DURING SURGERY

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Abstract: Purpose

Accurate intraoperative monitoring of the premature infant is paramount to success in neonatal surgery. Conventional monitoring systems are difficult to position and maintain, and the most accurate tools are invasive. Innovative solutions are desperately needed to advance operative safety for premature infants. We developed a multiparameter premature infant monitoring (PreMo) probe with an integrated pulse plethysmography sensor and thermistor capable of real-time measurements of oxygen saturation, heart rate (HR), temperature, and respiratory rate (RR). We hypothesize that this probe is capable of primary or adjunctive monitoring of premature neonatal physiology.

Methods

Experiments were performed after institutional IACUC approval. The probes were fixed to a 5-French feeding tube for esophageal monitoring or a low-pressure actuator balloon for rectal monitoring. Lamb fetuses at 115-day gestation (n = 3) were surgically delivered, intubated, and ventilated, while probes were placed in the esophagus and rectum and an umbilical artery catheter placed. The fetuses were then fully separated from the placenta while on a warmer. A conventional pulse oximeter was applied to the ear. Simultaneous arterial blood gas, oral temperature probe and transthoracic echocardiography were used to obtain reference measurements of SpO₂, temperature, and HR for comparison at baseline and during periods of induced hypoxia with resulting bradycardia.

Results

Continuous monitoring of HR and oxygenation were maintained throughout newborn surgical procedures with both probes while RR was measured with the esophageal probe only. SpO₂ measurements from both the esophageal and rectal probes were more accurate when compared to the peripheral pulse oximeter. Although red and infrared light spectrograms demonstrated more prominent background signal in the esophageal compared to rectal probes, reliable monitoring was achieved throughout the procedures with both probes. Temperature measurements from the multiparameter probe tracked consistently with the oral probe.

Conclusions

In these preliminary studies, PreMo accurately measured oxygenation, heart rate, and temperature when compared to gold-standard measurements. Furthermore, it demonstrated superior reliability compared to a conventional pulse-oximetry during periods of hypoxia and physiologic instability. With either esophageal or rectal monitoring, the singular probe offers an adaptable system for hemodynamic monitoring of the premature infant throughout the range of physiology during surgery.

Abbreviations: PreMo: Premature Monitoring Probe

HR = Heart Rate

RR = Respiratory Rate

SpO2 = Oxygen Saturation

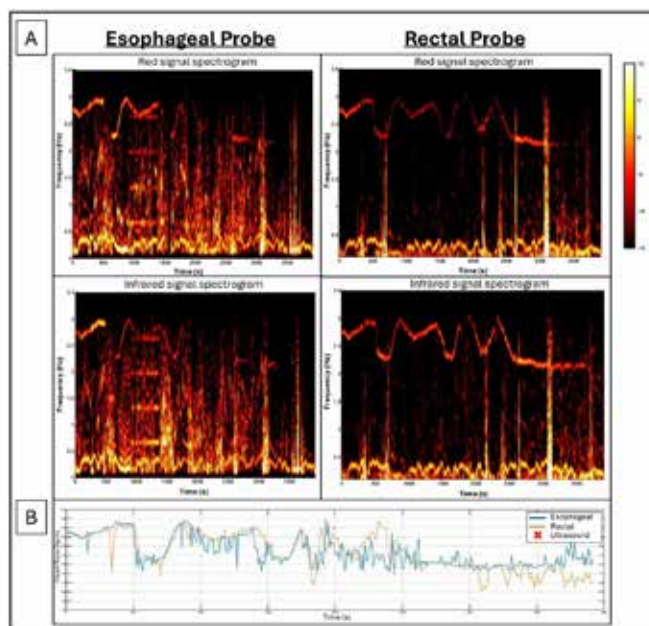


Figure 1. (A) Spectrogram plots of red and infrared signals comparing esophageal and rectal probes and resulting continuous heart rate plots. Spectrogram plots of the esophageal probe demonstrate larger background signal compared to rectal probe. However, there is still a discernable frequency plot for both red and infrared wavelengths in both esophageal and rectal probes. (B) Comparison of esophageal versus rectal heart rates demonstrate concordance with each other and in comparison to ultrasound reference.

Q31

EVOLVING UTILIZATION OF INHALED NITRIC OXIDE IN CONGENITAL DIAPHRAGMATIC HERNIA OVER TIME: A NATIONAL COHORT STUDY OF 4016 INFANTS

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Abstract: Purpose: Numerous studies have suggested the lack of efficacy of inhaled nitric oxide (iNO) in the treatment of pulmonary hypertension associated with congenital diaphragmatic hernia (CDH). In this study, we sought to evaluate patient- and hospital-level data on current iNO use in CDH infants.

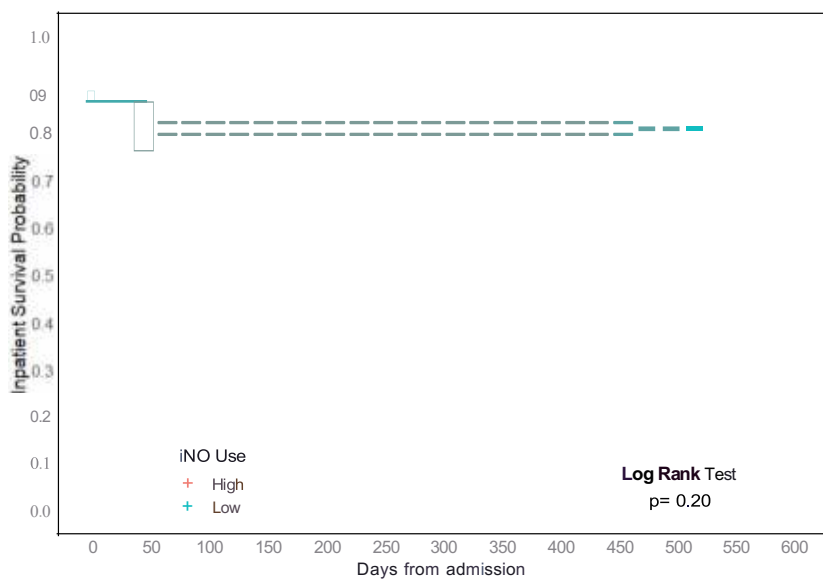
Methods: The Pediatric Health Information System database was queried for infants with CDH managed at 48 major children's hospitals in the United States (2016-2023). Hospitals were stratified into high-use (>50% iNO) and low-use (< 50% iNO) centers. The primary outcome variable was in-hospital mortality, and secondary outcomes included ECMO use, duration of mechanical ventilation, length of stay, and hospital costs. Data were analyzed using Wilcoxon rank sum test and chi-squared test ($p < 0.05$).

Results: Of 4016 CDH infants, iNO was the most commonly used pulmonary vasodilator ($n=2055$, 51.2%), followed by milrinone ($n=1108$, 27.6%) and sildenafil ($n=1088$, 27.1%). Rates of iNO significantly decreased over the study period (2016: 55.9% vs. 2023: 46.0%, $p=0.01$). iNO was associated with increased mortality [iNO: 121 (27.1%) vs. no iNO: 698 (19.6%), $p=0.0002$]. By center, iNO use ranged from 24% and 92% of patients treated. There were no significant differences between high-use ($n=22$; mean iNO: 64.0%) and low-use ($n=26$; mean iNO: 38.4%) institutions with respect to birthweight ($p=0.16$), cardiac disease ($p=0.56$), and ECMO cannulation ($p=0.08$). Although there was no significant difference in inpatient mortality between high-use and low-use centers (high-use: 21.3% vs. low-use: 19.5%, $p=0.17$; Figure), high-use centers were associated with increased mechanical ventilation duration [high-use: 18(8-46) days vs. low-use: 14(7-31) days, $p < 0.0001$], longer length of stay [high-use: 50 (27-94) days vs. low-use: 40 (22-72) days, $p < 0.0001$], and increased hospital cost (high-use: \$236,789 vs. low-use: \$207,787, $p < 0.0001$). High-use iNO hospitals were more likely to use other pulmonary vasodilators [high-use: 1082(53.9%) vs. low-use: 850(42.3%), $p < 0.0001$].

Conclusion: In this large multicenter study, iNO use has been declining, but nearly half of CDH patients still receive iNO therapy. Given the unclear efficacy of iNO and other pulmonary vasodilators on CDH outcomes, these data represent a call for more prospective trials and observational studies to help develop evidence-based guidelines to optimize the management of pulmonary hypertension in these children.

Abbreviations: CDH = congenital diaphragmatic hernia
ECMO = extracorporeal membrane oxygenation
iNO = inhaled nitric oxide

Figure: Kaplan-Meier survival curve of CDH infants at institutions based high vs. low use of inhaled nitric oxide (iNO)



Q32

OUTCOMES FOLLOWING IMPLEMENTATION OF A RISK-BASED TREATMENT ALGORITHM FOR INFANTS WITH NECROTIZING ENTEROCOLITIS AND CONGENITAL HEART DISEASE

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Abstract: Purpose:

Necrotizing enterocolitis (NEC) is a disease of prematurity characterized by bacterial infiltration and necrosis of intestinal tissue. Children with congenital heart disease (CHD) are at risk for bowel ischemia due to splanchnic hypoperfusion. Despite divergent pathophysiology, infants with CHD and features of NEC receive identical treatment to premature infants with NEC. We hypothesized that directed treatment for infants with NEC+CHD safely reduces treatment duration. This study evaluates clinical outcomes following implementation of a risk-based treatment algorithm for infants with NEC+CHD.

Methods:

This single-institution pretest-posttest study evaluated implementation of a treatment algorithm for infants with NEC+CHD aged ≤6 months and with corrected gestational age ≥36 weeks. Infants were stratified into low-, medium-, or high-risk categories based on 11 clinical factors including cardiac anatomy and physiology, echocardiogram findings, laboratory values, and vasopressor support. We assessed the following outcomes: antibiotic days, NPO days, and number of abdominal radiographs, with balancing measures of 10- and 30-day recurrences. We compared outcomes among those in the pre-implementation period (01/2021-04/2023) and the post-implementation period (05/2023-07/2024). We demonstrated variation with run charts and analyzed differences using chi-squared and t-tests.

Results:

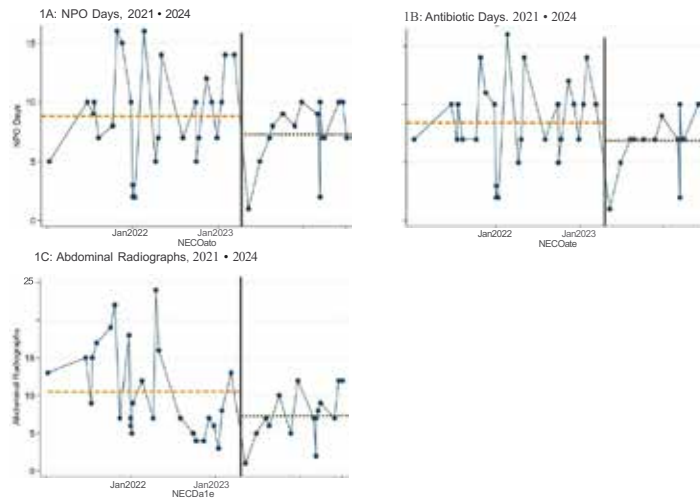
Overall, 47 patients received treatment for NEC+CHD including 17 (36%) post-implementation. The most frequent cardiac defects were hypoplastic left heart syndrome (19%) and double-outlet right ventricle (17%). Single ventricle physiology was more common in the post-implementation period (76% vs 23%, $p < 0.001$). Four (9%) infants required surgery and 5 (11%) died during NEC treatment, with no difference in rates pre- vs post-implementation. Run charts (Figure) qualitatively demonstrated less variation in treatment following implementation with trends suggesting decreased mean NPO days (7.3 vs 8.8; $p = 0.25$), antibiotic days (6.9 vs 8.4; $p = 0.19$), and abdominal radiographs (7.3 vs 10.5; $p = 0.07$). There were no changes in 10-day (21% vs 15%; $p = 0.59$) nor 30-day (29% vs 22%; $p = 0.20$) recurrence.

Conclusion:

Implementation of a risk-based treatment algorithm may safely reduce treatment duration for infants with NEC+CHD. Infants with NEC+CHD merit directed treatments that differ from those of classical NEC. While limited by a small sample, these preliminary data support a prospective multicenter study powered to fully evaluate the safety and efficacy of this algorithm.

Abbreviations: NEC: necrotizing enterocolitis; CHD: congenital heart disease; NPO: nothing by mouth.

Figure 1: Run Charts Depicting NPO Days, Antibiotic Days, and Abdominal Radiographs, January 2021 to July 2024



Black vertical line, represents algorithm implementation in May 2023. Dashed orange line represents pre-implementation mean and dotted orange line represents the post-implementation mean.

Q33

MULTICENTER EXTERNAL VALIDATION OF METHODS TO IDENTIFY SURGICAL NECROTIZING ENTEROCOLITIS

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Abstract: Purpose

Many methods of identifying need for surgery in infants with Necrotizing Enterocolitis (NEC) have been developed and reported. We aimed to externally validate these to understand which is most accurate and whether any are suitable for clinical practice.

Methods

Data were obtained from electronic patient records at two tertiary neonatal surgical units over 7 years (2017-24). NEC diagnosis was based on clinical and radiological features. Surgical NEC was defined as surgery or death from NEC, excluding negative laparotomy. Those not meeting these criteria were classified as medical NEC. Existing methods for identifying surgical NEC identified via systematic review were applied to this cohort. Sensitivity, specificity and accuracy (true positives and true negatives within whole cohort) for each method were calculated. Data are median (IQR), ethical approval (REC:23/HRA/0220) and funding were obtained (NIHR302541).

Results

The dataset comprised 216 infants with NEC: birthweight 1000(740-1970) grams and gestational age 28.1(25.7-34.7) weeks. Of these, 136 (63%) underwent surgery, 74 (34%) recovered without surgery and 6 (2.8%) died without surgery. Overall, 142 (66%) were classified as surgical NEC. Of the previously published 63 methods, 36 used routinely available data and were amenable for external validation. The most sensitive test was platelet to lymphocyte ratio with a sensitivity of 87.1% however low specificity (18.3%). The most accurate test was the metabolic derangement score (69.7%). The eight most sensitive tests are shown ordered by sensitivity (Table).

When published methods provided sufficient measures of test effectiveness in the source article, a direct comparison to this external validation was made. Four out of the eight most sensitive tests performed better on external validation than when originally derived.

Conclusion

This study has undertaken the largest external validation of methods proposed to identify surgical NEC. These data suggest some of these methods may be useful in clinical practice when deciding whether to operate, or continue medical management, for infants with NEC.

Further research should focus on improving method accuracy to assist with surgical decision making in NEC. An effective and useful method would be objective, based on routinely available data and allow for dynamic assessment as the disease progresses.

Abbreviations: Necrotizing Enterocolitis (NEC)

Study	Description	Cut-off value	Sensitivity	Specificity	Accuracy
..	Platelet to lymphocyte ratio	<271.53	87.1%	18.3%	61.5%
	Serum lactate (mmol/l)	>1.25	85.8%	36.1%	67.7%
1111 Qin 2022	score Metabolic derangement	≤2	76.7%	55.9%	69.7%
	Serum neutrophils (x 10 ⁹ /L)	>2.53	72.6%	23.9%	56.4%
..	C-reactive protein (mg/L)	≤10	72.3%	41.4%	61.8%
..	13 feature score	≤3	71.9%	60.3%	68.0%
..	Duke abdominal assessment scale	≤7	68.3%	38.6%	58.5%
..	C-reactive protein (mg/L)	>14.65	67.9%	47.1%	60.9%

Table -The eight most sensitive methods of identifying surgical NEC or death. Accuracy= true positives and true negatives/ all infants.

Q34

ELEVATED HEALTHCARE UTILIZATION AND MORTALITY IN MOTHERS OF CHILDREN WITH CONGENITAL SURGICAL ANOMALIES: A 50-YEAR POPULATION-BASED CASE-CONTROL STUDY

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Abstract: Purpose: Congenital surgical anomalies (CSA) require ongoing care posing significant psychological, social and financial burdens on parents. Mothers of CSA children are at higher risk of cardiovascular and mental health conditions. The purpose of this study was to investigate the healthcare utilization and mortality in mothers of children with CSA .

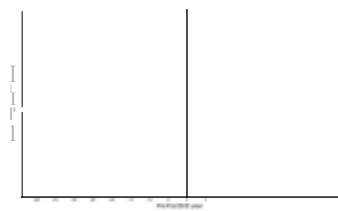
Methods: We included 768 mothers who gave birth to a CSA infant and 7687 mothers of birth-matched control infants. Primary outcomes were the number of healthcare visits (outpatient and hospital admission) and death. The secondary outcomes were the medical specialists and ICD-9 diagnoses for which they presented. Outcome measures were adjusted for socioeconomic factor, rural/urban residency and the number of children in the family.

Results: Mothers of CSA and control children showed similar central tendencies for age and marriage or common-law partnership at birth. Mothers of CSA infants had greater utilization of outpatient services (incidence rate ratio: 1.25, $p < 0.001$) and hospital admissions (incidence rate ratio: 1.13, $p < 0.001$) after the birth of the CSA child. The socioeconomic factor, urban residency and the number of children in the family significantly influenced the frequency of both ambulatory and hospital healthcare utilization ($p < 0.001$). Rates of outpatient family physician visits (adjusted risk ratio: 1.07; 95% CI 1.06 - 1.08), internal medicine (adjusted risk ratio 1.25; 95% CI 1.2 - 1.3) and obstetrics/gynecology (adjusted risk ratio: 1.18; 95% CI 1.13 - 1.21) and surgery (adjusted risk ratio: 1.11; 95% CI 1.06 - 1.17) were significantly higher in mothers after the birth of a child with CSA. The total number of ambulatory healthcare visits among mothers and their children demonstrated a positive correlation. Further, mothers of children with CSA had significantly higher mortality than controls (CSA mothers: 2.9% and control mothers 1.5%, $p = 0.01$).

Conclusions: Mothers of CSA children have an increased healthcare utilization which is influenced by the socioeconomic factor, number of children in the family and urban residency. Further, CSA mothers exhibited higher mortality rates. An improved understanding of health issues and care utilization patterns of mothers will promote the implementation of appropriate support structures for potentially vulnerable families.

Abbreviations: Congenital surgical anomalies (CSA)

A



B



Q35

IDENTIFYING RISK FACTORS EXPLAINING A RISE IN GASTRIC PERFORATION IN THE NICU: THE FIRST STEP OF A QUALITY IMPROVEMENT INITIATIVE

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Abstract: Purpose: Gastric perforation is an uncommon, but deadly complication in patients admitted to the neonatal intensive care unit (NICU). Recently, providers at our institution observed a rise in the number of gastric perforations. As the first step of a quality improvement project, we evaluated the incidence of gastric perforation over the last ten years, identified risk factors, and assessed patient outcomes.

Methods: A single-center retrospective chart review of all patients diagnosed with a gastric perforation in the NICU of a tertiary mother-child hospital between July 2014 and June 2024 was performed. In July 2019, polyurethane (PUR) nasogastric tubes were introduced in our NICU. Before and after comparisons (pre-PUR era: 7/2014-6/2019 n=4 perforations, vs. PUR era: 7/2019-6/2024 n=17 perforations) were made using Mann-Whitney U or Fischer's exact testing (p< 0.05 considered significant). IRB approval was waived.

Results: Twenty-one gastric perforations (7 female) were identified. There was a significant increase in gastric perforations after July 2019 (pre-PUR: 4/4799 NICU admissions, 0.1%, vs. PUR: 17/4713 NICU admissions, 0.4%, p=0.004). Sixteen perforations (76%) were proven intraoperatively. The remaining five were suspected on imaging, but surgery was not performed due to hemodynamic instability, extreme prematurity, or comorbidities. Risk factors for gastric perforation are presented in Table 1. Nasogastric tube exchanges prior to perforation were significantly more frequent recently. Overall, five patients (24%) died (operative 2/16, 12.5%, vs. non-operative management 3/5, 75%, p=0.063), all during their initial hospital stay (one intraoperatively from hemorrhagic shock, four after transitioning to comfort care). Median time to death was 9 days after diagnosis (2 hours-9.5 days). Amongst surviving patients, the median hospital length of stay was 85.8 days (20.8-397.4). Median outpatient follow-up was 0.9 year (64 days-4.4 years). Eleven patients (11/16, 69%) had ≥6 months follow-up: only two reported mild gastrointestinal complaints (occasional vomiting).

Conclusion: Neonatal gastric perforations significantly increased at our institution in the last five years. A change in nasogastric tube material and an increase in tube exchanges were identified as significant risk factors. These findings support reviewing our institutional nasogastric tube practice guidelines in preterm infants to implement change as the next step of this quality improvement project.

Abbreviations:

Table 1. Risk factors for developing gastric perforation in the NICU				
Risk factors	All patients (n=21)	pre-PURera (n=4)	PURera (n=17)	p value
Prematurity (<37 weeks)	18 (86%)	3 (75%)	15 (88.2%)	0.49
Gestational age (weeks)	28.3 (22.9-39.6)	29.5 (6.7)	29.6 (4.8)	0.79
Birth weight (grams)	1240 (430-3674)	1516 (1462)	1431 (905)	0.79
Antenatal steroids administration	17(81%)	3 (75%)	13 (76.5%)	1.0
Invasive or non-invasive ventilation used prior to perforation	20 (95%)	4(100%)	16(94%)	1.0
Nasogastric tube placed prior to perforation	20 (95%)	4(100%)	19(95%)	1.0
Nasogastric tube duration (days)	3.1 (6 min-16 days)	2.0 (2.5)	4.9 (4.8)	0.23
Nasogastric tube size (French)	7 (6-10)	8 (2)	7 (1)	0.61
<i>Number of nasogastric tube exchange before perforation</i>	<i>2 (1-8)</i>	<i>1 (0.5)</i>	<i>3 (2)</i>	<i>0.045</i>

Results are presented either as median (range) for all patients (n=21) or mean (SD) (continuous variables) and n (%) (categorical variables) when eras are compared

Legend: PUR: Polyurethane

Thursday, May 8, 2025

Quickshot 4 - Colorectal

3:00 PM – 3:45 PM

Q36

PRIOR ABDOMINAL SURGERY AND SECUREMENT TECHNIQUE PREDICT PERSISTENT GASTROECUTANEUS FISTULA AFTER GASTROSTOMY TUBE REMOVAL

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Abstract: Purpose: Gastrostomy tube (GT) removal is complicated by gastrocutaneous fistula (GCF) requiring operative closure in up to one-third of patients. We examined factors affecting the need for operative closure.

Methods: A single-center, case-control study of patients with a GT placed and removed between June 2018 and May 2022 (n=180). Cases were patients needing operative closure (n=51), whereas controls were those with spontaneous closure (n=129). Patient characteristics, operative techniques, and postoperative outcomes were compared between these groups. Operative technique was classified as laparoscopic, open, or percutaneous and subclassified by securement method (pursestring, transabdominal tacking, open Stamm, or percutaneous without gastropexy). Continuous data is reported as median and interquartile ranges and compared with the Mann-Whitney test. Categorical data is reported as percentages and compared using the chi-square or Fisher's exact test as appropriate. A multivariate logistic regression model based on clinical associations was created to control for various confounders. A p-value less than 0.05 was considered significant.

Results: Persistent GCF occurred in 28% of patients. Univariate analysis demonstrated younger age at placement (3.15 [1.45, 7.29] vs 5.29 [3.65, 11.24] months, $p < 0.001$) was associated with GCF closure. There were no statistical differences in race, number of comorbidities, prematurity, or tube dwell time. Prior (27.5% cases vs 7.8% controls, $p = 0.001$), concurrent (37.3% vs 10.9%, $p < 0.001$), and post-GT (23.5% vs 10.1%, $p = 0.029$) abdominal surgery was associated with operative closure. Those requiring closure more frequently had GT-associated complications including granulation tissue (86.3% vs 62%, $p = 0.001$), leaking (52.9% vs 34.1%, $p = 0.027$), and dislodgement (37.3% vs 21.7%, $p = 0.039$). Multivariate logistic regression (Table 1) demonstrated that prior or concurrent abdominal surgery and pursestring securement had higher odds ratios of GCF closure. Pursestring securement may prevent dislodgement; however, subgroup analysis on dislodgement between pursestring and transabdominal demonstrated no effect (26.7% vs 32.6% respectively, $p = 0.817$).

Conclusions: Younger age, prior abdominal surgery, and GT-associated complications were associated with operative GCF closure. Non-modifiable risk factors of prior and concurrent

abdominal surgery independently increased the odds of persistent GCF, which should be considered in counseling families upon GT removal. Transabdominal tacking may reduce the development of persistent GCF without increased risk of GT dislodgement.

Abbreviations: GT, Gastrostomy tube; GCF, gastrocutaneous fistula

Table 1: Multivariate Analysis

Characteristic	OR ¹	[95% CI] ¹ , p-value	Characteristic	OR ¹	[95% CI] ¹ , p-value
Age	0.97	[0.93, 1.00], 0.10	Pursestring vs Transabdominal Tacking	8.97	[2.92, 29.8], <0.001
Sex			Open vs Laparoscopic	0.24	[0.02, 3.34], 0.3
Male	0.47	[0.17, 1.25], 0.14	Prior Abdominal Surgery	5.86	[1.51, 25.1], 0.013
Race			Concurrent Abdominal Surgery	4.40	[1.20, 16.8], 0.026
White	1.00	Reference	Subsequent Abdominal Surgery	2.90	[0.74, 11.2], 0.12
Minority	1.94	[0.67, 5.65], 0.2	GT site infection	1.74	[0.44, 6.35], 0.4
Prematurity	0.82	[0.31, 2.20], 0.7	Granulation tissue	1.74	[0.59, 5.69], 0.3
Number of Comorbidities	1.00	[0.81, 1.23], >0.9	Leakage	1.52	[0.56, 4.10], 0.4
Time from placement to removal	1.02	[0.99, 1.07], 0.3	Emergency room tube changes	2.26	[0.83, 6.12], 0.11

¹OR = Odds Ratio, CI = Confidence Interval

Q37

"VACTERL-G" IS AN IMPROVED MNEMONIC FOR SCREENING GENETIC FEMALES WITH ANORECTAL MALFORMATIONS: FINDINGS FROM A QUALITY IMPROVEMENT STUDY

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Abstract: Purpose

Anorectal malformations (ARMs) often co-occur with developmental anomalies, and the VACTERL mnemonic aids screening for these associated conditions. Despite the fact that reproductive anomalies occur in up to 50% of genetic females with ARMs, the VACTERL mnemonic omits them. This perpetuates a systematic oversight in identifying reproductive anomalies in this patient population. This quality improvement study aimed to evaluate and enhance our screening protocols for the detection and management of reproductive anomalies in genetic females with ARMs.

Methods

We conducted a retrospective analysis to quantify the reproductive anomaly screening and positivity rate in genetic females with ARMs at our institution between April 1, 2003 and December 31, 2023. Patients aged over 1 year at time of ARM diagnosis were excluded. Through electronic medical record review, we collected basic demographic information; anorectal malformation type; VACTERL status; pelvic imaging results (US or MRI); vaginotomy findings; and involvement of a pediatric gynecologist. Simple descriptive statistics were then computed.

Results

Seventy patients were included in our study with an average current age of 111 months (9 years). The three most common anorectal malformations were rectovestibular (24/70, 34.3%) and rectoperineal (21/70, 30%) fistula, and persistent cloaca (11/70, 15.7%). Less common anorectal malformations included rectal atresia (4/70, 5.7%), rectovaginal and recto-bladder neck (each 1/70, 1.43%) fistulas. Twenty-three patients (32.8%) met criteria for VACTERL association. Fifty-three percent (37/70) underwent reproductive anomaly screening with a positivity rate of 51% (19/37). Over 90% (12/13) of patients with cloaca, rectovaginal and recto-bladder neck fistulas had a reproductive anomaly (Table 1). Over 15% (6/32) of patients with rectovestibular and unspecified ARMs had a reproductive anomaly. Five percent (1/21) of patients with rectoperineal fistula had a reproductive anomaly. Sixty-one percent (14/23) of patients with VACTERL had a reproductive anomaly.

Conclusion

A substantial number of genetic females with ARMs and VACTERL were found to have reproductive anomalies, including those with rectoperineal and rectovestibular fistulas. Mapping of anatomy is crucial to planning future gynecologic care, therefore expansion of the VACTERL mnemonic to include gynecologic anomalies ("VACTERL-G") will enhance patient care and support the reproductive health of these individuals.

Abbreviations: ARMs - Anorectal malformations ; VACTERL - Vertebral defects, Anal atresia,

Cardiac anomalies, Tracheo-esophageal fistula with esophageal atresia, Renal anomalies, Limb anomalies; US - Ultrasound; MRI - Magnetic Resonance Imaging

VARIABLE	TOTAL, N	PERCENTAGES	Had Repro Anomaly	% with Repro Anomaly
Rectovestibular	24	34.29%	4	16.7%
Rectoperineal	21	30.00%	1	4.8%
Cloaca	11	15.71%	10	90.9%
Rectal atresia	4	5.71%	0	0.0%
Rectovaginal	1	1.43%	1	100.0%
Rectobladderneck	1	1.43%	1	100.0%
Unspecified ARM	8	11.43%	2	25.0%
Total N, %	70	100.00%	19	

FUNDOPLICATION IN GASTROSTOMY TUBE PLACEMENT DECISION MAKING FACTORS AND MORBIDITY OUTCOMES: A MULTI-INSTITUTIONAL RETROSPECTIVE COHORT STUDY

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Abstract: Purpose: The decision to perform fundoplication at time of gastrostomy tube (GT) placement is controversial, and studies have shown significant variability in the rate of concurrent fundoplication across centers. This study aimed to 1) examine the trend of performing concurrent fundoplication over time, 2) identify demographic and clinical characteristics associated with performing fundoplication versus GT alone, and 3) assess the association of concurrent fundoplication with morbidity outcomes.

Methods: This was a retrospective cohort study of children (0-17 years) who underwent GT placement with or without fundoplication in the National Surgical Quality Improvement Program – Pediatric database from January 2018-December 2023. For aim 1, descriptive statistics were used to assess hospital-level rates with interquartile range (IQR) of GT with concurrent fundoplication over time, and a Cochran-Armitage test was performed to evaluate significance of this trend. For aims 2 and 3, cases underwent stepwise backwards multivariable logistic regression with adjustment for demographic and clinical characteristics, adjustment for operation year, and cluster by hospital. Aim 2 identified variables significantly associated with performing concurrent fundoplication versus GT alone. Aim 3 identified whether fundoplication was associated with composite morbidity, mortality, readmission, or reoperation. This study was exempt from institutional review board evaluation.

Results: Rates of concurrent fundoplication significantly decreased from 8.26% (287/3476; median 2.13%, IQR: 0-12.4%) in 2018 to 2.81% (127/4513; median 0%, IQR 0-3.42%) of GT in 2023 (Cochran-Armitage p trend < 0.001). Characteristics associated with fundoplication versus GT alone included esophageal/gastrointestinal disease [odds ratio (OR): 7.71], structural pulmonary abnormalities (OR: 1.37), oxygen support (OR: 1.31), inpatient status (OR: 3.80), and operation year (OR, 1.18) (Table). Patients undergoing concurrent fundoplication had higher odds of 30-day composite morbidity compared to GT alone (OR: 1.31). There were no significant associations between concurrent fundoplication and readmission, reoperation, and mortality (Table).

Conclusion: The rate and inter-hospital variability of concurrent fundoplication at time of GT placement has declined significantly. Notably, concurrent fundoplication is associated with higher odds of 30-day composite morbidity even after adjusting for relevant factors. Further research could inform clinical decision making regarding concurrent fundoplication in light of the higher associated postoperative morbidity.

Abbreviations: Gastrostomy tube (GT)
Interquartile range (IQR)
Odds ratio (OR)
Confidence Interval (CI)

Table. Factors associated with performing concurrent fundoplication and association of fundoplication with 30-day postoperative outcomes in pediatric gastrostomy tube placement. Select variables included in the model are displayed in the below table. CI= confidence interval.

Characteristics associated with fundoplication versus GT alone (Aim 2) Odds ratio (95%CI)		Association of concurrent fundoplication with 30 day postoperative outcomes(Aim3) Odds ratio (95%CI)	
<u>Operative year vs 2023</u>	1.18 (1.15, 1.22)	<u>Morbidity</u>	1.34 (1.08, 1.66)
Minor cardiac risk factors vs none	1.18 (0.99, 1.48)	<u>Readmission</u>	0.89 (0.71, 1.10)
Severe cardiac risk factors vs none	1.19 (0.78, 1.46)	<u>Reoperation</u>	1.26 (0.93, 1.71)
Esophageal or gastrointestinal disease vs none	7.71 (6.49, 9.17)	<u>Mortality</u>	1.14 (0.54, 2.40)
Chronic lung disease vs none	0.96 (0.79, 1.15)		
Structural pulmonary abnormality vs none	1.37 (1.16, 1.63)		
Oxygen support vs none	1.31 (1.08, 1.59)		
Open operation vs laparoscopic operation	1.34 (1.17, 1.47)		
Inpatient status vs outpatient	3.80 (2.80, 5.15)		

RECENT TRENDS AND OUTCOMES IN PEDIATRIC PATIENTS WITH ULCERATIVE COLITIS WHO UNDERWENT A TOTAL ABDOMINAL COLECTOMY, USING THE NSQIP-PEDIATRIC DATABASE.

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Abstract: Purpose: This study utilized the National Surgical Quality Improvement Program – Pediatric (NSQIP-P) database to examine current trends among patients undergoing colectomy for ulcerative colitis (UC) including the effect of pre-operative steroid administration and the potential influence of increased utilization of enhanced recovery after surgery (ERAS) principles.

Methods: A retrospective cohort study was performed using NSQIP-P to investigate patients less than 18 years old who underwent either laparoscopic or open total abdominal colectomy (with or without J-pouch) for ulcerative colitis from 2012-2022. Comparative uni- and multivariate analyses were performed to evaluate for trends among patients undergoing colectomy for UC, including the impact of laparoscopic approach, pre-operative steroids, and the year of treatment (Early – 2012-2016; Late – 2017-2022).

Results: 852 patients met inclusion criteria, of which 465 (54.5%) were male and the median age was 15 years (IQR 12.6, 16.7). Additionally, 753 (88.3%) identified as white and 67 (7.9%) identified as black. Most patients underwent a laparoscopic colectomy (621, 79.3%) and there was no significant difference in outcomes based on approach. Most cases were elective (774, 90.8%), while 78 (9.2%) of cases were defined as emergent/urgent. There were no significant differences in case acuity when stratified based on race, approach (laparoscopic vs open), or pre-operative steroid use. 436 (51.2%) received either oral or IV steroids within 30 days of their surgery. This was associated with higher incidence of post-operative organ space surgical site infections (steroids 7.7% vs. none 2.8%, $P=0.001$), sepsis (4.3% vs. 1.1%, $P=0.004$), reoperation within 30 days (12% vs 7.1%, $P=0.011$) and longer length of stay (11 days (IQR: 6, 20) vs. 6 days (IQR: 4,10)). Results of multivariable analyses are presented in the Figure.

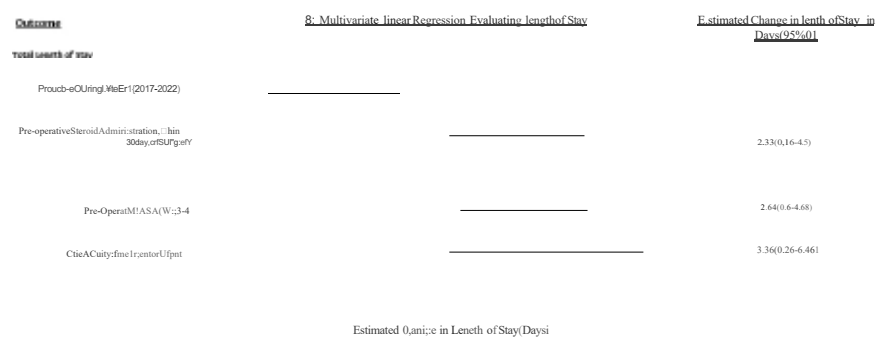
Conclusions: This analysis utilizing NSQIP-P found that of patients undergoing colectomy for UC, approximately half received steroids just prior to surgery. Steroid administration was found to be associated with worse post-operative outcomes, including increased organ-space SSI, risk of reoperation, and longer length of stay. Further, a trend towards shorter length of stay in the more recent years may suggest the increasing adoption of ERAS principles in pediatric surgery.

Abbreviations: National Surgical Quality Improvement Program- Pediatric-- NSQIP-P

Enhanced recovery after surgery-- ERAS

Ulcerative Colitis-- UC

Interquartile Range-- IQR



Q40

TREATMENT OUTCOMES IN PEDIATRIC INTESTINAL FAILURE PATIENTS WITH IBD-LIKE DISEASE

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Abstract: Purpose: Chronic intestinal inflammation mimicking inflammatory bowel disease (IBD-like disease) has only recently been identified in pediatric intestinal failure (PIF). Symptoms can include bleeding, pain and/or failure to thrive. Effective medical and surgical interventions are needed but remain undefined.

Methods: Patients managed Dec 2010-Dec 2023 at an intestinal rehabilitation program (IRP) were reviewed to identify those with IBD-like disease (chronic intestinal mucosal injury or persistent active inflammation on multiple endoscopies). Patients with diversion or eosinophilic colitis, isolated anastomotic ulcers, or monogenic diseases predisposing to IBD were excluded. Medical treatment consisted of stepwise escalation from standard of care (including enteral antibiotics) to aminosalicylates (5-ASA) to enteral corticosteroids to IBD-targeted biologics (e.g., infliximab). Treatment and outcomes are described. Non-parametric testing was performed to identify correlates of treatment.

Results: Of 365 PIF patients, 30 (8.2%) were diagnosed with IBD-like disease. Median follow up was 5 years. Overall, 24 (80%) were treated with 5-ASA, 15 (50%) with a corticosteroid, 7 (23%) with a biologic agent and 6 (20%) underwent surgical intervention (Figure 1). Histopathologic severity of disease was significantly higher in patients requiring biologics ($p < 0.001$), corroborating appropriate escalation of treatment. Among 7 patients requiring a biologic, 4 underwent surgery, 1 before and 3 after biologic initiation, of whom 3 remain on biologics. Biologics resulted in endoscopic and histologic improvement in 3/7 (42.9%). Surgical intervention required segmental resection in 6 patients, 4 for bleeding ulceration and 2 for fistulizing disease. Of surgical patients, 3/6 (50%) had endoscopic improvement, 2 had persistent severe inflammation, and 1 had symptom improvement without repeat endoscopy. Both patients with fistulizing disease remained on biologic therapy post-operatively, while 2 of the 4 with bleeding successfully discontinued medical therapy.

Conclusions: In a large IRP, IBD-like intestinal inflammation affects less than 10% of PIF patients but represents a significant cause of morbidity. Most patients can be managed medically using the described stepwise protocol. Surgical intervention with bowel resection should be used judiciously but holds value in refractory cases. Further study should focus on identification of ideal medical therapy, methods for assessing therapy response, including appropriate endoscopic monitoring and identification of appropriate disease biomarkers.

Abbreviations:

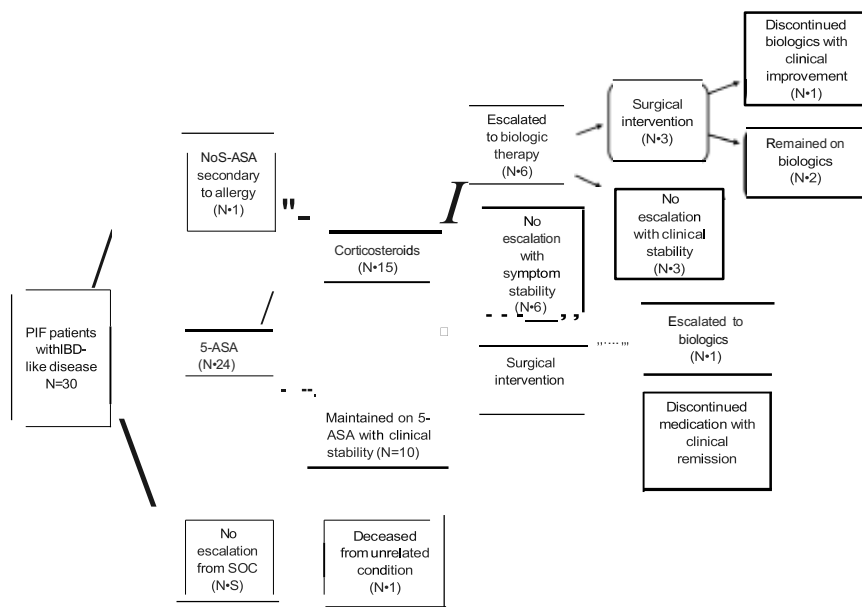


Figure 1: treatment pathways and outcomes for intestinal failure patients with IBD-like disease

Q41

RELATIONSHIP BETWEEN HOSPITAL SURGICAL VOLUMES AND PATIENT OUTCOMES IN HIRSCHSPRUNG'S DISEASE: A CANADIAN POPULATION-BASED STUDY

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Abstract: Purpose: While increased operative volumes are associated with improved outcomes in high-risk adult surgeries, the volume-outcome relationship in pediatric surgery remains understudied. This work investigated the relationship between hospital volume and outcomes in infants with Hirschsprung's disease. It was hypothesized that pediatric hospitals performing a greater number of anorectal pull-through surgeries have improved patient outcomes.

Methods: This retrospective cohort study utilized data from the Canadian Institute for Health Information, spanning April 2010 to March 2023. Patients aged ≤ 18 months who underwent pull-through surgery for Hirschsprung's disease were included (n=563). The relationship between hospital volume and length of stay (LOS) was analyzed using negative binomial regression. Restricted cubic spline analysis was conducted to assess the nonlinear association between hospital volume and binary secondary outcomes, including mortality, blood transfusion, readmission, and reoperation. Inflection points were used to dichotomize high- and low-volume centers.

Results: A total of 563 infants with Hirschsprung's disease were treated across 18 Canadian hospitals, with a median age at surgery of 3 months (IQR 1-5). The median annual hospital volume was 4 pull-through surgeries (IQR 2.5-8), and the median LOS was 5 days (IQR 4-9). Regression analysis showed no significant association between LOS and hospital volume [IRR 0.98 (95% CI 0.96, 1.01), p=0.18]. Two patients (0.2%) died, 222 (39%) were readmitted within one year, and 125 (22%) underwent reoperation. Spline plots revealed a decrease in the probability of blood transfusion with increasing hospital volume, with an inflection point at 6 cases/year. An inflection point for readmission was also observed at 6 cases/year, beyond which readmission rates increased. When dichotomized at 6 cases/year, only 6 (33%) hospitals were classified as high-volume centers.

Conclusions: Findings suggest that pediatric surgical outcomes for Hirschsprung's disease are relatively homogenous across Canadian hospitals, with no significant association between hospital volume and LOS. Higher-volume centers exhibited lower rates of blood transfusion but higher rates of readmission, potentially due to referral patterns. Further research is warranted to explore the volume-outcome relationship in pediatric surgery.

Abbreviations: LOS: length of stay

IRR: Incidence rate ratio

CI: confidence interval

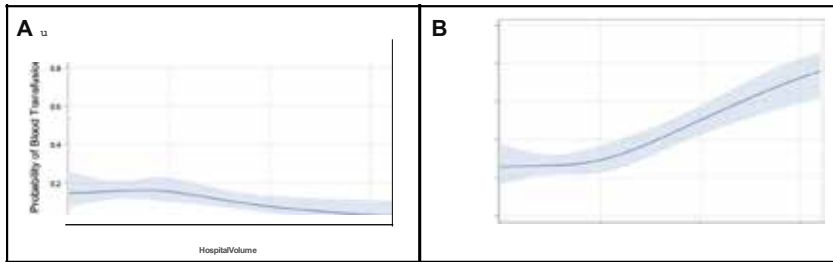


Figure: Restricted cubic spline models (three knots) showing the estimated probability of A) blood transfusion at the time of index surgery and B) 1-year readmission for any cause, for patients with Hirschsprung's disease. The solid dark blue line indicates the estimated probability for the spline model and the light blue area represents the 95% confidence intervals.

Q42

CHARACTERIZING CHRONIC ENTERITIS RESEMBLING INFLAMMATORY BOWEL DISEASE IN PEDIATRIC SHORT BOWEL PATIENTS: A CASE CONTROL STUDY

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Abstract: Purpose: In patients with intestinal failure secondary to short bowel syndrome, the development of intestinal inflammation resembling inflammatory bowel disease has been reported, but data is limited. This study aimed to evaluate characteristics associated with chronic non-infectious intestinal inflammation in pediatric short bowel syndrome.

Methods: A single-center retrospective case-control study was performed using patients diagnosed with short bowel syndrome (SBS) within our pediatric intestinal failure program (n=50). Cases were defined by chronic or recurrent non-infectious enteritis diagnosed on endoscopy or MR enterography. Patients with isolated anastomotic ulceration were excluded. Clinical factors were compared between children with SBS who developed chronic intestinal inflammation and who did not develop chronic intestinal inflammation.

Results: Fifteen cases with SBS who developed chronic intestinal inflammation were identified and compared to thirty-five control patients with SBS. Mean age was 13 for cases and 10 for controls, and both groups were evenly distributed by sex (47% male vs 49% male). Children who lacked an ileocecal valve were more likely to develop chronic intestinal inflammation (93% vs 60%, p=0.018). There was no correlation based on residual small intestinal length measured at the time of surgery (63 cm vs 50 cm, p=0.41). Analysis of remaining colon length by the presence of intact colon, partial colectomy, or total colectomy showed no significant difference between the two groups (33% intact, 53% partial, 13% total colectomy vs 51% intact, 49% partial, 0% total colectomy, p=0.065). Current parenteral nutrition (73% vs 37%, p=0.019) and use of a GLP-2 analog (33% vs 9%, p=0.029) were associated with chronic intestinal inflammation, as were intestinal dysmotility (40% vs 11%, p=0.021) and small intestinal bacterial overgrowth (60% vs 26%, p=0.021).

Conclusion: Short bowel syndrome patients are at risk for the development of chronic intestinal inflammation, which is associated with ongoing parenteral nutrition dependence and use of a GLP-2 analog. Absence of an ileocecal valve emerges as a surgical factor related to the risk of chronic intestinal inflammation, while intestinal dysmotility and dysbiosis are additional associations. Further analysis of the mechanism underlying impaired mucosal homeostasis and optimal therapies in this population is warranted.

Abbreviations: SBS: short bowel syndrome

MR: magnetic resonance

TPN: total parental nutrition

GLP-2: glucagon-like peptide-2

Q43

UTILIZATION OF SUBSTANCE USE DISORDER TREATMENT INCREASES DRAMATICALLY FOLLOWING ADOLESCENT BARIATRIC SURGERY

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Abstract: Purpose:

The purpose of this study was to analyze the trends in utilization of mental health services and substance use disorder treatment before and after adolescent bariatric surgery.

Methods:

Using the MarketScan commercial health insurance claims database from 2011-2019, bariatric surgery patients 18 years and younger were assessed for patterns of mental health services and substance use treatment utilization over 3 time periods: pre-surgery (first MarketScan claim to 6 months before surgery), peri-surgery (6 months before to 12 months after surgery), and post-surgery (>12 months after surgery). Rates of psychiatric medication prescriptions, inpatient psychiatric services, self-harm or suicide events, and substance use disorder treatment were extracted. We calculated standardized rates in person-months (pms) and ran generalized estimating equations clustered on patients with a Poisson distribution to test for differences in each category across the various time intervals.

Results:

There was no significant change in the utilization patterns of psychiatric medications (0/1000 pms), inpatient psychiatric treatment (2-5/1000 pms), or self-harm/suicide events (0-1/1000pms) across the three time periods. However, rates of substance use disorder treatment increased dramatically from 1/1000 pms in the pre-surgery and peri-surgery time intervals to 30/1000 pms in the post-surgery period. The incidence rate ratio for substance abuse treatment encounters in the post-surgery period compared to the pre-surgery period was 46.81 (12.34-177.68, $p < 0.001$).

Conclusions:

A 47-fold increase in the rate of substance use disorder treatment was found in adolescent bariatric surgery patients following bariatric surgery. This finding is even more pronounced than the increased risk for substance use disorder that has been previously demonstrated in adult bariatric surgery patients following surgery. Additionally, there was no change in utilization of psychiatric medications, inpatient psychiatric services, or self-harm/suicide events, suggesting that this association is specific to substance use disorders. Bariatric surgery is an important evidence-based option to improve long term adolescent health and reduce the long-term risk of obesity-related health problems. Importantly, our results demonstrate the need for increased awareness of the risk for substance use disorders following surgery and the need for developing best practices for substance use prevention and counseling within multidisciplinary adolescent bariatric surgical clinical programs.

Abbreviations: pms: person-months

Q44

A MODIFICATION OF THE NEWBORN OPERATION FOR CLOACAL EXSTROPHY: LEAVING THE CECAL PLATE UNTOUCHED

Thomas O. Xu, MD¹, Andrea T. Badillo, MD¹, Briony K. Varda, MD, MPH¹, Christina P. Ho, MD¹, Caitlin A. Smith, MD², Richard J. Wood, MD³, Christina Feng, MD¹, Marc A. Levitt, MD¹

1Children's National Hospital, Washington, DC, USA, 2Seattle Children's Hospital, Seattle, WA, USA, 3Nationwide Children's Hospital, Columbus, OH, USA

Abstract: Introduction

The conventional approach to managing a newborn with cloacal exstrophy, the rarest of malformations, involves separating the cecal plate from between the two hemi-bladders, tubularizing it to be included in the fecal stream, creating an end colostomy, and bringing the two bladder halves together. In two previously reported cases that utilized the traditional method, the tubularized cecal plate developed bacterial overgrowth attributed to stasis, which required removal and led to use of it for augmentation of the bladder. Learning from these cases, we developed a novel way to perform the newborn operation which leaves the cecal plate untouched. This technique is easier to perform, should avoid the problems seen with the traditional approach, and has the potential for better functional outcomes.

Methods

Three newborn cases of cloacal exstrophy utilizing the new operative approach were reviewed between 2020 and 2024 including a video demonstration of the most recent case.

Results

In three newborns with cloacal exstrophy, the cecum was left in situ. Then, a distal ileum to proximal hindgut anastomosis was performed with an end colostomy. The most recent case had an operative time of only 140 minutes (Video 1). In this case, the patient had a small omphalocele and thus the bladder was able to be closed to a vesicostomy. The patient developed a ureteral obstruction related to postoperative bladder prolapse that required stenting. In the other two cases with larger omphaloceles, the bladder halves and cecum were reconnected to the edge of the omphalocele, which may be the better choice to avoid prolapse. No postoperative metabolic acidosis occurred in these three patients. All of the patients thrived and are awaiting their definitive bladder reconstruction, bladder diversion reversal, and possible colonic pull-through.

Conclusions

We propose an alternative approach to the newborn operation for cloacal exstrophy whereby the cecal plate is left in situ, which allows for auto-augmentation of the bladder, eliminates the potential for postoperative bacterial overgrowth related to cecal dysmotility, is a technically easier operation to perform, preserves the cecal vascularity, and conserves the appendices which may be useful as catheterizable urinary channels in the future.

Abbreviations: None

Q45

PREVALENCE OF HIRSCHSPRUNG DISEASE AMONG CHILDREN PRESENTING WITH COLONIC VOLVULUS: A MULTI-CENTER RETROSPECTIVE ANALYSIS

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1Cincinnati Children's Hospital, New York, NY, USA, 2Cincinnati Children's Hospital, Cincinnati, OH, USA

Abstract: Purpose: Hirschsprung disease (HD) is typically diagnosed in the neonatal period, with a minority of patients diagnosed in a delayed fashion after suffering from chronic abdominal distension or constipation. While colonic volvulus can occur in patients with colonic dysmotility, it remains uncommon in the pediatric population. There are currently no established screening guidelines for HD in children presenting with colonic volvulus, and existing data on the incidence of HD in children presenting with colonic volvulus is limited to small single-institution case series. We evaluated the association between colonic volvulus and HD in a national multi-institution sample, to better elucidate the utility of HD work-up in this patient population.

Methods: We queried the Pediatric Health Information System (PHIS) for cases of colonic volvulus confirmed through procedural intervention between 2017 and 2022. We summarized clinical and demographic variables and reported the incidence of HD diagnosis within this cohort.

Results: A total of 467 patients with colonic volvulus from 48 children's hospitals were identified, with a median age at presentation of 12 years (interquartile range: 6, 16). Two-thirds (n=308) underwent surgical intervention involving colonic resection during the index admission, while 7.9% (n=37) received endoscopic decompression alone. Eight patients (1.7%) had a diagnosis of HD, four of whom were diagnosed prior to presenting with colonic volvulus (Table 1). Among those diagnosed with HD, the median age at volvulus presentation was 3 years (interquartile range: 0, 9). Of the 463 patients without an initial HD diagnosis, only 12.5% (n=58) underwent rectal biopsy, with 6.9% of those biopsies resulting in a diagnosis of HD. Notably, three of the four children diagnosed with HD post-volvulus had a prior admission for constipation; similarly, 38.1% of those without HD had a prior admission for constipation (n=175).

Conclusion: Hirschsprung disease was diagnosed in less than 2% of children presenting with colonic volvulus, yet rectal biopsy was performed in only 12.5% of all presenting patients. Nearly 7% of those who underwent rectal biopsy were subsequently diagnosed with Hirschsprung disease. These findings suggest that rectal biopsy should be routinely performed in patients with colonic volvulus to facilitate timely diagnosis of Hirschsprung disease.

Abbreviations: HD: Hirschsprung disease
PHIS: Pediatric Health Information System

Variable	All patients N = 467	Patients with Hirschsprung disease N = 8
Median age at presentation in years, (IQR)	12 (6, 16)	3 (0, 9)
Female gender, n (%)	205 (43.9)	0 (0.0)
Intervention for volvulus*, n (%)		
Endoscopic decompression alone	37 (7.9)	2 (25.0)
Colonic resection	308 (66.0)	4 (50.0)
Ileostomy or colostomy creation	126 (27.0)	5 (62.5)
Underwent rectal biopsy†, n (%)	58 (12.5)	4 (100.0)
Prior admission for constipation‡, n (%)	178 (38.1)	3 (75.0)

*Intervention categories are not mutually exclusive
†Denominator is patients who were not diagnosed with Hirschsprung disease prior to volvulus episode: N = 463 for all patients and N = 4 for patients with Hirschsprung disease
IQR: Interquartile range

Q46

A MULTICENTER RETROSPECTIVE REVIEW ON BOWEL PREPARATION PRACTICES FOR PEDIATRIC OSTOMY REVERSALS

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1Cohen Children's Medical Center, Northwell Health, Manhasset, NY, USA, 2University of North Carolina- Chapel Hill, Chapel Hill, NC, USA, 3Columbia University, New York City, NY, USA, 4Columbia University- New York Presbyterian- Morgan Stanley Children's Hospital, Wayne, NJ, USA, 5Boston Children's Hospital, Boston, MA, USA, 6Boston Children's Hospital, Boston, MA, USA, 7Children's National Hospital, Washington, DC, USA, 8Johns Hopkins, Baltimore, MD, USA, 9Johns Hopkins All Children's Hospital, St Petersburg, FL, USA, 10Children's of Alabama, Birmingham, AL, USA, 11Children's of Alabama, University of Alabama at Birmingham, Birmingham, AL, USA, 12Division of Pediatric Surgery, Department of Surgery, Massachusetts General Hospital, Boston, MA, Boston, MA, USA, 13Mass General for Children, Massachusetts General Hospital, Boston, MA, USA, 14Emory University School of Medicine and Children's Healthcare of Atlanta, Atlanta, GA, USA, 15Children's Healthcare of Atlanta, Atlanta, GA, USA, 16Connecticut Children's Medical Center, Hartford, CT, USA, 17CHOP, Philadelphia, PA, USA, 18New York Presbyterian-Weill Cornell / The Children's Hospital of Philadelphia, Philadelphia, PA, USA, 19UPMC Children's Hospital of Pittsburgh, University of Pittsburgh, Pittsburgh, PA, USA, 20UPMC Children's Hospital of Pittsburgh, University of Pittsburgh, Pittsburgh, PA, USA, 21Yale New Haven Children's Hospital, New Haven, CT, USA, 22University of Florida, Gainesville, FL, USA, 23University of Florida, Gainesville, FL, USA, 24Pennsylvania State University, University Park, PA, USA, 25The Pennsylvania State University, University Park, PA, USA, 26Cleveland Clinic Children's, Cleveland, OH, USA, 27Cleveland Clinic Children's Hospital, Cleveland, OH, USA, 28Duke University, Durham, NC, USA, 29University of North Carolina, Chapel Hill, NC, USA, 30Cohen Children's Medical Center/Northwell Health, New Hyde Park, NY, USA, 31Eastern Pediatric Surgery Network, Baltimore, MD, USA

Abstract: Purpose: Utilization of bowel preparation (BP) prior to pediatric ostomy reversal is not standardized and approaches vary among surgeons. The aim of this study was to describe the practice patterns of BP within a regional consortium of children's hospitals.

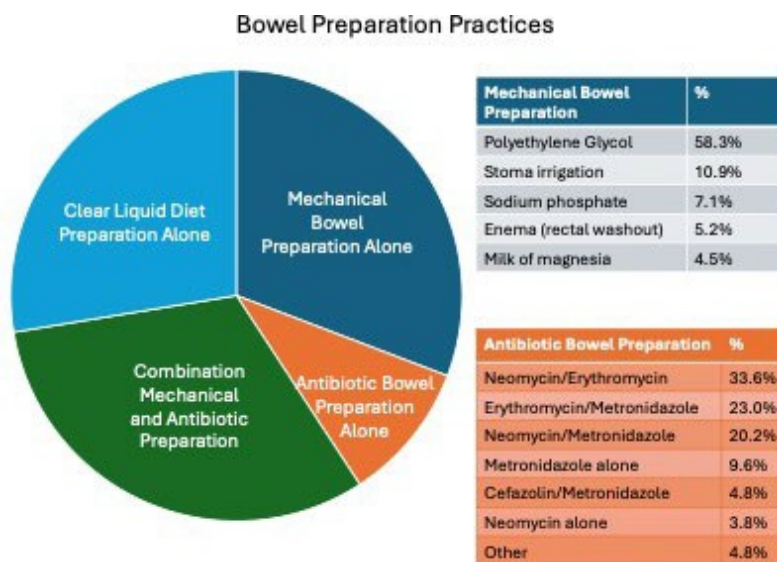
Methods: Sixteen member institutions retrospectively reviewed BP practices for children < 2 years old with diagnoses of anorectal malformation and Hirschsprung's disease undergoing colostomy reversals (2017-2023). Preparations included mechanical BP, antibiotic BP, or instruction for clear liquid diet the day prior to surgery.

Results: There were 501 cases collected with diagnoses of Hirschsprung's Disease (15%) and anorectal malformation (85%). The mean age of the cohort was 10.1 months. 251 (50.1%) patients had no BP, 77 (15.4%) had mechanical BP alone, 25 (5.0%) had antibiotic BP, 79 (15.8%) had a

combination of antibiotic and mechanical BP, and 69 (13.8%) had pre-operative clear liquid diet only. Practices varied widely by institution; the median usage within an institution was 44.0% (IQR 7.7%-66.7%). BP strategies significantly varied regarding the type of mechanical or antibiotic BP (Figure). Most mechanical BP were with polyethylene glycol (58.3%), and the majority of antibiotic BP were with neomycin and erythromycin (33.6%). Intra-operative rectal washout was performed in 159 (31.7%) of patients, with similar utilization rates between patients who underwent BP and those who did not. For patients who received BP, documentation of preparation quality was noted to be good to excellent in 11 patients (4.4%) and poor to inadequate in 3 patients (1.2%), whereas it was not documented in the remaining 236 patients.

Conclusion: BP utilization and strategies vary widely between and within institutions. Understanding the practices decisions relating to the choice of BP for pediatric surgeons will guide further efforts to understand how to provide effective evidence-based guidelines for pre-operative BP to improve outcomes in children.

Abbreviations: BP: Bowel Preparation



Friday, May 9, 2025

Plenary 3 - Standardization of Care

9:15 AM – 10:45 AM

21

REDUCTION OF PROPHYLACTIC ANTIBIOTICS FOR ELECTIVE PEDIATRIC CHOLECYSTECTOMY: A QI INITIATIVE TO PROMOTE ANTIMICROBIAL STEWARDSHIP

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1Nationwide Children's Hospital, Columbus, OH, USA, 2Department of Pediatric Surgery, Center for Perinatal Research, Nationwide Children's Hospital; Department of Surgery, Virginia Commonwealth University Health, Columbus, OH, USA, 3Division of Pediatric Surgery, Department of Surgery, Nationwide Children's Hospital, The Ohio State University College of Medicine, Columbus, OH, USA, Columbus, OH, USA, 4Nationwide Children's Hospital/ The Ohio State University, Columbus, OH, USA

Abstract: Purpose: While antibiotic prophylaxis may minimize the risk of post-operative infections, overtreatment can lead to antimicrobial resistance and infectious colitis. Although well-studied in adults, there is a paucity of literature regarding the need for prophylactic antibiotics for elective cholecystectomy in children. We initiated a quality improvement project aimed to decrease prophylactic antibiotic use for elective cholecystectomies from 100% to $\leq 50\%$ and maintain that rate for 9 months.

Methods: Pediatric surgeons, anesthesiologists, peri-operative nursing, and antimicrobial stewardship were stakeholders. Prior to initiation, changes to the pre-operative order set were made, education was provided to all practitioners, and consensus was achieved from all surgeons after careful review of the (mostly adult) literature. All patients undergoing elective minimally invasive (laparoscopic or robotic) cholecystectomy were included. Exclusion criteria included acute cholecystitis, choledocholithiasis, immunocompromised state, or performance of a combined procedure. Compliance was measured by chart review, with feedback provided to surgeons in cases of noncompliance. Project initiation was 1/24. Data were collected for 12 months prior (1/23-12/23) and nine months after initiation (1/24-9/24). The balancing measure was surgical site infection (SSI).

Results: 153 patients underwent minimally invasive cholecystectomy during the study period. Eighty-two patients met inclusion criteria - 40 pre-protocol and 42 post-protocol. Median age at surgery was 16 years (IQR 14, 17.2). Seventy (85%) patients were female; the median post-procedure length of stay was 6.4 hours (IQR 2.3,23). Pre-implementation, all patients (n=40) received prophylactic antibiotics. In the first three months post-implementation, only 3/16 (19%) received antibiotic prophylaxis (due to inadequate communication with anesthesia), and in the subsequent 6 months, 0/26 (0%) received antibiotic prophylaxis (Figure 1). Ten patients in the post-implementation group (24%) had bile spillage intraoperatively, with only 3 receiving antibiotics (2 prophylactic and 1 intraoperative). One (2.5%) patient in the pre-implementation group was noted to have an SSI requiring antibiotics vs. 2 (4.7%) patients in the post-implementation group (p=0.59).

Conclusion: We were able to decrease the use of prophylactic antibiotics for elective minimally invasive cholecystectomies from 100% to 12% without increasing the rate of SSI. Appropriately decreasing the use of prophylactic antibiotics can decrease the risk of antimicrobial resistance.

Abbreviations: SSI = surgical site infection
UCL = upper control limit

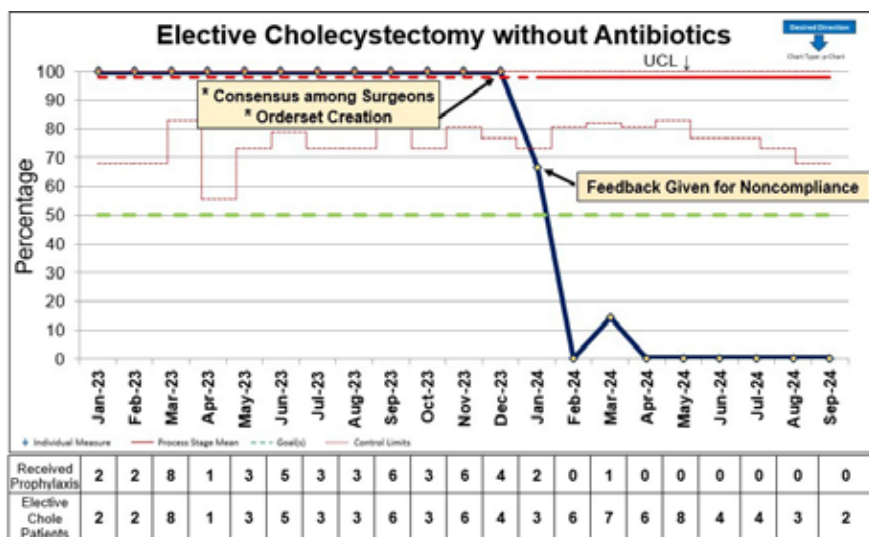


Figure 1. P chart showing the rate of antibiotic prophylaxis for elective minimally invasive cholecystectomies for 12 months pre-implementation and 9 months post-implementation. UCL = upper control limit

PRE-OPERATIVE BOWEL PREPARATION DECREASES COMPLICATIONS IN CHILDREN UNDERGOING COLOSTOMY REVERSALS

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Abstract: Purpose: Pre-operative practices of bowel preparation (BP) before pediatric colorectal surgery are varied with unclear efficacy. This study aimed to determine the impact of BP on complications after colostomy reversals in young children.

Methods: A multi-institutional retrospective review was performed for children ≤ 2 years old with a diagnosis of anorectal malformations or Hirschsprung's disease and underwent colostomy reversal between 2017-2023. Patients were grouped by BP type, including antibiotic bowel preparation (ABP) and/or mechanical bowel preparation (MBP), or preoperative clear liquid diet (CLD). Chi-square analyses were used to compare outcomes between groups.

Results: 501 cases were included from 16 institutions, of which 427 (85%) had anorectal malformations and 74 (15%) had Hirschsprung's disease. BP was not used in 251 cases (50.1%).

Of the 250 patients who had BP, strategies included ABP alone (N=25, 10.0%), MBP alone (N=77, 30.8%), ABP and MBP (N=79, 31.6%), and CLD (N=69, 27.6%). 159 patients (31.7%) also underwent on-table rectal washout (32% of no BP and 31% of BP patients). 453 patients (90.1%) had open surgery, 471 (94.0%) underwent hand-sewn anastomosis, and 440 (87.8%) had primary skin closure of the ostomy site. 185 patients (36.9%) received post-operative antibiotics beyond 24hrs. There were no significant differences in baseline demographics, operative time or approach, and closure techniques between no BP and BP patients. No BP patients had longer LOS (6.4 v. 4.8 days, $p=0.031$), higher incidence of anastomotic leak (3.6% v. 0.4%, $p=0.037$), increased wound dehiscence (4.4% v. 0.8%, $p=0.038$) and return to the OR (9.2% v. 1.6%, $p<0.001$) compared to BP patients. In a sub-analysis comparing no BP, MBP and/or ABP, and CLD, the rates of anastomotic leak and wound dehiscence remained higher in the no BP group; however, there was no difference between MBP and/or ABP and CLD groups (Table).

Conclusion: These data represent the largest study of BP in children and suggest BP may decrease rates of anastomotic leak, wound dehiscence, and return to the OR. CLD may afford similar protection against complications as MBP and/or ABP. Future prospective randomized trials are warranted to understand efficacy of BP strategies and optimize best-practices in children.

Abbreviations: BP, bowel preparation; MBP, mechanical bowel preparation; ABP, antibiotic bowel preparation; CLD, clear liquid diet

Table: Bowel Preparations and Complications

			Total Cohort N=501	No BP N=251	MBP and/or ABP N=181	CLD Only N=69	p-value
	0.139	No complications	415 (82.8%)	205 (81.7%)	157 (86.7%)	53 (76.8%)	
	0.740	Surgical site infection	14 (2.8%)	8 (3.2%)	5 (2.8%)	1 (1.4%)	
1 (1.4%)	0.605	Deep space infection		6 (1.2%)	4 (1.6%)	1 (0.6%)	
0 (0%)	0.037	Anastomotic leak		10 (2.0%)	9 (3.6%)	1 (0.6%)	
1 (1.4%)	0.038	Wound dehiscence		13 (2.6%)	11 (4.4%)	1 (0.6%)	
1 (1.4%)	0.147	Enterocolitis		9 (1.8%)	2 (0.8%)	6 (3.3%)	
2 (1.1%)	0.875	Intestinal obstruction		3 (1.2%)	2 (0.8%)	2 (0.8%)	
6 (3.3%)	0.399	Prolonged ileus requiring decompression		22 (4.4%)	11 (4.4%)		
3 (1.7%)	0.001	Return to the operating room		22 (4.4%)	11 (4.4%)		

BP, bowel preparation; patients who received no BP; CLD, clear liquid diet; MBP, mechanical bowel preparation; ABP, antibiotic bowel preparation; CLD, clear liquid diet

Table: Comparison of outcomes between patients who did not receive BP and patients who received BP. P-values represent comparison between the two groups by chi-square analysis. BP, bowel preparation; MBP, mechanical bowel preparation; ABP, antibiotic bowel preparation; CLD, clear liquid diet

FEELING THE DIFFERENCE: LONG-TERM SENSORY OUTCOMES FOLLOWING THE MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM WITH AND WITHOUT INTERCOSTAL NERVE CRYOABLATION

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Abstract: Introduction

The minimally invasive repair of pectus excavatum (MIRPE) involves implanting metal bars to reshape the chest wall. Intercostal nerve cryoablation (INC) during MIRPE provides effective post-operative analgesia, but the long-term sensory effects of MIRPE/INC on the chest wall remain unclear. The study aimed to compare chest wall sensation at pectus-bar removal in patients who previously had MIRPE with and without INC.

Methods

We conducted a multi-institutional prospective study of patients ≤21 years who underwent MIRPE with and without INC and subsequently presented for pectus bar removal between 1/11/2021-8/18/2024. Participants underwent chest wall sensory testing with dermatomal mapping pre-bar removal at 2- and 8-weeks post-bar removal. Demographics and operative details of MIRPE and INC were reviewed. Chest wall hypoesthesia to cold, soft touch and pinprick stimulation were compared between groups.

Results

Among 164 participants that were enrolled, 86% were male with a median age of 18.3 [IQR:17.2-19.3] years at bar removal and a median duration of pectus bar implantation of 3.0 [IQR:2.9-3.1] years. INC was performed in 78% (n=130) of patients during MIRPE and a median of 8 [IQR:8-10] nerves were treated. Compared to no INC, INC patients were more likely to have >1 pectus bar (82% vs 46%, $p < 0.001$) and pericostal suture fixation (85% vs 60%, $p = 0.004$). Sensory examination prior to bar removal revealed chest wall hypoesthesia to ≥1 dermatome in 58% of ICN vs 50% of no ICN ($p = 0.451$); and hypoesthesia to ≥2 dermatomes in 47% ICN vs 25% no ICN ($p = 0.022$). Among patients with hypoesthesia prior to bar removal and complete follow up, sensation returned to normal at follow-up in 42% (21/50) of ICN and 33% (1/3) of No ICN, $p = 0.767$. Figure 1 demonstrates the proportion of patients with normal sensation over time. On multivariable regression, persistent hypoesthesia was not associated with INC, pericostal suture use, or implantation of more than 1 bar ($p > 0.05$).

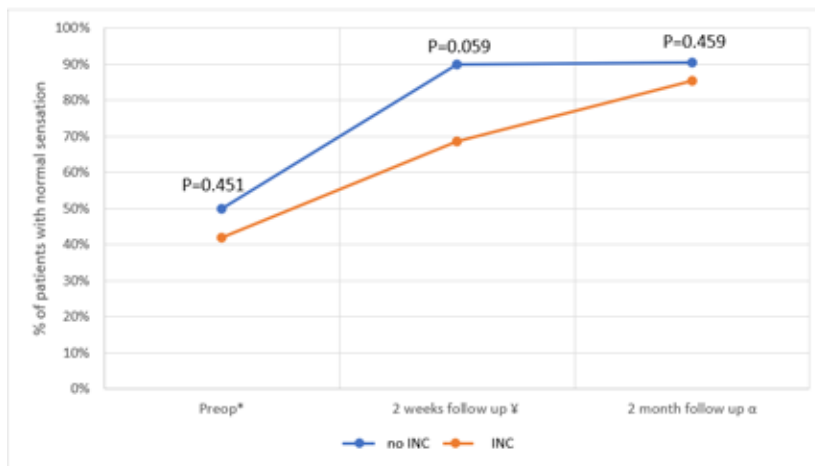
Conclusion

Three years following MIRPE, hypoesthesia to 1-2 dermatomes is common prior to bar removal and was not found to be associated with intercostal nerve cryoablation. Chest wall sensation is normal in approximately 80% of all patients following bar removal.

Abbreviations: Intercostal Nerve Cryoablation - INC

Minimally invasive repair of pectus excavatum - MIRPE

Figure 1. Proportion of patients with normal sensation over the duration of the study.



*INC n=130, No INC n=36

‡ INC - normal sensation on preoperative sensory exam and patients with 2 week follow-up (n=102); No INC - normal sensation on preoperative sensory exam and patients with 2 week follow-up (n=20)

α INC - normal sensation on preoperative sensory exam or at 2 week follow-up and patients with 2 month follow-up (n=89); No INC normal sensation on preoperative sensory exam or at 2 week follow-up and patients with 2 month follow-up (n=21)

IMPLEMENTATION YIELDS SUCCESS – RESULTS OF THE ENHANCED RECOVERY IN CHILDREN UNDERGOING SURGERY (ENRICH-US) RANDOMIZED CONTROLLED TRIAL

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Abstract: Purpose: Although enhanced recovery protocols (ERP) have transformed many areas of surgical care, their implementation and evaluation in pediatric surgery have lagged. The purpose of the ENhanced Recovery in CHildren Undergoing Surgery (ENRICH-US) study was to implement and evaluate the effectiveness of a 17-element pediatric ERP in gastrointestinal (GI) surgery.

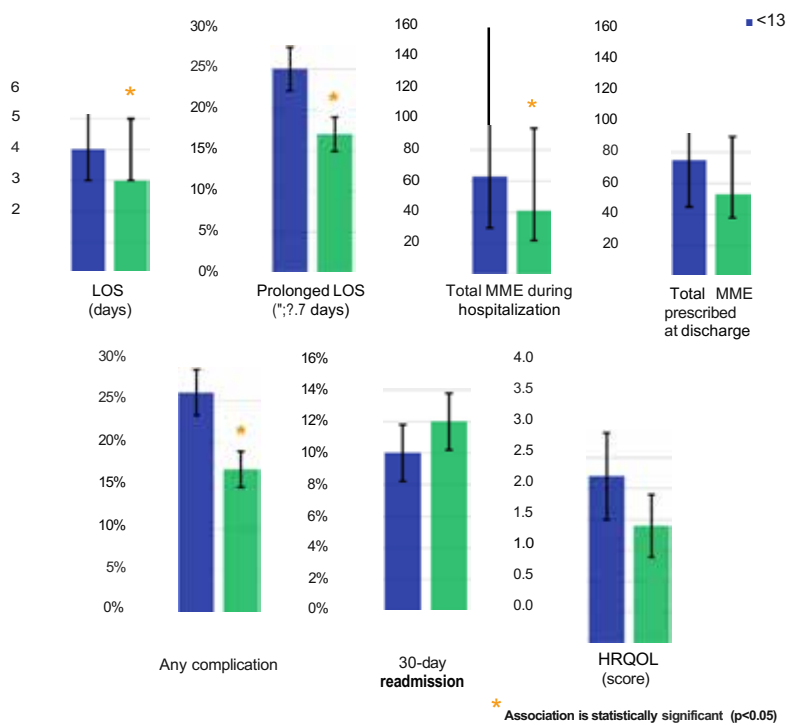
Methods: This national, prospective, stepped-wedged, cluster-randomized trial was conducted at 18 U.S. children's hospitals from 9/2019-6/2024 in patients 10-18 years old undergoing elective GI surgery. Hospitals were evaluated across three ERP study phases: baseline, implementation, and sustainability. The implementation phase involved extensive education, cross-collaboration, and access to resources. The primary outcome was surgical length of stay (LOS). Secondary clinical outcomes included opioid use, complications, 30-day readmission, and patient-reported health-related quality of life (HRQOL). Associations between clinical outcomes and study phase, as well as, patient-level implementation, defined as the number of ENRICH-US elements per patient, were evaluated using chi-square tests, Kruskal-Wallis tests, and ANOVA.

Results: Of 597 patients, 433 (73%) had inflammatory bowel disease. Procedures included bowel resection/stricturoplasty (206, 35%), ostomy creation with/without colectomy (113, 19%), ostomy closure (158, 26%), and J-pouch creation (120, 20%). Across the study phases, there was no significant difference in median LOS (4 days) or secondary outcomes, except for opioid use. Total morphine milligram equivalents (MME) both during the hospitalization and prescribed at discharge decreased ($p < 0.001$). The median number of ENRICH-US elements per patient by phase was 11 (10-13), 14 (12-15), and 14 (13-15), respectively ($p < 0.001$). Patients who received ≥ 13 elements had shorter median LOS compared to those who received < 13 (3 versus 4 days, $p < 0.001$, FIGURE). Among patients who received ≥ 13 elements, the proportion with prolonged LOS (≥ 7 days) decreased from 26% to 17% ($p = 0.008$), and there was a lower incidence of complications ($p = 0.006$).

Conclusion: Patients who received more ENRICH-US elements had shorter median LOS, particularly benefiting those who may have experienced prolonged LOS. By study phase, opioid use decreased both during the hospitalization and at discharge. Gaining a more robust understanding of the role of implementation on clinical outcomes is a critical next step to optimizing future dissemination of pediatric enhanced recovery protocols.

Abbreviations: ERP: enhanced recovery protocol
ENRICH-US: ENhanced Recovery In CHildren Undergoing Surgery
GI: gastrointestinal
LOS: Length of stay
HRQOL: Health-related quality of life
MME: morphine milligram equivalent

FIGURE. Clinical Outcomes by Patient-Level Implementation (<13 versus ≥13 ENRICH-US elements)



WORK RELATIVE VALUE UNITS AND THE ASSOCIATION WITH OPERATIVE TIME AND SURGICAL COMPLEXITY: A PEDIATRIC NSQIP ANALYSIS

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Abstract: Purpose

In the United States, physician compensation for surgical procedures is largely based on Current Procedural Terminology (CPT)-specific work Relative Value Units (wRVUs), which are meant to reflect operative time, technical skill and effort, mental effort and judgement, and stress. We sought to determine if operative time and case complexity are appropriately compensated for in pediatric surgical procedures.

Methods

The ACS Pediatric NSQIP database was surveyed for procedures that individually accounted for at least 0.1% of the database in the year 2022. The median operative time and complication rates for these procedures from 2018-2022 were calculated. Major complications were defined as complications that cause significant deviation from the typical clinical course for the index procedure, as determined by the authors. Complications defined as minor were those that were judged to have little effect on a patient's expected clinical course or outcome. These were utilized as a surrogate for case complexity. 2022 wRVU and median operative time were used to calculate wRVU per hour of operative time (wRVU/h). Linear regression analysis was utilized to investigate the relationship between operative time and wRVU, operative time and wRVU/h, and complication rate and wRVU/h.

Results

Linear regression analysis demonstrated a moderate positive association between median operative time and wRVU ($R^2 = 0.2265$, $p < 0.0001$). For every additional hour of operative time, however, there was an associated decreased in wRVU/hr by 2.16 (or 0.36 for every 10 minutes, $R^2 = 0.0525$, $p = 0.0019$). The association of major complications and wRVU/hr was found to be weakly positive but just under the threshold of clinical significance ($R^2 = 0.0205$, $p = 0.0547$). Minor complications were not significantly associated with wRVU/h.

Conclusions

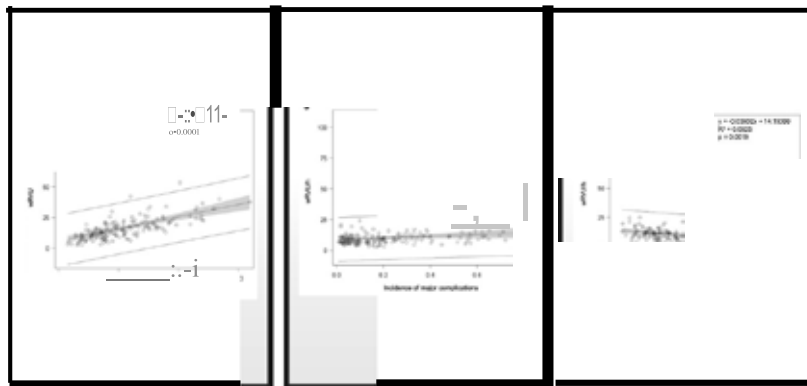
We conclude that for pediatric surgical procedures, compensation is positively correlated with operative time, but the current wRVU system significantly favors shorter procedures. Case complexity is only weakly correlated with wRVU and below the threshold of statistical significance, suggesting that the wRVU system is not adequately compensating pediatric surgeons for the increased stress and effort experienced when performing complex procedures.

Abbreviations: wRVUs = work relative value units

NSQIP = National Surgical Quality Improvement Program

CPT = Current Procedural Terminology

Figure 1



IMPROVED MORTALITY IN GASTROSCHISIS PATIENTS AFTER IMPLEMENTATION OF A STANDARDIZED MANAGEMENT BUNDLE IN CENTRAL MALAWI: A SINGLE-CENTER FOLLOW-UP AT FOUR YEARS

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Abstract: Purpose: While mortality from gastroschisis was 2% in North America in 2023, it remains 60 – 80% in many countries in Sub-Saharan Africa (SSA). In 2019, a gastroschisis management bundle was implemented in 7 tertiary pediatric surgery centers in SSA, showing significant improvement in mortality after one year. We sought to compare outcomes four years post-intervention.

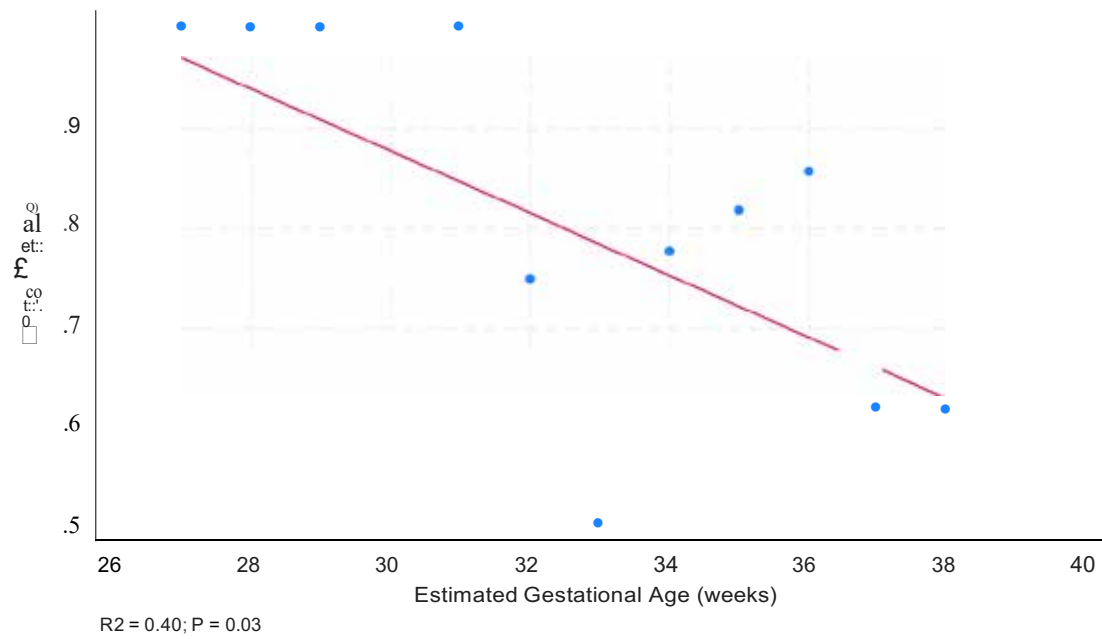
Methods: We retrospectively reviewed prospectively collected data at a tertiary pediatric surgery center in Malawi. All patients presenting with gastroschisis between June 2023 and June 2024 were included. The primary outcome was in-hospital mortality. We compared the contemporary data to the one-year post-implementation data from October 2019 to October 2020 using the 2-proportion Z-test. Secondary analysis was performed on the contemporary cohort: the T-test was used to compare the mean weight between patients who died versus survived, and linear regression was performed to correlate gestational age with mortality.

Result: Ninety-nine patients with gastroschisis were admitted to the contemporary group compared to 55 in the post-implementation group, demonstrating an 80% increase in disease burden at this facility. Of the 55 patients who consented to the initial study in the post-implementation group, 50 died (90.9%). Among the contemporary group, 97% (n=96) of patients were transferred from another facility, and 92.9% (n = 92) presented within the first day of life. Forty eight percent (n = 48) were male. The mortality rate improved from 90.9% (50/55) to 71.7% (71/99) (p = 0.005). The mean admission weight in the contemporary group was 2.13kg (95% CI 2.03–2.23) for those who died versus 2.39kg (2.25–2.53) for those who survived (p = 0.002). Gestational age was inversely related to mortality (R² = 0.40, p = 0.03) (Figure 1).

Conclusion: Overall mortality among gastroschisis patients in SSA remains much higher than that in high-income countries. However, this study highlighted continued improvement in survival four years after implementing the district- and tertiary-hospital management protocols. The data also demonstrate that prematurity and low birthweight are risk factors for death. These data may help clinicians make patient- and family-centered treatment decisions in similar low-resource settings.

Abbreviations: Sub-Saharan Africa (SSA)

Figure 1: Effect of gestational age on mortality among neonates with gastroschisis.



COST-EFFECTIVENESS OF METABOLIC AND BARIATRIC SURGERY IN ADOLESCENTS: A 10-YEAR ANALYSIS

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Abstract: Purpose

Obesity affects approximately one in five children in the United States with an estimated annual medical cost of \$1.3 billion. While metabolic and bariatric surgery provides substantial weight-loss and improvement in weight-related comorbidities in adolescents with severe obesity, there are limited data regarding its long-term cost-effectiveness.

Methods

A patient-level, state-transition model was developed to assess the cost-effectiveness of three strategies: Roux-en-Y gastric bypass (RYGB), vertical sleeve gastrectomy (VSG), and no surgery over 10 years. Demographic, pre-operative, and postsurgical outcomes for the model's hypothetical cohort were based on the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) study. A non-surgical comparator group was modeled from a separate cohort study of adolescents with obesity who did not undergo bariatric surgery. Costs of surgery, complications, micronutrient deficiency management, and total direct health care were incorporated. Quality-of-life was dependent on surgical complications, type 2 diabetes status, and BMI reduction. Endpoints included quality-adjusted life years (QALY), total costs, and incremental cost-effectiveness ratios (ICERs). A willingness-to-pay (WTP) threshold of \$100,000 per QALY gained was used to determine cost-effectiveness. To assess the impact of model uncertainty on cost-effectiveness results, one-way and probabilistic sensitivity analyses were performed.

Results

Over 10 years, no surgery, VSG, and RYGB were estimated to cost \$40,882, \$72,048, and \$79,626, respectively (Table 1). RYGB was associated with the most QALYs at a value of 6.888 compared to no surgery and VSG at 6.117 and 6.875, respectively. The ICER of VSG versus no surgery was \$41,164 per QALY gained, which was below our WTP threshold of \$100,000 per QALY gained. Therefore, VSG was cost-effective over 10 years. When compared with VSG, RYGB had an ICER of \$557,751 per QALY gained and was not cost-effective. However, when RYGB was compared with no surgery in a scenario where VSG was unavailable, it was cost-effective with an ICER of \$50,271 per QALY gained.

Conclusion

Our model demonstrates that VSG and RYGB are cost-effective when compared to no surgery alone. However, when all three strategies were simultaneously compared, VSG was the cost-effective option.

Abbreviations: Roux-en-Y gastric bypass (RYGB)

Vertical sleeve gastrectomy (VSG)

Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS)

Quality-adjusted life years (QALY)

Incremental cost-effectiveness ratio (ICER)

Willingness-to-pay (WTP)

Table 1: Cost-Effectiveness Results

Strategy	Total Cost(\$)	QALYs	ICER (\$/QALY gained)	
			vs. no surgery	vs. VSG
No surgery	40,882	6.117	REF	
SG	72,048	6.875	41,164	REF
RYGB	79,626	6.888	50,271	557,751

Abbreviations: VSG, vertical sleeve gastrectomy; RYGB, Roux-en-Y gastric bypass; QALYs, quality-adjusted life years; ICER, incremental cost-effectiveness ratio; REF, reference

MULTICENTER PEDIATRIC SURGERY QUALITY COLLABORATIVE (PSQC) NSQIP PILOT STUDY: PEDIATRIC COLORECTAL SURGERY BUNDLE UTILIZATION

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Abstract: Purpose:

Evidence-based checklists have been shown to decrease surgical site infections in pediatric colorectal surgery. PSQC implemented a pilot study of a colon bundle checklist across 27 centers in 2023 using the NSQIP platform. The purpose of this study was to analyze bundle compliance in a multicenter surgical quality initiative and identify checklist item specific compliance rates.

Methods:

A seven-item perioperative and postoperative colon bundle checklist was implemented based on literature and pilot site discussions. After custom variables were created for the checklist items on the NSQIP platform, pediatric colorectal cases were identified and analyzed from January, 2023 to March, 2024. Plan-Do-Study-Act (PDSA) cycles were performed throughout the study period. Bundle compliance of the seven checklist items were analyzed between control sites vs implementation sites.

Results:

A total of 226 pediatric colorectal cases were analyzed from January, 2023 to March, 2024. 118 cases were abstracted from the implementation sites. 108 cases were abstracted from the control sites. 25 out of 27 sites improved their overall bundle compliance rate during the study period (mean compliance rate of 1.90 to 2.86, $p=0.002$). Implementation sites improved their compliance rate significantly during the study period, from 2.07 to 3.24 ($p=0.012$). Control sites did not see statistically significant improvement, from 1.71 to 2.44 ($p=0.079$). The checklist item most adhered to was antibiotic administration prior to skin incision, 116 (50.9%), and least adhered to was preoperative umbilical cleansing, 48 (21.1%). Implementation sites outperformed control sites in preoperative umbilical cleansing (32 vs 16, $p=0.041$) and discontinuation of antibiotics 24 hours postoperative (50 vs 27, $p=0.006$). Decrease in superficial surgical site infection (5.2% vs 8.4%, $p=0.343$) and mean length of stay (8.37 days vs 10.73 days, $p=0.425$) in implementation vs control sites were not statistically significant.

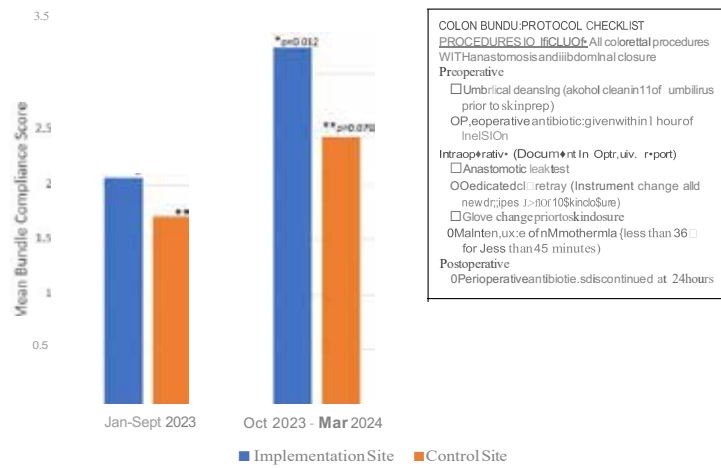
Conclusions:

We present the largest pediatric colorectal multicenter NSQIP initiative of colon bundle checklist utilization. Significant compliance improvement, albeit imperfect, over 18 months reflects a realistic adoption rate of a multicenter initiative using NSQIP platform. Future direction will include identifying high performing sites' implementation modalities and site-specific engagement methods. Ongoing data collection with a larger dataset and continued compliance improvement may potentially show statistically significant clinical improvement.

Abbreviations: PDSA cycle: Plan-Do-Study-Act cycle

PSQC: Pediatric Surgery Quality Collaborative

Figure 1: Comparison of Implementation Site and Control Site's Pediatric Colorectal Surgery Bundle Mean Compliance Scores Across Two Time Periods



PLEURAL DRAIN PLACEMENT FOLLOWING RESECTIONAL LUNG SURGERY IN CHILDREN: A PROSPECTIVE OBSERVATIONAL STUDY OF THE WESTERN PEDIATRIC SURGERY RESEARCH CONSORTIUM

Anastasia M. Kahan, MD¹, Lorraine I. Kelley-Quon, MD MSHS², Shannon Acker, MD³, Justin Lee, MD⁴, David H. Rothstein, MD, MS⁵, Stephanie D. Chao, MD⁶, on behalf of the Western Pediatric Surgery Research Consortium

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Abstract: Purpose

Pleural drains (PD) are routinely used after thoracic surgery in children despite evidence that drainage is not always necessary. The purpose of this study was to provide a contemporary characterization of the use of pleural drains after resectional lung surgery in children, assess the utility of an intraoperative air leak test, and evaluate post-operative pleural drain management.

Methods

A multi-institutional prospective cohort study was performed at 10 free-standing children's hospitals in the United States from 2023-2024. Children < 18 years old who underwent open or thoracoscopic wedge resection or lobectomy were included. Children with spontaneous pneumothorax, bi-lobectomy, pneumonectomy, trauma, or ECMO were excluded. Intraoperative air leak testing was performed in the OR under direct visualization. Operative parameters, intra-operative air leak, length of post-operative drain placement, and number of post-operative chest x-rays were evaluated using bivariate comparisons.

Results

156 children were included: 83 (53.2%) underwent wedge resection, and 73 (46.8%) underwent lobectomy. 139 patients (89.1%) had PD vs 17 (10.9%) without. Air leak testing was performed for 138 children. A negative air leak test was confirmed in 112 children (81.2%) and 98 (87.5%) still received PD. Of the 56 children undergoing wedge resection with air leak test results available, 43 (76.8%) had a negative leak test and still received PD. None of the 16 cases without PD required subsequent insertion of PD postoperatively due to the development of symptomatic pneumothorax or pleural effusion. The mean number of days of post-operative drainage for children with post-operative PD and a negative intraoperative air leak test was 1.9±1.7. Children with PD and a negative air leak test had significantly more post-operative chest x-rays compared to those without (5.6 vs 3.0, p=0.003).

Conclusion

Pleural drain placement after resectional lung surgery in pediatric patients is routine. However, the high proportion of negative intraoperative leak testing and subsequent early removal of the pleural drains suggests that index placement may not have been necessary. Additionally, pleural drain placement results in significantly more postoperative radiation exposure. Randomized control trials of pleural drainage after thoracic surgery are needed to examine further if the routine use of pleural drainage is necessary.

Abbreviations: ECMO = extracorporeal membranous oxygenation

PD = pleural drain

	Wedge	Lobe	P-value
% leaving OR with pleural drain	67183 (80.7)	72113 (98.6)	<0.001
% with air leak in OR*	12168 (17.7)	14170 (20.0)	0.72
Average # pleural drainage days	2.2	2.3	0.89
Average # air leak days	0.5	0.7	0.44
Average # CXR	5.7	5.8	0.80
% removed on water seal	51161 (83.6)	62169 (90.0)	0.29

* 18 patients did not have air leak data recorded

SMALL CHANGE, BIG IMPACT: PROPOSAL OF THE BRAIN INJURY GUIDELINES FOR KIDS (KBIG)

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Abstract: Introduction

The Brain Injury Guidelines (BIG) have been widely adopted by adult trauma centers to identify low-risk intracranial hemorrhage and minimize resource utilization. In this study, we investigate the safety of BIG in our pediatric trauma population. We hypothesize that BIG is safe in children and that similar guidelines should be implemented to optimize resource utilization, decrease repeat imaging, and prevent unnecessary transfers in pediatric trauma.

Methods

All pediatric trauma patients < 18 years with traumatic brain injury (TBI) from January 2018 through December 2023 were retrospectively reviewed. Registry data was used to identify patient and injury characteristics, and detailed chart review was performed to categorize all patients into the modified BIG score. Based on our data, we created a pediatric-specific BIG criterion.

Results

1915 patients with TBI, including intracranial hemorrhage and isolated skull fractures, were identified during the study period. The median age was 5.6 years (1.0, 12.5), 61% were male, 78% were Caucasian, and the most common mechanism was fall (48%). There were 906 BIG-3 patients, of which 231 (25%) needed neurosurgical intervention, and all BIG-3 patients were excluded from further analysis. Based on our current practices, we altered the modified BIG guidelines to allow nondisplaced skull fractures in BIG-1. There were 427 BIG-1 and 215 BIG-2 patients, and 0 (0%) BIG-1 and 9 (4%) BIG-2 patients required neurosurgical intervention. We created a 4th category, BIG-0, that included isolated skull fractures without intracranial hemorrhage that otherwise met BIG-1 inclusion. There were 367 BIG-0 patients, 1 required neurosurgical intervention after a neurologic decline and a CT showing a new epidural hematoma. Following mBIG recommendations would have eliminated 263 repeat head CTs and 862 neurosurgical consultations. If we recommended local observation instead of transfer for BIG-0 and BIG-1, we would have prevented 793 transfers without missing any patients that required neurosurgical intervention.

Conclusion

The modified pediatric BIG score appears safe in our local population, and implementation may substantially reduce resource utilization. We propose a new BIG criterion specifically for the pediatric trauma patient based on our findings. Implementation of these guidelines may significantly reduce preventable transfers to pediatric centers.

Abbreviations: Abbreviations:

BIG = brain injury guidelines

TBI = traumatic brain injury
CT = computerized tomography scan

Table 1. Inpatient and neurosurgical care (all patients)

	All (N = 1915)	pBBI 0 (n = 367)	pBBI 1 (n = 427)	pBBI 2 (n = 215)	pBBI 3 (n = 906)
Repeat head CT					
Yes	794 (41)	58 (16)	105 (25)	84 (39)	547 (60)
No	1121 (59)	309 (84)	322 (75)	131 (61)	359 (40)
Progression on repeat head CT					
Yes	188 (10)	3 (1)	6 (1)	13 (6)	166 (18)
No	607 (32)	55 (15)	99 (23)	71 (33)	382 (42)
Neurosurgical consultation					
Yes	1655 (89)	218 (59)	404 (95)	213 (99)	860 (95)
No	220 (11)	149 (41)	23 (5)	2 (1)	46 (5)
OR neurosurgery					
Yes	237 (13)	1 (0)	0 (0)	9 (4)	277 (31)
No	1678 (88)	366 (100)	427 (100)	206 (96)	629 (69)
Neurosurgical intervention					
Craniotomy	1 (0)	0 (0)	0 (0)	0 (0)	1 (0)
Craniectomy	37 (2)	0 (0)	0 (0)	0 (0)	37 (4)
Craniotomy	135 (7)	2 (1)	0 (0)	2 (1)	131 (14)
ICP monitor (EVD, BOLT)	139 (7)	0 (0)	0 (0)	6 (3)	133 (15)
Admission					
ICU	571 (30)	14 (4)	38 (9)	49 (23)	570 (63)
Floor	1244 (65)	333 (91)	389 (91)	166 (77)	336 (37)
Ventilator day	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 0)	0 (0, 1)
LOS, day	2 (1, 4)	1 (1, 2)	1 (1, 2)	2 (1, 4)	3 (1, 9)
ED bounce-back					
Yes	29 (1)	6 (2)	4 (1)	4 (2)	6 (1)
No	1885 (99)	161 (98)	423 (99)	211 (98)	900 (99)

All data are presented as frequency (%) except that Ventilator day and LOS are presented as median (IQR).

Friday, May 9, 2025

Scientific Session 9 - Basic Science 2

2:00 PM – 3:30 PM

S140

INTESTINAL EPITHELIUM DYSREGULATION IN NECROTIZING ENTEROCOLITIS

Yi Xiong, MD¹, Andrea Zito, HBSc², Haoyan Liang³, George Biouss, PhD², Jieli Yang², Felicia A. Balsamo, MSc², Mina Yeganeh, MSc², Carol Lee, MSc², Dorothy Lee, HBSc², Haitao Zhu⁴, Bo Li, PhD², Agostino Pierro, OBE, MD, FRCS(Eng.), FRCS(Ed), FAAP²

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Abstract: Purpose: Necrotizing enterocolitis (NEC) is a devastating gastrointestinal disease predominantly affecting premature infants, characterized by severe intestinal inflammation and tissue necrosis. Despite advances in neonatal care, NEC remains a significant clinical challenge with high mortality and morbidity. The aim of this study is to define the molecular and cellular mechanisms underlying NEC pathogenesis as this is crucial for developing targeted therapies and improving clinical outcomes.

Methods: In this study, we utilized a mouse model of NEC induced by hypoxia, formula feeding, and lipopolysaccharide administration (post-natal days 5-9) to investigate the molecular changes at single-cell resolution. We performed bulk RNA sequencing, single-nucleus RNA sequencing (snRNA-seq), single-nucleus assay for transposase-accessible chromatin sequencing (snATAC-seq) and multiplexed error-robust fluorescence in situ hybridization (MERFISH) spatial transcriptomics on intestinal tissues collected from control and NEC groups at post-natal day 9 (end of experimental NEC induction). Data were analyzed to identify cell populations, epigenetic profiles, and regulatory pathways associated with NEC progression.

Results: Our analysis revealed distinct cellular compositions and epigenetic landscapes between control and NEC groups (Figure 1A). The epithelium exhibited impaired proliferation in transit amplified (TA) cells and stem cells (Figure 1B), reduced stemness, and altered differentiation trajectories in NEC compared to normal control. Chromatin accessibility analysis identified differential regulatory elements and transcription factor motifs linked to disease progression. VIPER analysis identified master regulators, notably the polycomb repressive complex 2 (PRC2) components, which are involved in intestinal stem cell maintenance and epithelial regeneration. We further experimentally validated and confirmed the critical role of one of the PRC2 components, Enhancer of zeste homolog 2 (Ezh2), in NEC pathogenesis, demonstrating its impact on intestinal homeostasis, regeneration, and overall survival.

Conclusions: These findings deepen our understanding of NEC pathophysiology at a cellular and molecular level. The identification of dysregulated pathways in epithelial cells, such as EZH2-mediated intestinal stem cell impairment, underscores potential therapeutic targets for mitigating intestinal damage and improving clinical outcomes in NEC.

Abbreviations:



UNTARGETED METABOLOMICS REVEALS DISTINCT METABOLOME CHANGES IN THE GUT-LIVER AXIS AFTER MASSIVE SMALL BOWEL RESECTION

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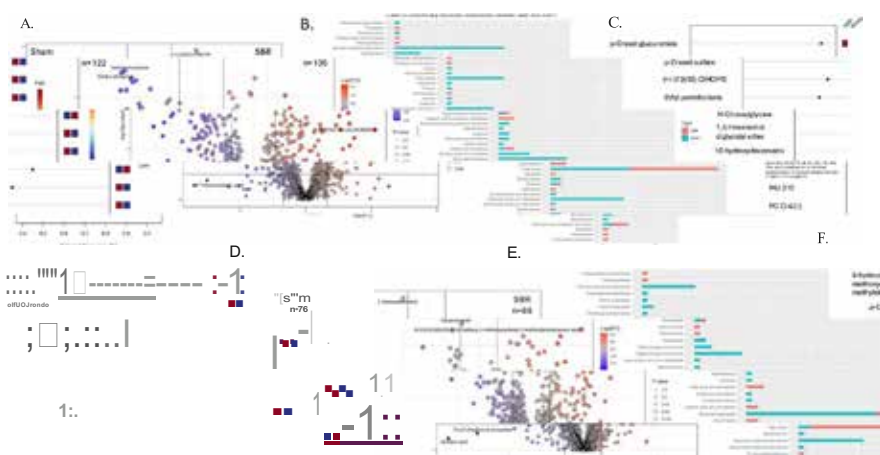
Abstract: Purpose: Intestinal failure-associated liver disease (IFALD) is a condition with high morbidity secondary to short gut syndrome. Using a murine model of IFALD, we have shown small bowel resection (SBR) alone disrupts the intestinal transcriptional signature and lymphatic drainage. As such, we sought to compare the SBR portal vein serum (PVS) and liver metabolome to sham-operated mice.

Methods: 8-week-old B6 female mice underwent sham (n=7) or 75% SBR (n=12) operations and fed a liquid enteral diet for ten weeks. Peripheral serum, PVS, and liver tissue were collected. LC-MS/MS was performed on PVS and liver samples. Metabolomic data was analyzed with Metaboloanalyst 6.0 software and R. Multivariate biomarker analysis was performed with Monte Carlo cross validations using partial least squares analysis for classification and feature ranking. Animal studies were approved by IACUC protocol #23-0421.

Results: SBR mice demonstrate increased AST (465 +/- 151.4 U/L vs. 115.2 +/- 55.29 U/L, p = 0.0002) and ALT (249 +/- 91.41 U/L vs 27.7 +/- 3.978 U/L, p = 0.0001) at ten weeks compared to sham-operated mice. A fold change analysis shows the differential metabolites between conditions (Figure 1A, D). After enriching these notable metabolites with their metabolite class, SBR PVS demonstrated a higher relative abundance of fatty acyl metabolites than sham (Figure 1B). These differential fatty acyls were predominantly long-chain fatty acids in the SBR PVS and medium-chain fatty acids in the sham PVS. Furthermore, sham PVS demonstrated a higher relative abundance of steroids, which were predominately bile acids. Liver untargeted metabolomics re-demonstrated a predominance of fatty acyls in the SBR (Figure 1E). A multivariable biomarker analysis created two 10-feature models, both with 94% prediction (Figure 1C, F). Notable biomarkers common to PVS and liver models were p-cresol glucuronide (microbial metabolite), ethyl palmitoleate (ethyl fatty acid), and (+/-)12(13)-DiHOME (lipokine).

Conclusions: Untargeted metabolomics suggests an altered intestinal lipid uptake in SBR mice with more fatty acids shunted towards the portal vein. Biomarker analysis showed evidence of microbial metabolites and ethylated fatty acids which suggests altered microbial and ileal metabolism in the SBR. Future work includes multi-omic network analysis to combine genomic, microbiome, and metabolomic results.

Abbreviations: Small bowel resection (SBR); portal vein serum (PVS); Institutional Animal Care and Use Committee (IACUC); Liquid chromatography-tandem mass spectrometry (LC-MS/MS); Intestinal failure-associated liver disease (IFALD); Aspartate aminotransferase (AST); Alanine aminotransferase (ALT); 12,13-dihydroxy-9Z-octadecenoic acid ((+/-)12(13)-DiHOME)



CYTOKINE-DRIVEN PRO-FIBROTIC RESPONSE TO MECHANICAL STRESS IN VITRO IN PRIMARY FETAL ESOPHAGEAL FIBROBLASTIC CELLS.

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Abstract: Purpose: To identify cytokines implicated in a pro-fibrotic phenotype in stretched primary fetal esophageal fibroblasts (FEF3).

Methods: FEF3 cells were seeded onto aligned PCL nanofibrous scaffolds and stretched using a custom tensile loading bioreactor (8% strain, 1Hz), before performing RNA sequencing, to identify the five most upregulated cytokines, between stretched and non-stretched fibroblasts. FEF3 cells were cultured (Dulbecco's Modified Eagle Medium, 10% fetal bovine serum, 0.2% Primocin, 37°C) for 24 hours, before stimulation with IL1B (10 and 100 ng/mL), IL8 (10 and 100 ng/mL), IL11 (10 and 100 ng/mL), IL33 (10 and 100 ng/mL) and CXCL5 (10 and 100 ng/mL) for 24 or 48 hours. Non-stimulated cells were used as controls. FEF3 cells were then harvested to perform RNA extraction and reverse transcription. Real-time qRT-PCR was performed (TaqMan Gene Expression Assays) for ACTA2 (alpha-smooth muscle Actin), FN1 (Fibronectin 1), COL1A1 (Collagen 1A1) and GAPDH. Relative mRNA levels of each gene were normalized to GAPDH levels for each condition and compared to controls using a paired t-test ($p < 0.05$ considered significant). Duplicate experiments were performed to confirm the results.

Results: When FEF3 cells were exposed to traction forces in vitro, IL8 ($\log_2FC=3.7$), IL33 ($\log_2FC=2.9$), IL1B ($\log_2FC=2.7$), IL11 ($\log_2FC=2.7$) and CXCL5 ($\log_2FC=2.7$) were the five most upregulated cytokines ($p < 0.001$). Cytokine stimulation of FEF3 cells showed that IL1B was associated with an increased expression of ACTA2 in a dose-dependent and time-dependent manner (Figure). IL8 (10 ng/mL) was associated with a later and more limited stimulation of ACTA2 expression (Figure). An early peak (24 hours) of FN1 and COL1A1 expression was observed when FEF3 cells were stimulated with a higher concentration of IL11 (100 ng/mL), with IL33 (10 and 100 ng/mL) and CXCL5 (10 and 100 ng/mL). This response in FN1/COL1A1 expression seemed transient as it was not observed after 48-hour stimulation (Figure).

Conclusion: In response to traction forces in vitro, FEF3 cells seem to secrete IL1B, IL8, IL11, IL33 and CXCL5, which may be implicated in an autocrine profibrotic process, by stimulating fibroblast activation and expression of extracellular matrix proteins. Further research may uncover novel therapeutic targets to prevent stricture in long-gap esophageal atresia.

Abbreviations: PCL: poly(ϵ -caprolactone), RNA: Ribonucleic acid, IL1B: Interleukine 1B, IL8: Interleukine 8, IL11: Interleukine 11, IL33: Interleukine 33, CXCL5: CXC motif chemokine ligand 5, qRT-PCR: quantitative reverse transcription polymerase chain reaction, GAPDH: Glyceraldehyde 3-phosphate dehydrogenase, mRNA: messenger ribonucleic acid, FC: Fold change.



CONVERSION OF OMEGA-6 TO OMEGA-3 FATTY ACIDS PROTECTS AGAINST LIVER INJURY IN A MURINE MODEL OF PARENTERAL NUTRITION-INDUCED HEPATOSTEATOSIS

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Abstract: Purpose

Parenteral nutrition (PN) is life-sustaining in pediatric patients with intestinal failure, however, existing lipid emulsions used in PN contain high levels of pro-inflammatory omega-6 fatty acids associated with hepatic steatosis. The fat-1 transgenic mice have an omega-3 fatty acid desaturase enzyme that converts omega-6 to omega-3 fatty acids, which have anti-inflammatory and anti-steatotic properties. Humans lack this enzyme. We hypothesized that in a murine model of PN-induced hepatic steatosis, fat-1 mice will have greater protection against the development of hepatic steatosis compared to wild-type mice when administered the same lipid emulsions.

Methods

Hepatosteatosi s was induced in eight-week-old C57BL/6J and fat-1 transgenic mice over a 19-day period through the provision of an oral high-carbohydrate, PN-equivalent solution ad lib and intravenous injection of one of two commercial lipid emulsions used in the clinical setting (Intralipid and SMOFlipid, 4g fat/kg/d) or isovolumetric saline control q.o.d. Age-matched, chow-fed control groups of wild-type and fat-1 mice were euthanized on day 19. The primary outcome was hepatosteatosi s as measured by liver histology and triglyceride quantification. Statistical analysis was performed using analysis of variance (ANOVA) or unpaired t-test where applicable, with values expressed as mean and standard error of the mean (SEM).

Results

Representative liver histology demonstrated reduced steatosis in fat-1 mice compared to wild-type controls on Oil Red O stain (Figure 1A). Chow-fed fat-1 and wild-type mice had similar liver triglyceride content (Figure 1B). Liver triglyceride concentrations were reduced in fat-1 mice compared to wild-type mice for groups treated with high-carbohydrate oral solution plus intravenous saline (90.08 ± 7.287 vs. 144.6 ± 11.90 mg/dL, $P=0.0045$) and intravenous Intralipid (80.52 ± 3.385 vs. 98.22 ± 4.827 mg/dL, $P=0.017$); differences trended towards significance for SMOFlipid-treated mice (86.31 ± 13.27 vs. 116.1 ± 13.27 mg/dL, $P=0.089$).

Conclusions

Most commercial lipid emulsions contain low concentrations of omega-3 fatty acids. In a murine model of PN-induced hepatosteatosi s, fat-1 transgenic mice capable of converting pro-inflammatory omega-6 to anti-inflammatory omega-3 fatty acids have reduced fatty liver disease compared to wild-types when treated with the same lipid emulsions. Humans lack this omega-3 fatty acid desaturase enzyme. Therefore, nutritional supplementation with omega-3 fatty acids should be considered in PN-dependent patients for the prevention of steatosis and other liver injury.

Abbreviations: PN-parenteral nutrition;
ANOVA-analysis of variance

Figure 1A. Liver Histology (Oil Red O Stain)

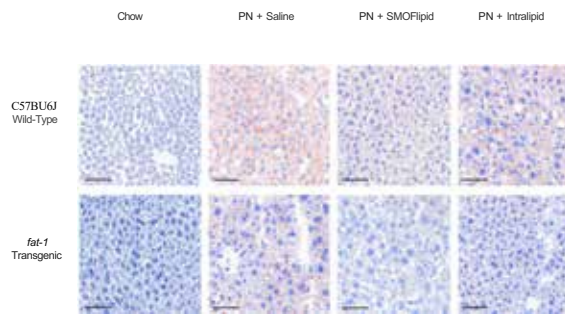


Figure 1B. Liver Triglyceride

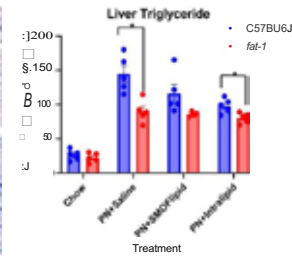


Figure 1. Representative liver histology and liver triglyceride quantification of C57BL/6J wild-type and *fat-1* transgenic mice in a murine model of parenteral nutrition-induced hepatosteatosis. **Figure 1A.** Oil Red O stain demonstrates areas of lipid and triglyceride deposition as orange-red. 40X magnification, bar= 60 μ m. **Figure 1B.** Liver triglyceride for different treatment groups including chow, PN+Saline, PN+SMOFlipid, PN+Intralipid. PN-Parenteral nutrition. * denotes $P < 0.05$ on student t-test.

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THE ROLE OF MEG3 IN PROMOTING MOTILITY AND CLONOGENICITY IN HEPATOBLASTOMA

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Abstract: Purpose

Metastatic hepatoblastoma continues to have a poor prognosis. To study metastatic hepatoblastoma, we developed the metastatic hepatoblastoma cell line, HLM_2, from the parent cell line, HuH6. Long non-coding RNAs (lncRNA) are sequences >200 nucleotides that are not translated into protein and function as epigenetic regulators. We performed RNA sequencing comparing metastatic HLM_2 to the parent HuH6 cells and found that the lncRNA, MEG3, is significantly more abundant in HLM_2 cells. MEG3 has been shown to play a role in cancer cell proliferation. We hypothesized that MEG3 supports proliferation and growth of metastatic hepatoblastoma cells.

Methods

We employed small interfering RNA (siRNA) to knockdown MEG3. For these studies, HLM_2 cells were transfected for 12 hours with 20 nM of control siRNA (siNeg) or siRNA directed toward MEG3 (siMEG3). Downregulation of MEG3 was confirmed with quantitative PCR. Cell proliferation was assessed using a cell counting experiment, and clonogenic potential using a colony formation assay. For cell counting, transfected cells were plated in standard culture conditions. Cells were counted with a hemocytometer at 24, 48, 72, and 96 hours and reported as mean percent live cells + standard error of the mean (SEM). For the colony formation assay, HLM_2 cells transfected with siNeg or siMEG3 were plated into 6-well plates and after 11 days, colonies were stained and counted. Data are reported as mean number of colonies + SEM. Student's t-test was used to compare means between groups with $p < 0.05$ considered statistically significant.

Results

Abundance of MEG3 mRNA was decreased by 96% in cells transfected with siMEG3 indicating target engagement. MEG3 knockdown significantly decreased the percentage of live cells at 48 hours compared to siNeg treatment (84.9 +/- 1.6% vs 94.0 +/- 1.1%, siMEG3 vs siNeg, $p < 0.001$) indicating decreased proliferation. Clonogenic potential of HLM_2 cells was significantly decreased following siMEG3 treatment compared to siNeg (mean colony count 51.3 +/- 5.2 vs 87.0 +/- 5.3, $p < 0.01$).

Conclusion

MEG3 knockdown results in decreased proliferation and clonogenic potential of HLM_2 cells. These results provide evidence that MEG3 plays a role in the metastatic phenotype and support the further exploration of MEG3 in metastatic hepatoblastoma.

Abbreviations: MEG3 - Maternally expressed gene 3

lncRNA - long non-coding RNA

siRNA - small interfering RNA

Standard error of the mean - SEM

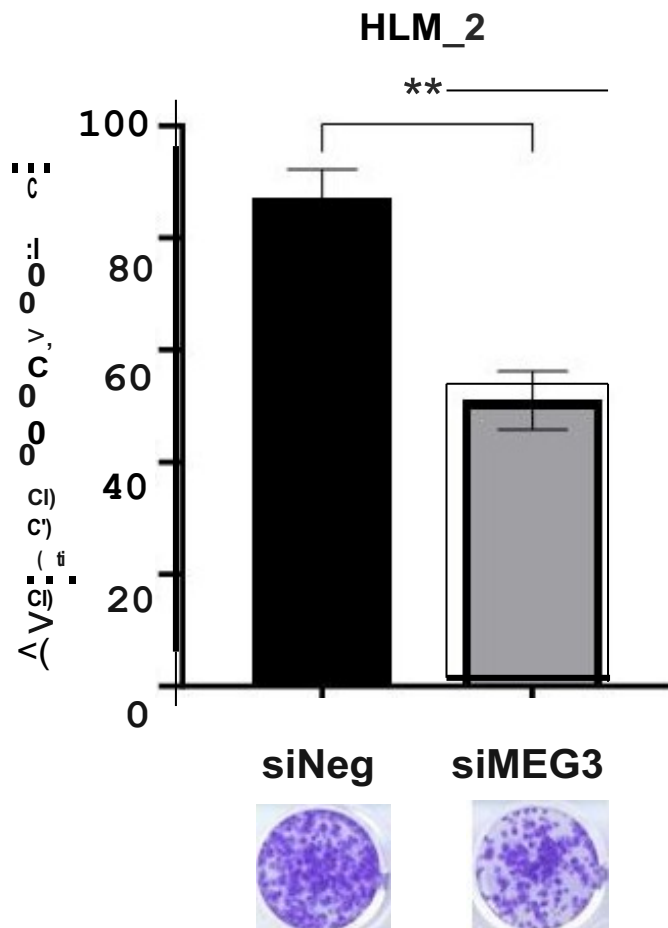


Figure 1: Clonogenic assay. The clonogenic potential of the HLM_2 cells following knockdown of *MEG3* was assessed with a colony formation assay. There were significantly fewer colonies following transfection with siMEG3 compared to control siNeg .. $p < 0.01$

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DELINEATING THE PRODUCTION OF MATRISOME PROTEINS BY OVARIAN STROMAL CELLS FOR A BIOPROSTHETIC AND TRANSPLANTABLE OVARY

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Abstract: Purpose:

The only fertility preservation option for prepubertal female patients undergoing gonadotoxic chemotherapy is ovarian tissue cryopreservation, which requires unilateral oophorectomy and preservation of ovarian tissue. Ovarian tissue transplantation has been successful in restoring fertility in adults but is not advisable for patients with disease metastatic to ovary and restores fertility in only 23-36% of patients. An alternative approach utilizing a bioengineered matrix that regulates follicle activation could provide a safe, long-term solution for fertility and hormone restoration. Stromal cells and the matrisome (extracellular matrix proteins) are essential for ovarian hormone production, immune response, and vascularization in vivo. The purpose of this work is to characterize the matrisome products of ovarian stromal cells for future incorporation into a bioprosthetic transplantable ovary.

Methods:

Ovaries from reproductive-aged cows were sliced into cortical and medullary compartments and bottom-up shotgun proteomics, Jess Western, and immunohistochemistry were utilized to characterize the compartmental differences of matrisome proteins in vivo. Stromal cells from the cortical and medullary compartment of the ovary were isolated into a single cell suspension and cultured. Growth rates were compared between compartments. Immunocytochemistry was performed to characterize matrisome products of stromal cells in culture.

Results:

Proteomic analysis of sliced ovarian tissue identified 1471 unique proteins, of which 218 (14.8%) are matrisome proteins. 39 (17.9%) matrisome proteins were significantly differentially expressed by ovarian compartment in the sagittal plane and 35 (16.1%) in the axial plane. Compartmental differences were confirmed by Jess Western for select proteins (COL4, VTN, PLOD1, EMILIN1, and ZP3). Stromal cells were successfully isolated from the cortical and medullary compartments, with doubling times of 18.8 and 27.1 hours, respectively. Immunocytochemistry confirmed that stromal cells produce proteins from several matrisome divisions including collagens (COL1), ECM glycoproteins (AGRN, EMILIN1, MFAP5, TGFB1, VTN), ECM regulators (CST3, PLOD1), proteoglycans (DCN).

Conclusion:

This novel information can be utilized to inform a bioengineered matrix design that will recapitulate the ovarian microenvironment. Stromal cells isolated from both cortical and medullary ovarian compartments grow rapidly and produce ECM proteins from multiple matrisome divisions. Next steps include investigations of stromal cells within a 3D culture that supports our bioprosthetic scaffold design.

Abbreviations: ECM: extracellular matrix

COL4: Collagen 4

VTN: Vitronectin

PLOD1: Procollagen-Lysine,2-Oxoglutarate 5-Dioxygenase 1

EMILIN1: Elastin Microfibril Interfacer 1

ZP3: Zona Pellucida-3

COL1: Collagen 1
AGRN: Agrin
MFAP5: Microfibril Associated Protein 5
TGFB1: Transforming Growth Factor Beta 1
CST3: Cystatin C
DCN: Decorin

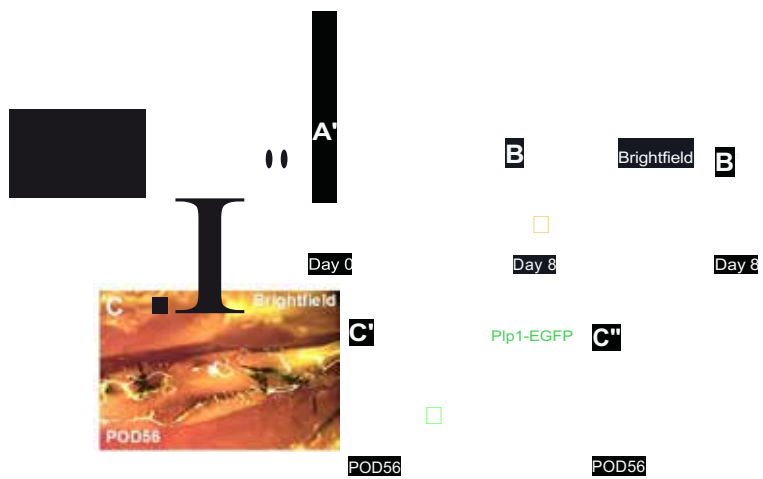
SUBCUTANEOUS ADIPOSE TISSUE-DERIVED NEURAL STEM CELLS: A NOVEL AUTOLOGOUS CELL THERAPY TO BRIDGE THE GAP IN THE TREATMENT OF NEUROTOMESIS

Leah C. Ott, MD¹, Rhian Stavely, PhD¹, Abigail R. Leavitt, BS¹, Aki Kashiwagi, BS¹, Christopher Y. Han, BS¹, Ahmed A. Rahman, PhD¹, Ryo Hotta, MD, PhD¹, Allan M. Goldstein, MD²

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Abstract: Purpose: Peripheral nerves (PNs) can repair themselves, but functional outcomes remain poor for transection injuries with large gaps. Nerve guidance conduits (NGCs) can bridge such gaps between nerve stumps following neurotmesis but demonstrate limited efficacy without support cells to stimulate regeneration. Neural stem cells (NSCs) have been proposed as novel support cells, as they can differentiate into Schwann-like cells to guide regenerating axons and remyelinate the reformed PN. We have previously shown that Schwann cells residing in subcutaneous adipose tissue (SAT) can adopt NSC properties in vitro, and can be transplanted into the gastrointestinal tract to replace damaged neurons and glia. Whether SAT-NSCs can survive and engraft in the non-enteric peripheral nervous system (PNS) is unknown. Methods: Schwann cells were isolated from the SAT of Wnt1-tdTomato+ reporter mice (in which glia constitutively express red fluorescent protein) and Baf53b-tdTomato+ Plp1-EGFP+ dual neuron/glia reporter mice (in which neurons and glia express red and green fluorescent proteins, respectively) by enzymatic digestion and filtering. Cells were then transferred to neuroproliferation media, yielding clusters of SAT-NSCs termed neurospheres. Neurospheres were then cultured directly on 5mm-long decellularized NGCs to enable their delivery (Fig1A). Adult Plp1-EGFP+ pan-glial reporter mice underwent PN injury surgery, in which the left sciatic nerve was sharply resected and repaired with these NGCs. On postoperative day (POD) 56, mice were sacrificed and NGCs dissected to assess for SAT-NSC survival and engraftment. Results: SAT-NSCs could successfully seed NGCs for delivery to the PNS, adhering and migrating along the conduit after eight days in vitro (Fig1B). SAT-NSCs survived within NGCs following transplantation to the injured sciatic nerve, integrating with host-derived EGFP+ Schwann cells at POD56. Following transplantation of Baf53b-tdTomato+ Plp1-EGFP+ SAT-NSCs, only EGFP expression persisted at POD56 (Fig1C), suggesting SAT-NSCs differentiate into Schwann-like cells (but not neurons) in the injured PN. Conclusions: Subcutaneous adipose tissue-derived neural stem cells can be delivered to injured nerves via conduits and survive and integrate with the host. In this environment, they differentiate into Schwann-like cells, which may aid in axonal regeneration. These cells may represent a novel, easily accessible source of autologous stem cells to treat peripheral nerve injuries.

Abbreviations: PN: peripheral nerve
NGC: nerve guidance conduit
NSC: neural stem cell
SAT: subcutaneous adipose tissue
POD: postoperative day



REPEATED LENGTHENING UTILIZING DISTRACTION ENTEROGENESIS: A PORCINE MODEL

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Abstract: Introduction:

Short bowel syndrome describes a condition in which individuals lack adequate functional intestinal length to effectively absorb nutrients. Spring-mediated distraction enterogenesis is a novel method that aims to use mechanical stretch to generate new functional intestinal tissue. Due to the incremental nature of spring-mediated distraction enterogenesis, patients would require multiple spring insertions to generate sufficient new intestinal tissue to wean off parenteral nutrition (PN). However, short bowel patients have limited intestinal length and therefore may be restricted in the number of springs that can be inserted at one time. For that reason, we aim to demonstrate the feasibility of repeated distraction within the same intestinal segment.

Methods:

Juvenile Yucatan pigs underwent an initial laparotomy to introduce encapsulated nitinol springs into the jejunum along with an adjacent control segment without a spring. After 14-21 days, a second laparotomy was performed to remove the initial spring and insert a new encapsulated spring into a portion of the previously lengthened jejunum. At the time of euthanasia, the repeatedly lengthened jejunal segments and control segments were retrieved for histological analyses.

Results:

Spring insertion produced a statistically significant increase in jejunal length when compared to control after the first operation (Figure. 1A). Jejunal segments that were repeatedly distracted, significantly increased in length after the second procedure. The springs used for the second spring insertion were stronger than the springs used for the initial spring insertion but produced an equivalent amount of lengthening. Crypt depth, mucosal thickness, muscularis thickness, and the outer perimeter of the repeatedly distracted jejunal segments all increased compared to the control segments ($p < 0.05$).

Conclusion:

Previously lengthened segments of jejunum were successfully re-lengthened in our porcine model. This implies that children with short bowel syndrome may be offered repeat distraction procedures to achieve adequate bowel length. Moreover, this increases the potential for distraction enterogenesis to successfully wean patients with short bowel syndrome off of PN.

Abbreviations: parenteral nutrition = PN

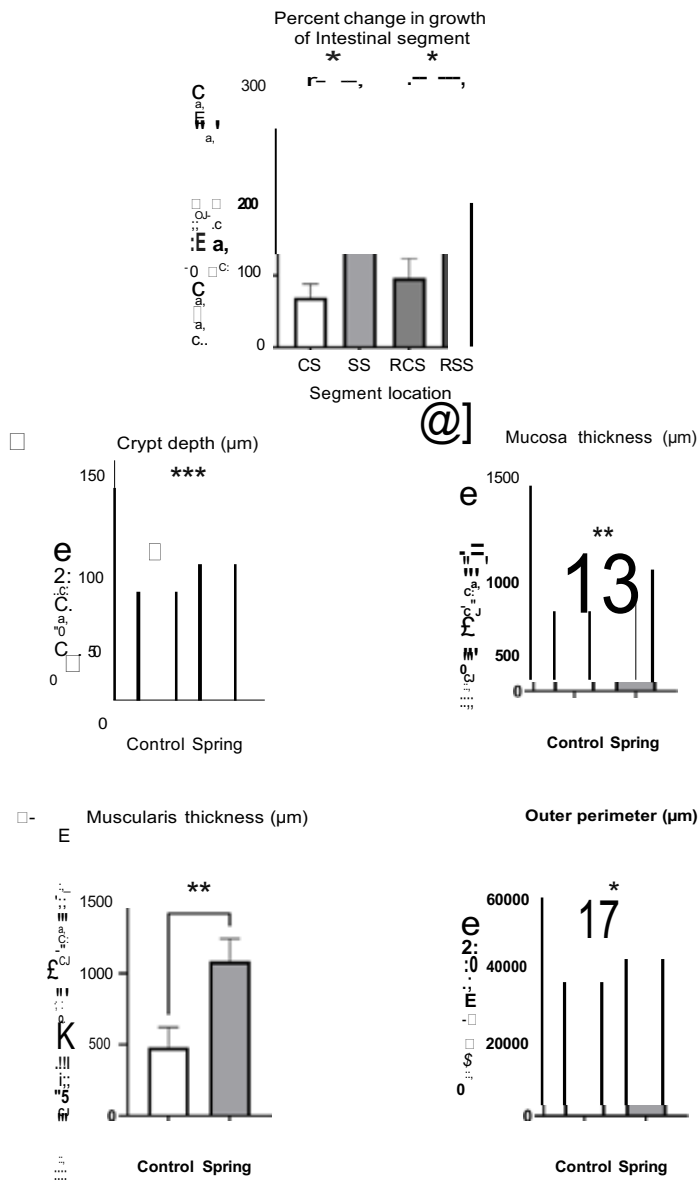


Figure 1. Changes in intestinal structure in the repeated lengthening intestinal segment. (A) represents the percent change in intestinal growth for each intervention group. Control Segment (CS) represents the control bowel segment in the first surgery. Spring Segment (SS) represents the bowel segment that was distracted in the first surgery. Repeated Control Segment (RCS) represents the control bowel segment used in the second surgery. Repeated Spring Segment (RSS) represents the bowel segment that was distracted in the second surgery. (B-E) represent significant changes seen in the histologic analyses of the repeated segment. Data represent an average of the measures for each pig sample. An* represents $p < 0.05$, a** represents $p < 0.01$, and a*** presents $p < 0.001$.

S149

EFFECT OF DISTRACTION ENTEROGENESIS ON MECHANOSENSITIVE PATHWAYS IN THE MURINE CECUM

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1Stanford University, Palo Alto, CA, USA, 2Stanford University School of Medicine, PALO ALTO, CA, USA, 3Stanford University, MENLO PARK, CA, USA

Abstract: Purpose:

Short bowel syndrome can often lead to intestinal failure, which is typically managed using parenteral nutrition and surgical procedures. However, these surgical procedures carry a significant risk of complications. Distraction enterogenesis has shown promise in successfully lengthening the intestine in animal models by using mechanical force to generate intestinal growth. We wanted to investigate the effect of this mechanical force and the physiological changes it induces, paying special attention to the mechanosensitive ion channels, piezo1, and piezo2.

Methods:

All animal experiments were conducted in accordance with the institutional guidelines and approved by the Animal Care and Use Committee (Protocol #32497). C57BL/6 mice underwent surgical insertion of compressed and uncompressed nitinol (nickel and titanium) springs into the blind end of the cecum. The spring segments were measured at the time of placement and on post-operative day 7 (POD7) following euthanasia. The differences in spring segment lengths between the 2 groups were evaluated using t-tests. Additionally, the gene expression changes in the tissue were analyzed using RNA sequencing. We specifically investigated the genes commonly implicated in mechanical force and intestinal lengthening including piezo1, piezo2 and its downstream effectors.

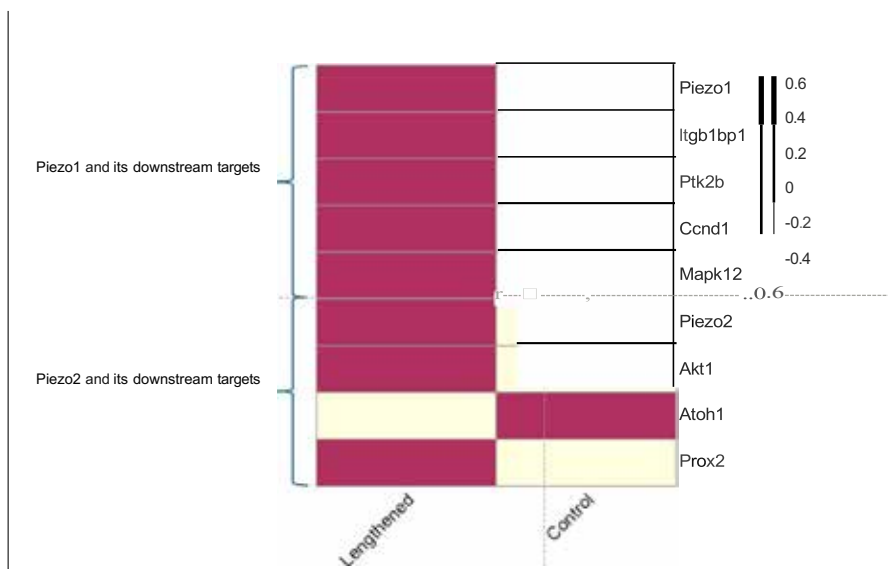
Results:

We found a significant increase by 74% in the length of the cecum in the mice treated with compressed springs. However, the gene expression analysis revealed that the acute changes caused by the mechanical force had normalized by POD-7 across both groups. We further investigated mechanosensitive genes to look for subtle differences in genetic expression. Gene expression profiling indicated upregulation of mechanosensitive genes, Piezo1 and Piezo2, along with their downstream effectors associated with cell proliferation, growth, and differentiation in the lengthened tissue, compared to the control (figure.1).

Conclusion:

These findings are promising, suggesting that distraction enterogenesis is a safe procedure that effectively promotes the lengthening and regeneration of intestinal tissue. Importantly, this process appears to normalize over time, resembling control tissue without sustained upregulation of proliferative pathways. Our next step will be to identify the various pathways activated in response to mechanical forces at shorter time points, allowing us to investigate significant differences more thoroughly.

Abbreviations:



S150

MECHANICAL FORCE-DRIVEN EPITHELIAL GROWTH: YAP ACTIVATION AND ISC STEMNESS IN NON-REGENERATIVE MECHANISMS

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1Stanford University School of Medicine, PALO ALTO, CA, USA, 2Stanford University, Stanford, CA, USA, 3Stanford University, MENLO PARK, CA, USA, 4Stanford University, Palo Alto, CA, USA

Abstract: Introduction:

Current treatment strategies for inflammatory bowel diseases primarily focus on reducing intestinal inflammation, with limited attention to targeting the epithelium to promote homeostasis and growth. Yes-associated protein (YAP) is a mechanosensitive coactivator that plays a key role in determining cell fate. YAP activation during post-injury regenerative processes is known to restrict intestinal stem cells' (ISCs') stemness through inflammatory mechanisms and by inhibiting Wnt signaling. In this study, we examined YAP activation in ISCs during force-induced epithelial growth.

Methods:

5 mm rubber bands were placed around the terminal ileum of C57BL/6 mice. Mice were euthanized at serial post-operation days (POD) 1-7, and dilated ileum proximal to the tube was harvested and compared with the normal ileum of untreated mice. Immunofluorescence was used to evaluate ISCs, YAP expression, and proliferation. YAP activation was assessed by tracking its nuclear translocation using an image-based model. RNA sequencing of the tissue was performed.

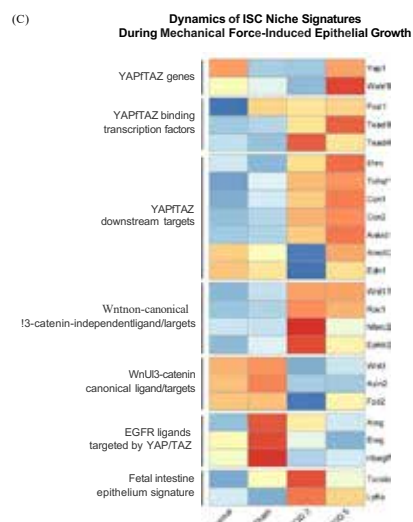
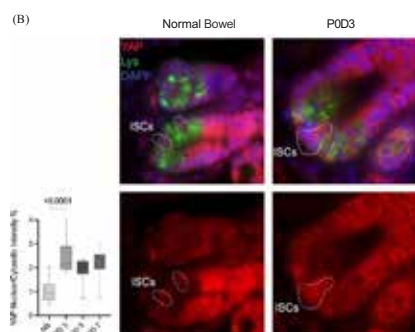
Results:

Intestinal dilation was observed after band placement. The maximal decrease in crypt density observed on POD3 suggests that the tissue experiences peak mechanical force at this time. YAP expression progressively increased, with the highest nuclear-to-cytosolic ratio also occurring on POD3. Peak crypt density, along with the highest expression of the proliferation marker Ki-67 and ISC marker Olfr4, was observed on POD5. Gene expression profiling revealed the activation of mechanosensitive pathways, ISC stemness, and Wnt signaling, while inflammatory pathways were downregulated during this process. By screening the targets of YAP, Wnt, EGFR signaling, and ISC niche homeostasis, we identified that the process of force-induced epithelial growth was tied to YAP activation and β -catenin-independent non-canonical Wnt signaling (Figure).

Conclusion:

These findings show that mechanical force induces epithelial growth and ISC expansion. YAP overexpression and nuclear activation in ISCs suggest a previously unexplored role in intestinal growth, distinct from inflammation-related regenerative mechanisms. This points to potential new targets for improving epithelial homeostasis and developing treatments for epithelial impairments.

Abbreviations: Yes-associated protein (YAP); intestinal stem cell (ISC); post-operation days (POD)



Friday, May 9, 2025

Scientific Session 10 - General Pediatric Surgery 2

2:00 PM – 3:30 PM

S11

QUALITY OF COMMON SURGICAL PROCEDURES AT CRITICAL ACCESS HOSPITALS AMONG PEDIATRIC PATIENTS

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Abstract: Background: Critical access hospitals are small, rural hospitals that one in four Americans rely on as their primary source of healthcare. While CAHs have demonstrated high quality surgical care for adults, their performance in pediatric surgical procedures remains understudied. The aim of this study was to assess the quality of care for common pediatric surgical conditions at CAHs, compared to non-CAHs.

Methods: We conducted a cross-sectional retrospective study from 2015-2020 analyzing data from pediatric patients ages 1-19 years who underwent appendectomy or cholecystectomy. The study utilized the Healthcare Utilization Project State Inpatient Databases across 10 states (AR, AZ, FL, MD, NC, NJ, NY, WA, WI) and American Hospital Association Annual Survey data to identify CAHs and non-CAHs where pediatric patients underwent surgery. Outcome measures included complications (e.g., acute kidney injury, postoperative hemorrhage, surgical site infection), serious complications (defined as complication with >75th percentile hospital length of stay), and unplanned procedure rates (e.g., drainage procedures, ERCP, or reoperations). Risk adjustment was performed using multivariable logistic regression, accounting for demographic factors, state, year of surgery, and comorbidities.

Results: We identified 47,060 pediatric patients (503 at CAHs) who underwent appendectomy or cholecystectomy. Patients at CAHs were older (14.0 years [95%CI: 10.0-17.0] versus 13.0 [95%CI: 9.0-17.0], $p=0.001$), more white (58.3% versus 44.3%, $p<0.001$), and less medically complex (percent with zero Elixhauser comorbidities: 76.5% versus 71.4%, $p=0.011$). Case mix was similar at CAHs and non-CAHs with 85.1% and 85.0% of cases being appendectomy, respectively ($p=0.94$). Risk adjusted rates of any complications and serious complications were significantly lower at CAHs, compared to non-CAHs (OR: 0.42 [95%CI: 0.20-0.86], $p=0.02$ and OR 0.37 [95%CI: 0.16-0.83], $p=0.002$, respectively). Rates of unplanned procedures were also lower at CAHs, compared to non-CAHs (OR: 0.21 [95%CI: 0.16-0.28], $p<0.001$). Length of stay at CAHs was lower than non-CAHs (2.58 [95%CI: 2.35-2.80] versus 3.19 [95%CI: 3.16-3.22], $p<0.001$).

Conclusion: This comprehensive analysis demonstrates that CAHs provide high-quality surgical care for common pediatric conditions, particularly in older and less medically complex patients. These findings support the potential for expanded utilization of CAHs in delivering localized surgical care to rural pediatric populations, potentially improving access and outcomes.

Abbreviations: CAH: Critical access hospital
ERCP: Endoscopic retrograde cholangiopancreatography

CI: confidence interval

QUANTIFYING RECOVERY TIME AFTER COMMON PEDIATRIC SURGICAL PROCEDURES**Elizabeth M. Reynolds, MD¹**, Jonathan E. Kohler, M.D., M.A.¹, Minna M. Wieck, MD²*1University of California Davis Health, Sacramento, CA, USA, 2UC Davis Children's Hospital, Sacramento, CA, USA*

Abstract: Purpose: Parents need to plan for patients' recovery after pediatric operations. Standard guidance for pain medication use and time off school is not evidence based, for lack of data. This study aims to quantify recovery time and pain medication usage after common pediatric operations to improve the post-operative experience for families.

Methods: We performed a single-center retrospective survey at an academic tertiary care center. By protocol, patients who are discharged after routine outpatient surgery do not have scheduled post-operative visits. They are followed with a telephone call in 2-4 weeks. We modified the post-operative call template to include asking the post-operative day (POD) the patient returned to school and to baseline behavior, the POD parent(s) returned to work, and the number of days requiring pain medications. We abstracted these encounters for pediatric surgical cases from December 2022-August 2024. Missed school days were omitted if the operation occurred during a school vacation or if the patient was not school-aged. Chart review was compliant with the IRB. Statistical methods included descriptive statistics, 95% confidence intervals, ANOVA and t-tests for ad hoc analyses. A p-value of < 0.05 was considered significant.

Results: Follow-up data from the post-operative phone call was available for 160 patients who underwent laparoscopic appendectomy (uncomplicated appendicitis) (n=65), umbilical hernia repair (n=41), laparoscopic inguinal hernia repair (n=40), or out-patient laparoscopic cholecystectomy (n=14). The average number of POD required for recovery is summarized in Table 1. On average, patients used non-narcotic pain medications for 2-3 days, but parents did not think they were at baseline until POD 5-6 and patients did not return to school until POD 6-8. Despite having different procedures, there was no significant difference in the POD patients returned to school (p=0.7) or parents to work (p=0.1). On average, parents returned to work on POD 1-2.

Conclusion: Children miss a predictable number of school days after common pediatric surgeries, which may be more than pediatric surgeons anticipate. Data driven pre-operative counseling can improve families' trust in their health care team and facilitate anticipation of discharge needs regarding school and work excuse notes and pain medications.

Abbreviations:

Table 1: Reported number of post-operative days required to recover from surgery

Operation	Mean POD Return to School [95% CI]	Mean POD Return to Baseline [95% CI]	Mean POD Return to Work [95% CI]	Mean POD Stopped Medications [95% CI]
Appendectomy (n=65)	7.6 [6.2, 9.0]	7.1 [6.0, 8.1]	1.3 [0.7, 2.0]	2.9 [2.2, 3.5]
Umbilical hernia repair (n=41)	7.3 [5.5, 9.2]	4.3 [3.1, 5.6]	2.6 [1.4, 3.8]	2.3 [1.9, 2.8]
Laparoscopic inguinal hernia repair (n=40)	5.8 [4.1, 8.5]	4.8 [3.7, 8.3]	1.6 [0.8, 4.2]	2.7 [2.1, 4.7]
Laparoscopic cholecystectomy (n=14)	6.2 [4.8, 7.6]	8.1 [6.2, 9.9]	1.3 [0, 1.8]	2.5 [0.4, 4.8]
Overall (n=160)	7.2 [6.3, 8.0]	5.9 [5.3, 6.5]	1.6 [1.1, 2.0]	2.7 [2.3, 3.1]

NEONATAL RENAL REPLACEMENT THERAPY PATTERNS AND ASSOCIATED OUTCOMES IN A NOVEL COHORT WITH PRENATALLY DIAGNOSED RENAL FAILURE

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1Johns Hopkins School of Medicine, Baltimore, MD, USA, 2Division of Pediatric Surgery, Johns Hopkins School of Medicine, Baltimore, MD, USA, 3Department of Gynecology and Obstetrics, Johns Hopkins School of Medicine, Baltimore, MD, USA, 4Department of Pediatrics, Johns Hopkins School of Medicine, Baltimore, MD, USA

Abstract: Purpose: The role of an isolated ultrafiltration device (Aquadex Smartflow®) as a temporizing measure to optimize timing of dialysis initiation in neonates is controversial. We aimed to describe patterns of Aquadex and dialysis initiation among a novel cohort of neonates with congenital kidney failure.

Methods: Participants were drawn from the renal anhydramnios fetal therapy (RAFT) trial, a multi-site prospective study of fetal management of severe congenital kidney/urinary tract disorders. Neonates who survived to initiation of at least one mode of renal replacement therapy (RRT) were included. Neonatal care was managed at the discretion of participating institutions. Demographic and clinical data were assessed at delivery, 15, 30, 60, and 90 days of life. RRT was defined as Aquadex and/or dialysis (hemodialysis [HD] or peritoneal dialysis [PD]). We examined crude associations of patient characteristics and Aquadex use, and fit logistic regressions to estimate associations of Aquadex use with access-related outcomes.

Results: Of 47 live births across 9 sites, 32 neonates (68.1%) survived to initiation of RRT (mean gestational age 33.4 ± 1.5 weeks, birthweight $2028g \pm 400g$, 28% female, 56% bilateral renal agenesis and 44% other fetal renal failure). Aquadex was the initial modality in 15 (47%) patients, HD in 3 (9%) and PD in 14 (44%). Most (13/15) patients who received Aquadex survived to initiate dialysis. Aquadex use varied significantly by study center ($\chi^2 P < 0.001$), but not by patient characteristics (Table). Adjusting for gestational age, birthweight, and diagnosis, early use of Aquadex was associated with lower odds of PD catheter use at 15d (aOR 0.10, 95% CI 0.01-0.71), but not with 30d PD catheter use or survival to initiate PD installation. Composite dialysis access-associated complications were less common in neonates who received Aquadex, but this difference did not reach statistical significance.

Conclusion: Even among a small group of expert sites, use of Aquadex in neonates with kidney failure varied significantly. Neonates initiated on Aquadex were less likely to receive early PD and showed a trend toward fewer HD/PD catheter complications. Larger studies may demonstrate a more definitive benefit of Aquadex as a bridge to surgical HD/PD access in this complex population.

Abbreviations: RAFT: Renal Anyhramnios Fetal Therapy Trial

RRT: renal replacement therapy

HD: hemodialysis

PD: peritoneal dialysis

Table. Clinical characteristics and dialysis access-related outcomes among neonates with congenital renal failure who did versus did not receive isolated ultrafiltration (Aquadex Smartflow®) before dialysis initiation

	No Aquadex N-17	Aquadex N-15	p-value
Patient Characteristics			
Female Sex	3 (18%)	6(40%)	0.16
Fetal Diagnosis			0.75
Bilateral Renal Agenesis	7 (41%)	7(47%)	
Other Fetal Renal Failure	10(49%)	8(53%)	
Gestational Age (weeks)	33.7 ± 1.6	33.1± 1.5	0.25
Birthweight (grams)	2129±403	1914 ± 377	0.13
Dialysis-related outcomes*			aOR(95% CI)
<i>PD catheter use (drainage or instillation)</i>			
15 days	13 (77%)	6(40%)	0.10 (0.01 , 0.71)
30 days	10(63%)	4(31%)	0.25 (0.05, 1.4)
60 days	9(60%)	5 (39%)	0.31 (0.04, 2.5)
Survived to PD instillation	9(53%)	9(60%)	1.5 (0.219.9)
<i>PD or HD-associated complication^f</i>			
15 days	11 (69%)	4(33%)	0.23 (0.04, 1.3)
30 days	9(82%)	3 (43%)	0.18 (0.02, 1.8)
60 days	10(71%)	5 (39%)	0.17 (0.03, 1.1)

*Multivariable logistic regression adjusted for gestational age, birthweight, and fetal diagnosis

^fIncludes catheter malfunction, occlusion, leakage, catheter-associated infection (CLABSI or peritonitis confirmed by culture data) or sepsis; only participants who survived to a given study period window were included in 30d and 60d outcome analyses

Bold indicates P<0.05

PATTERNS OF PRACTICE, RESEARCH, AND ENGAGEMENT IN THE FIRST 10 YEARS OF PRACTICE: A SURVEY OF APSA EARLY CAREER PEDIATRIC SURGEONS.

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Abstract: Background: The APSA Board of Governors Early Career Representative sought to better understand the experiences, organizational engagement, and challenges of early career surgeons (ECS).

Methods: A survey was performed of ECS, defined as within 10 years of fellowship completion.

Results: 102 ECS completed the survey. 51% were female. 50% of respondents have been in practice for 0-5 years, designated as the 'early early career surgeon' (EECS) group, and 50% for 6-10 years, designated as the 'late early career surgeon' (LECS) group. EECS are younger, had fewer publications and had lower faculty ranks. 98% of all ECS participated in research during residency and fellowship. However, only 71% of EECS and 82% of LECS still conduct research; 42% of those who no longer participate report that they are interested in continuing but are unable to, and 58% do not want to.

94% practice in the US in urban academic hospitals; 21% are also board certified in critical care (27% EECS, 14% LECS). 62% of all respondents hold a leadership role in their institution (61% EECS, 63% LECS). EECS average 305 cases/year versus 359 cases for LECS ($p=0.01$).

All survey respondents are dues paying members of APSA; 65% have presented at an APSA meeting. 43% of ECS have participated in roles within APSA and 45% (53% EECS, 37% LECS) have not but are interested in increasing their participation. 64% indicate interest in joining an APSA committee or serving on another one in the future and 34% (45% EECS, 22% LECS; $p=0.03$) are interested in leadership positions.

Overall, 75% of respondents report facing challenges as early career surgeons (86% EECS, 63% LECS; $p=0.01$). When asked if APSA prioritizes the needs of early career surgeons, 64% responded somewhat, 20% reported yes, and 16% reported no.

Discussion:

Early career pediatric surgeons experience challenges in their careers. Most feel that APSA only somewhat prioritizes their needs. Despite this, the majority desire ongoing engagement and leadership opportunities within the organization and feel APSA should focus more on contract negotiation, career counseling, mentorship, improving/maintaining skills, job search, and formal mentor pairings to better support early career surgeons.

Abbreviations: ECS: early career surgeons

EECS: early early career surgeons (0-5 years in practice)

LECS: late early career surgeons (6-10 years in practice)

CURRENT PRACTICE PATTERNS AND OUTCOMES FOLLOWING THE INGESTION OF WATER BEADS IN PEDIATRIC PATIENTS: A PEDIATRIC SURGERY RESEARCH COLLABORATIVE STUDY

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Abstract: Purpose: Water beads are superabsorbent polymer toys and decorations that expand by absorption. Associated injuries have caused >8000 US emergency department (ED) visits since 2007, with rates rapidly increasing since 2020. We aim to characterize outcomes and current practice patterns related to water bead ingestions.

Methods: A multi-institutional, retrospective review of patients < 18 years from January 2012 to July 2023 with suspected or witnessed ingestions of water beads is being conducted, with preliminary data available from 6 institutions. Records were screened for encounters related to water beads through free text searching of notes, then manual review. Relevant clinical variables were analyzed, and further details were obtained for those patients who underwent procedures (defined as intervention requiring general anesthesia).

Results: A total of 119 patients were identified. Median age at the time of ingestion was 29.6 months (IQR 21-47). Most patients (n=95) were evaluated in EDs; 12 patients had telephone encounters, 3 had office visits, and 9 were seen in urgent care. Median time between ingestion to presentation was 2.5 hours (IQR 1-24). Most patients (67%) were asymptomatic; the most common symptoms were abdominal pain (18%) and nausea/vomiting (15%). Regarding imaging, 42 patients (35%) had none; 68 (57%) had x-rays (8 depicted beads), 9 (8%) had ultrasounds (1 bead visualized; 2.7 cm), and 5 (4%) had CT scans (4 of which visualized beads; 0.6 – 3.0 cm). Laxative administration was the most common non-procedural intervention (n=14, 12%). Five patients had an upper endoscopy. One patient had a single 2 mm bead visualized but not removed, another had two 5 mm beads visualized; one was removed. Of the 22 patients under 18 months, 3 (14%) had a bowel obstruction requiring laparotomy. Two of those three required repeat laparotomy for retained water beads causing recurrent obstruction (Table 1).

Conclusion: Water bead ingestions are becoming more frequent and can lead to bowel obstruction requiring repeat interventions. Laxatives and endoscopy may not be effective. The need for

operative intervention is rare among all ingestions (2.5%), but more common for those < 18 months old (14%). Future work should focus on standardizing treatment for these patients.

Abbreviations: ED, Emergency Department

Table 1. Surgical details for patients who underwent surgery for obstruction after water bead ingestion

Intervention (n)	Patient age (months)	Water beads visualized (n)	Location	Water beads removed	Maximal diameter of bead (cm)
Initial laparotomy (3)	9	4	Terminal ileum	4	NR
	14	6	Distal ileum	6	3
	17	1	Jejunum	1	3.5
Repeat laparotomy (2)	9	1	Terminal ileum	1	NR
	14	2	Distal ileum, jejunum	2	3.1

A NATIONAL DATABASE STUDY OF ADJUVANT STEROIDS FOLLOWING KASAI PORTOENTEROSTOMY FOR BILIARY ATRESIA

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Abstract: **PURPOSE:** The practice of using adjuvant steroids following Kasai portoenterostomy (KPE) in patients with biliary atresia (BA) remains controversial. A review of the current literature regarding steroid use in BA demonstrates conflicting results, the majority of which are from small single-institution cohort studies. We sought to investigate the effect of steroid use on postoperative outcomes in a multi-institutional national cohort study of patients with BA.

METHODS: The Pediatric Health Information System (PHIS) database was queried for all patients between 2017 and 2023 who were diagnosed with BA and underwent Kasai portoenterostomy (KPE). PHIS includes billing data from all patients admitted to a consortium of over 200 hospitals in the United States. Patients who received at least one dose of methylprednisolone, prednisone, prednisolone, hydrocortisone or dexamethasone within 7 days of their procedure were considered to have received postoperative steroids. Postoperative outcomes including surgical complications, postoperative length of stay (LOS) and readmissions related to cholangitis or infections were abstracted using billing codes. Univariate and multivariate regressions were used to determine associations between steroid exposure and postoperative outcomes.

Results: 786 patients with a median age of 2 months (IQR: 1-8 months) met inclusion criteria. 65.3% of patients received postoperative steroids. When comparing patients who were treated with adjuvant steroids to patients who were not, patients that received postoperative steroids had a longer postoperative LOS ($p < 0.001$) and a higher rate of surgical complications ($p < 0.001$), but a lower rate of readmissions due to cholangitis ($p < 0.001$). There was no difference in rates of readmissions due to infections between the treatment groups. After adjusting for baseline demographics and race, patients treated with adjuvant steroids were found to have a longer postoperative LOS ($\beta = 16$, $p < 0.001$) and fewer cholangitis-related readmissions (OR = 0.56, 95% C.I. = 0.38-0.84).

Conclusion: In this large multi-institutional cohort study, postoperative steroid use appeared to reduce the proportion of patients who were readmitted with cholangitis. In the setting of recent studies purporting improved native liver survival with steroid use, these data support the use of adjuvant steroids in management of BA.

Abbreviations: Kasai portosterosotomy (KPE), biliary atresia (BA), interquartile range (IQR), length of stay (LOS)

ASSESSING PROCESS MEASURES AND PRACTICE VARIABILITY IN PEDIATRIC BUTTON BATTERY INGESTION: A MUTLI-INSTITUTIONAL COHORT STUDY

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Abstract: Purpose: An esophageal button battery (BB) is a time-sensitive pediatric emergency with potential for severe injury and fatality. However, the analysis of practice trends and development of improvement activities are hampered by the rarity of these events and lack of multi-institutional data. To address this gap, the National Surgical Quality Improvement Program-Pediatric (NSQIP-Ped) introduced esophageal BB process measures. This study aims to analyze first available data to identify trends in practice variability and identify opportunities for improving care.

Methods: A retrospective cohort analysis of children (0-17 years) from January 2021–December 2023 who underwent esophageal BB removal in the ACS NSQIP-Pediatric database was performed. Collected data included presentation to diagnosis time, diagnosis to operation time, presentation to operation time, repeat preoperative imaging, intraoperative 0.25% sterile acetic acid irrigation, and usage/timing of postoperative esophagram. Hospital-level variability was assessed by calculating cohort-level medians and interquartile ranges (IQRs). Subgroup analysis of patients referred to the operating institution was performed to evaluate the impact of repeat imaging on time variables. The medians between subgroups were compared using Wilcoxon rank sum test. This study met criteria to be exempt as human subjects' research.

Results: The study included 92 patients across 27 hospitals. The cohort-level median time from presentation to diagnosis was 31 minutes (IQR: 23-53), diagnosis to operation 76 minutes (IQR: 53-87), presentation to operation 98 minutes (IQR: 76-119), and operation to postoperative esophagram 1.4 days (IQR: 0.8-2.8) (Table). Postoperative esophagram was performed in 72% of cases. Among referred patients, performance of repeat imaging at the receiving institution significantly increased presentation to operation time (102 vs. 61 minutes, $p=0.0119$). Sterile acetic acid irrigation usage was documented in 70% of cases, with 87% of these cases receiving >50 mL of irrigation.

Conclusion: The study highlights opportunities to reduce repeat imaging for patients referred to institutions, establish the optimal timing for postoperative esophagram, and improve documentation/utilization of sterile acetic acid irrigation. These efforts may improve timeliness and care consistency to reduce morbidity associated with button battery ingestion. Continued industry focus on preventing ingestions and reducing hazard severity through development of a safe BB technology are critical.

Abbreviations: National Surgical Quality Improvement Program - Pediatric (NSQIP-Ped)
Interquartile ranges (IQRs)
Button battery (BB)

Table

Timely Intervention Measures. This table presents the cohort-level median, interquartile ranges (IQR) of hospital-level medians, and subgroup analysis for key timely intervention measures in pediatric patients who were referred from another institution for esophageal button battery removal.

	Cohort		Subgroup: Referred patients			p-value
	n cases	Cohort-level median	IQR of hospital-level medians	Imaging study repeated median	Imaging study not repeated median	
Presentation to diagnosis (min)	63	31	23-53	34		<.0001
Diagnosis to OR (min)	63	76	53-87	65	61	0.7618
Presentation to OR (min)	86	98	76-119	102	61	0.0119
Duration of operation (min)	86	35	27-49			
Operation to postoperative esophageal (days)	62	14	08-28			

IMPACT OF MICHIGAN PUBLIC ACT 246 ON OPIOID PRESCRIBING AFTER PEDIATRIC SURGERY

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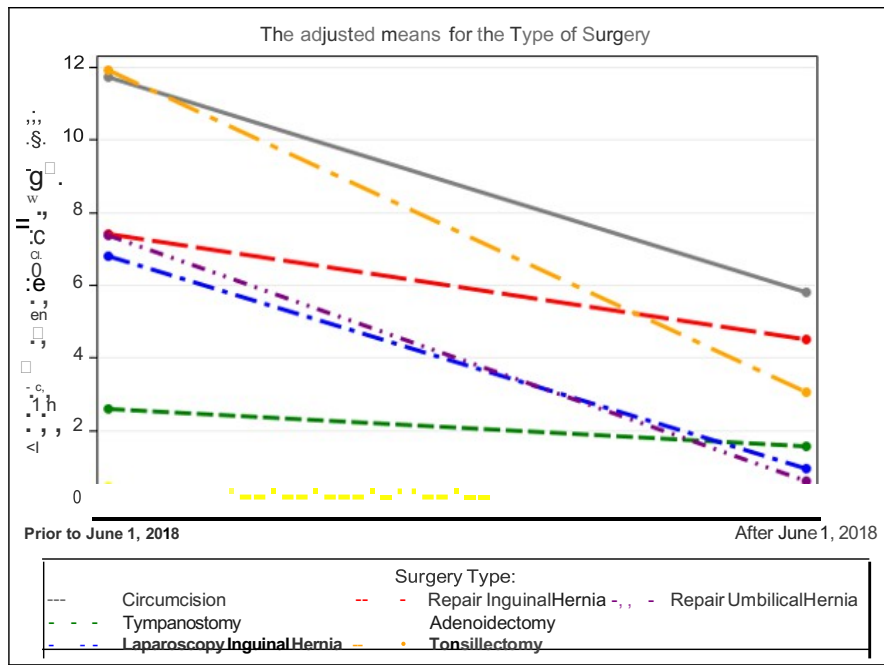
Abstract: Background: In December 2017, Michigan enacted Public Act 246(P246) to address rising opioid misuse. P246 states that, as of June 1, 2018, a prescriber of a controlled substance must discuss the risks of opioid addiction, overdose, and the dangers of taking opioids with benzodiazepine, alcohol or any other nervous system depressant with the minor and the minor's parent or guardian. This study aims to evaluate the impact of this legislation by comparing opioid morphine milligram equivalents (MME) prescribed to pediatric patients undergoing common general, urological, and ENT surgeries before and after June 1, 2018.

Methods: A single-center, retrospective chart review of pediatric patients who underwent circumcision, inguinal hernia repair, umbilical hernia repair, tympanostomy, tonsillectomy, or adenoidectomy between 2015 and 2021. MME was calculated from post-operative opioid prescriptions. Descriptive statistics, univariate, and multivariable analysis was performed, looking at changes in MME prescribed pre- and post- P246.

Results: A total of 7,280 patients, with a mean age of 3.1 years were included in the study; 3,512 pre-P246 and 3,786 post-P246. The post-P246 group included significantly more males (75.7 vs. 72.6%) and those with government insurance (34.5 vs 22.2%). There was no significant difference in age between the two groups. Children undergoing surgery after implementation of the law were found to have been prescribed 4.9 mg MME less than those before implementation (7.69 vs. 3.20, $p < 0.0001$). A multi-variate linear regression model, adjusting for age, surgery date, and specialty, showed that all three surgical specialties had a significant reduction in prescribed MME post-P246. Children undergoing circumcision, inguinal herniorrhaphy, and umbilical herniorrhaphy had significantly reduced MME prescribed to them after June 1, 2018. However, no significant decrease was observed for tympanostomy, tonsillectomy, and adenoidectomy.

Conclusion: Michigan Public Act 246 was significantly associated with a 58% reduction in prescription opioids for pediatric patients after routine surgery. These findings suggest that guardianship education about risks of opioid usage can significantly influence prescribing practices for pediatric surgical specialties, demonstrating the potential of legislation in promoting opioid stewardship.

Abbreviations: ENT: Ear, Nose, and Throat



POTENTIAL RISK OF MISSED DIAGNOSES WHEN CHOOSING NON-OPERATIVE MANAGEMENT IN PEDIATRIC UNCOMPLICATED APPENDICITIS: IS IT WORTH IT?

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Abstract: Purpose:

An antibiotic-only approach to managing pediatric uncomplicated appendicitis has the potential to offer parents more choice. However, this approach confers the risk of missed diagnoses of alternative pathologies. To evaluate this risk, we aimed to quantify the rate of alternative pathologies presenting as uncomplicated acute appendicitis at a large free-standing children's hospital. In addition, a review of contemporary perioperative clinical outcomes was undertaken to assess the potential benefits of avoiding surgical intervention.

Methods:

We conducted a retrospective review of patients who underwent appendectomy for presumed uncomplicated appendicitis at a tertiary children's hospital between January 1, 2019 and December 31, 2023. The inclusion criteria were appendectomy for a presumptive diagnosis of uncomplicated appendicitis and same-day discharge. Pathology reports, 30-day readmissions, emergency department visits, additional procedures, and post-operative length of stay were reviewed.

Results:

Among 5,244 patients, 50 (1.0%) had notable alternative pathologies including 26 occult malignancies (24 neuroendocrine tumors, 1 low-grade appendiceal mucinous neoplasm, 1 lymphoma) and 24 atypical infections (18 *Enterobius*, 3 *Actinomyces*, 1 *Ascaris*, 1 *Yersinia*, and 1 unspecified filamentous organism). Of these, 4 (15%) patients with occult malignancies and 14 (58%) patients with atypical infections received additional treatment or surveillance.

The median postoperative length of stay was 2.6 hours (IQR 2.0 – 12.6 hours). There were 187 (3.6%) emergency center visits post-discharge, primarily for abdominal pain (89), superficial surgical site infections (26), and constipation (16). There were 68 (1.3%) readmissions related to appendectomy and 18 patients (0.3%) required additional procedures, including 15 drainage procedures, 2 returns to the operating room, and 1 cystoscopy for hematuria. The negative appendectomy rate was 1.6%.

Conclusion:

A subset of children with uncomplicated appendicitis may experience treatment delays and potential harm from missed diagnoses when choosing non-operative management. Given the diagnostic accuracy, low morbidity, and excellent safety profile observed in our perioperative data, the risk-benefit ratio at our institution does not favor employing non-surgical management for most children. This decision should be carefully evaluated on an institution-specific basis.

Abbreviations:

Friday, May 9, 2025

Scientific Session 11 - NEC

2:00 PM – 3:30 PM

S21

ASSOCIATION OF SOCIOECONOMIC STATUS WITH DEVELOPMENT AND SEVERITY OF NECROTIZING ENTEROCOLITIS

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Abstract: Purpose:

Necrotizing enterocolitis (NEC) commonly afflicts infants after premature birth. Prematurity is associated with lower socioeconomic status (SES); however, it is not clear whether lower SES (apart from prematurity) is independently associated with the development or severity of NEC. Our objectives were to determine whether: (1) neonates of lower SES are at higher risk of developing NEC, and (2) neonates of lower SES are more likely to develop severe NEC requiring surgery.

Methods:

The Pediatric Health Information System (PHIS) database from 1/2016-12/2023 was used to identify infants ≤ 60 days of life with NEC using International Classification of Diseases (ICD-10) codes. Need for surgery was identified using ICD-10 procedure codes. Infants with NEC were 1:1 matched with non-NEC controls based on gestational age, chronological age (± 7 days), race/ethnicity, and presence of cardiac disease. SES was measured using median household income (MHI) by zip code and Child Opportunity Index (COI). A multivariable logistic model was used to measure associations with SES.

Results:

Among 11,151 infants with NEC, 11,108 (99.6%) were matched with appropriate controls. Infants with NEC were most commonly male (57.1%), non-Hispanic white (38.1%), and had a birth weight $< 1000\text{g}$ (39.1%). The primary source of health coverage in most cases of NEC managed medically or surgically was government insurance (64% and 65% respectively). Compared to patients without NEC, patients with NEC were significantly more likely to have lower SES as measured by MHI in the 1st-3rd quintiles and very low/low/moderate COI ($p < 0.0001$) (Table 1). Among infants with NEC, in a model adjusting for age, gestational age, race/ethnicity and cardiovascular disease, neither MHI (OR 1.07, CI 0.98-1.17) nor COI (OR 1.07, CI 0.97-1.17) was significantly associated with the need for surgery. On the other hand, both gestational and chronological age were significantly associated with the need for surgical intervention ($p < 0.0001$).

Conclusion:

These findings demonstrate that lower SES among infants of the same level of prematurity and same race/ethnicity is an important risk factor for developing NEC. Targeted socioeconomic interventions to support low-SES families may be important to reduce the disease burden of NEC.

Abbreviations: NEC - Necrotizing Enterocolitis

SES - socioeconomic status
 PHIS - Pediatric Health Information System
 ICD-10 - International Classification of Diseases-10
 MHI - median household income
 COI - child opportunity index

Table 1. Development of NEC vs. No NEC based on Median Household Income and Child Opportunity Index

	NEC (N=11,108)	No NEC (N=11,108)	p-value
MEDIAN HOUSEHOLD INCOME	n (%)	n (%)	
1 st quintiles (\$9,015-\$42,053)	6,878 (61.9)	6,389 (57.5)	<0.0001
2 nd quintiles (\$42,053-\$519,43)			
3 rd quintiles (\$51,943-\$62,637)			
4 th quintiles (\$62,637-\$79,621)	4,179 (37.6)	4,672 (42.1)	
5 th quintiles (\$79,621-\$250,001)			
Missing	51 (0.5)	47 (0.4)	
CHILD OPPORTUNITY INDEX	n (%)	n (%)	
Moderate, Low, and Very Low	8,252 (74.2)	7,842 (70.7)	<0.0001
Very High or High	2,856 (25.8)	3,265 (29.3)	

IMPACT OF EARLY VERSUS LATE ENTERAL FEEDING RE-INITIATION ON TISSUE REGENERATION AFTER NECROTIZING ENTEROCOLITIS IN MICE: A BASIC SCIENCE APPROACH

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Abstract: Introduction: Necrotizing enterocolitis (NEC) is a severe intestinal inflammation with tissue necrosis in preterm neonates. The optimal timing for reintroducing enteral feeding after NEC remains controversial yet may impact both intestinal recovery and NEC recurrence. To investigate the impact of early versus late enteral feeding re-initiation on intestinal tissue regeneration after NEC, we developed a newborn NEC re-feeding model, and assessed histopathological markers of inflammation, cellular repair, and tissue integrity.

Methods: A NEC refeeding model was developed in 7d old C57-BL/6 mouse pups by inducing NEC for 2 days using a combination of formula gavage fortified with enteric bacteria isolated from stool of infants with NEC 5x/d and hypoxia (10 min at 5% O₂) twice daily. Pups were then divided into Early (E), fed on day 3 for 24 hours or Late (L), receiving 5% dextrose until all groups received full enteral feeds for 24h until day 5. Serum was obtained for cytokine by ELISA, and ileum was harvested for histological analysis, Western Blot and PCR.

Results: Multiplex ELISA analysis of 32 inflammatory cytokines revealed a significantly increased IL6 levels and macrophage-stimulating cytokines GM-CSF, M-CSF, MIP1b, MIP2 and RANTES in the early enteral formula feeding group compared with late group, while there was a trend towards higher crypt cell proliferation in the early enteral feeding group indicated by Ki-67 staining. Histological evaluation revealed equal inflammation between groups.

Conclusions: These findings suggest that early feeding leads to increased early systemic inflammation and increased tissue regeneration, but no alterations in histology or tissue injury. These findings suggest that an early feeding strategy may offer benefits to patients with NEC.

Abbreviations: Necrotizing enterocolitis (NEC)
Enzyme-linked Immunosorbent Assay (ELISA)
Granulocyte-macrophage colony-stimulating factor (GM-CSF)
Macrophage colony-stimulating factor (M-CSF)
Macrophage inflammatory protein (MIP1b, MIP2)
Regulated and normal T-cell Expressed and Secreted (RANTES)

ARGON INHALATION PROMOTES M1/M2 MACROPHAGE POLARIZATION DURING EXPERIMENTAL NECROTIZING ENTEROCOLITIS

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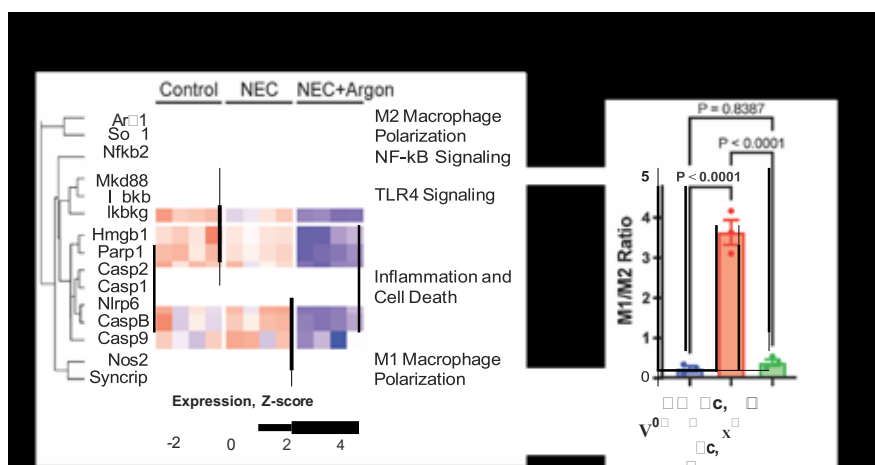
Abstract: Purpose: Neonates with necrotizing enterocolitis (NEC) are frequently mechanically ventilated, creating an opportunity for the investigation of inhalational therapy. Preliminary studies indicated that argon inhalation promotes intestinal rescue during experimental NEC. Argon has been shown to modulate M1/M2 polarization in macrophages. During NEC, polarization of M1 proinflammatory macrophages contributes to NEC development by enhancing inflammation and lytic cell death in intestinal epithelial cells. Upregulated TLR4 signaling, a hallmark of NEC intestinal damage, can polarize macrophages into M1 proinflammatory states. Herein, we investigated the mechanism of action of argon during NEC by analyzing whether argon inhalation can promote polarization in favor of M2 anti-inflammatory macrophages.

Methods: NEC was induced in C57BL/6 pup mice on postnatal days (P) 5-9 by gavage feeding of a hyperosmolar formula and lipopolysaccharide (4mg/kg) as well as hypoxia. The study groups included breastfed controls, NEC alone, and NEC with argon inhalation. In the NEC + argon group, NEC pups were receiving argon inhalation (70% argon, 30% oxygen) continuously from P6 to P8 in a sealable chamber positioned within an incubator. On P9, pup mice were sacrificed, and distal ileum was harvested for proteomic as well as immunofluorescence analysis.

Results: Differential protein expression analysis in intestinal tissue lysates shows that argon reduced proinflammatory TLR4 signaling and cell death (Fig. 1A), rescuing the NEC-induced intestinal damage (histological score $p < 0.01$). In addition, markers of M1 macrophage polarization were downregulated by argon while markers of M2 polarization were upregulated (Fig. 1A). We confirmed this result by the decreased M1 (CD86) to M2 (CD206) macrophage cell ratio in the intestine by immunofluorescence (Fig. 1B).

Conclusions: Argon inhalation during experimental NEC leads to reduced intestinal injury via inhibition of TLR4 signaling which reduces the polarization of M1 proinflammatory macrophages and increases that of M2 anti-inflammatory macrophages. The delivery of argon during NEC is a novel and practical therapeutic intervention as neonates with NEC are frequently mechanically ventilated. Argon inhalation has a great translational potential to reverse intestinal injury during NEC.

Abbreviations:



ADMINISTRATION OF SPECIFIC HUMAN MILK OLIGOSACCHARIDES PROTECTS AGAINST ENTERIC GLIA LOSS AND SMALL INTESTINE HYPOMOTILITY IN EXPERIMENTAL NECROTIZING ENTEROCOLITIS

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Abstract: Purpose

Necrotizing enterocolitis (NEC) is a devastating illness of premature infants stemming from exaggerated pro-inflammatory signaling in the intestinal mucosa and is preceded by a significant reduction in motility in the small intestine. Human milk oligosaccharides (HMOs) are non-digestible components of breast milk that have been shown to protect against experimental NEC development in preclinical models through pathways that remain incompletely understood. We hypothesize that HMOs can reduce the risk of experimental NEC through restoration of intestinal motility and sought to determine the mechanisms involved.

Methods

We induced experimental NEC in neonatal mice using a well-established disease model. Starting on postnatal day 7, pups were orally gavaged with a stool-mixed experimental formula containing enteric bacteria isolated from a human infant with surgical NEC (40 µl/g body weight, 5 times daily) and canine milk replacer. HMO-treated pups received the same experimental formula, supplemented with either 2'-fucosyllactose (2'-FL), 6'-sialyllactose (6'-SL) or a blend of 5 specific HMOs. All pups were subjected to 10 minutes of hypoxia (5% O₂, 95% N₂) twice daily. Sacrifice was performed after 4 days. Standard methods were employed for immunohistochemical analyses and quantitative real-time polymerase chain reactions. Intestinal motility was evaluated by a previously described 70 kDa fluorescein-dextran (FITC) assay.

Results

There was successful induction of inflammatory cytokine expression (Lcn2 Ctrl vs. NEC $p < 0.001$), oxidative stress (3'-nitrotyrosine mean fluorescent density Ctrl vs. NEC $p < 0.001$), and hypomotility characteristic of NEC (FITC geometric center Ctrl vs. NEC $p < 0.01$). NEC-induced hypomotility was attenuated by the supplementation with HMOs in both single-compound and blend formulations (FITC geometric center NEC vs. NEC+2'-FL $p < 0.001$, NEC+6'-SL $p < 0.01$, NEC+Blend $p < 0.001$). This protective effect was associated with reduced loss of enteric glia (GFAP mean fluorescent density NEC vs. NEC+Blend $p < 0.01$, Sox10 mean fluorescent density NEC vs. NEC+Blend $p < 0.001$) and reduced loss of Bdnf expression (Bdnf relative expression NEC vs. NEC+Blend $p < 0.001$).

Conclusion

In an experimental mouse model of necrotizing enterocolitis, we demonstrate that the protective effect of human milk oligosaccharides against necrotizing enterocolitis development occurs, in part, through reduced enteric glial cell loss and thereby preservation of intestinal motility.

Abbreviations: NEC - necrotizing enterocolitis

HMO - human milk oligosaccharide

FITC - fluorescein isothiocyanate

Lcn2 - lipocalin 2

Ctrl - control

GFAP - glial fibrillary acidic protein

Sox10 - SRY-box transcription factor 10

Bdnf - brain-derived neurotrophic factor

PLASMA TLR4 LEVELS AS A BIOMARKER OF INTESTINAL TLR4 ACTIVATION IN A MOUSE MODEL OF LIPOPOLYSACCHARIDE ENDOTOXEMIA

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Abstract: Purpose

Sepsis is a major cause of morbidity and mortality in children and requires early diagnosis in order to improve outcomes, leading to a search for effective biomarkers. Bacterial sepsis is often mediated by lipopolysaccharide (LPS, endotoxin) that is found on the outer membrane of gram-negative bacteria, and which is recognized by the toll like receptor 4 (TLR4). We and others have shown that TLR4 signaling leads to overwhelming tissue injury and mediates septic conditions including necrotizing enterocolitis (NEC). We therefore hypothesized that measurement of circulating TLR4 could serve as a biomarker for sepsis, which was tested in a pediatric endotoxemic sepsis model.

Methods

We developed a model of endotoxemic sepsis by injecting wild-type C57 BL/6 mice with either LPS (i.p., 5 mg/kg) or saline (i.p., 5 ml/kg) at age 6 weeks. For validation, we generated TLR4^{-/-} mice. After 6h, plasma was obtained for determination of TLR4 using a customized mouse TLR4 ELISA kit against known standards. Ileal samples were collected and processed for total RNA isolation, cDNA transcription and qPCR for cytokine expression. One-way ANOVA and Tukey's multiple comparison statistical tests were performed in GraphPad Prism.

Results

In wild-type mice, endotoxemic sepsis was achieved by activation of intestinal TLR4 signaling, which is demonstrated by the increased expression of inflammatory cytokines in the ileum (Il-6 ctrl 0.56 vs. LPS 7.7, $p < 0.0001$; Tnfa ctrl 1.8 vs. LPS 7.27, $p < 0.001$). TLR4^{-/-} mice were protected from LPS-induced TLR4 activation in the ileum (Il-6 ctrl 0.83 vs. LPS 1.38, $p = 0.95$; Tnfa ctrl 0.73 vs. LPS 2.03, $p = 0.68$). Strikingly, endotoxic sepsis induced a parallel rise in plasma TLR4 levels in wild-type mice (ctrl 0.16 ng/mL vs. LPS 14.37 ng/mL, $p < 0.05$), while that of TLR4^{-/-} mice was unchanged by LPS treatment (ctrl 0.24 ng/mL vs. LPS 1.56 ng/mL, $p = 0.96$), confirming the specificity of the assay.

Conclusion

We have now developed and validated a plasma assay for endotoxemic sepsis based on the serum measurement of TLR4, and which correlated with intestinal inflammation. These findings suggest the possibility of early detection of bacterial sepsis, and the opportunity to improve outcome in this disease.

Abbreviations: NEC - Necrotizing enterocolitis

TLR4 - Toll-like receptor 4

LPS - lipopolysaccharide

i.p. - intraperitoneal

RCF - relative centrifugal force

EDTA - Ethylenediaminetetraacetic acid

ELISA - enzyme-linked immunosorbent assay

qPCR - quantitative polymerase chain reaction

ANOVA - analysis of variance

Il-6 - interleukin 6

Tnfa - tumor necrosis factor alpha

SHORTER ANTIBIOTIC DURATION IN STAGE II NECROTIZING ENTEROCOLITIS DOES NOT INCREASE STRICTURE RATE

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Abstract: Purpose:

Bell's Stage II necrotizing enterocolitis (NEC) can be treated effectively with antibiotics, but no established protocol exists defining the optimal therapy. It is unknown how duration of antibiotic therapy affects the rate of stricture formation. We hypothesized that a 7-day protocolized antibiotic regimen would not result in increased stricture formation compared to longer antibiotic courses.

Methods:

We retrospectively reviewed a prospectively maintained registry of pediatric surgical consultations for NEC at an academic children's hospital from October 2015 through December 2022. Patients with a diagnosis of Bell's Stage II NEC were included. Our center instituted a 7-day NEC antibiotic protocol of oxacillin, tobramycin, and metronidazole in August 2018. Patients were stratified by having NEC occurring Before or After that date. Demographics, outcomes, antibiotic regimens, and complications were compared. The primary outcome of interest was stricture.

Results:

We analyzed 61 infants (54% female) with Stage II NEC. Thirty-two (53%) were diagnosed After our antibiotic protocol was instituted. The median gestational age was 30 weeks 0.5 days [25 weeks 5 days – 34 weeks], and the median birth weight was 1260 grams [752 g – 2150 g]. In the Before period, the median length of antibiotic duration was 11 [10 – 14] days versus 7 [7 – 10] days After ($p < 0.001$). There was no significant difference in the rate of stricture (6.9% Before vs 9.4% After, $p=0.124$). Adherence to the antibiotic protocol in the After period was 65%; nonadherence often occurred in cases of concomitant infections (73%).

Conclusion:

In newborns with Bell's Stage II NEC, a standardized antibiotic regimen of oxacillin, tobramycin, and metronidazole for seven days is well tolerated and associated with equivalent stricture rate compared to longer antibiotic regimens. These results suggest that newborns can be exposed to shorter antibiotic courses without increased rate of stricture formation. We recommend similar regimens be trialed at other centers to decrease antibiotic exposure for newborns with NEC.

Abbreviations: NEC = Necrotizing enterocolitis

ARNOLD SCHWARZENEGGER OR DANNY DEVITO? THE FATE OF TWINS WITH NECROTIZING ENTEROCOLITIS IN THE NICU

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Abstract: Purpose:

Previous literature suggests infants of multiple gestation pregnancies have a higher incidence of necrotizing enterocolitis (NEC) than singleton gestations. However, no study has examined the likelihood of co-incident NEC among multiples. We hypothesize there would be an increased incidence of NEC among multiples whose siblings had been diagnosed with NEC.

Methods:

The Pediatric Health Information System was queried for all neonatal intensive care unit (NICU) admissions between 2017-2023. Patients with incomplete gestational age or birth weight information were excluded, and internal validation of data was performed. Multiple gestational sets were identified by diagnostic code indicating multiple gestation, and matched hospital center, birthdate, race/ethnicity, and deidentified zip code. Univariate and multivariate logistical regression was performed to assess for likelihood of developing NEC if one sibling in a multiple set was diagnosed with NEC.

Results:

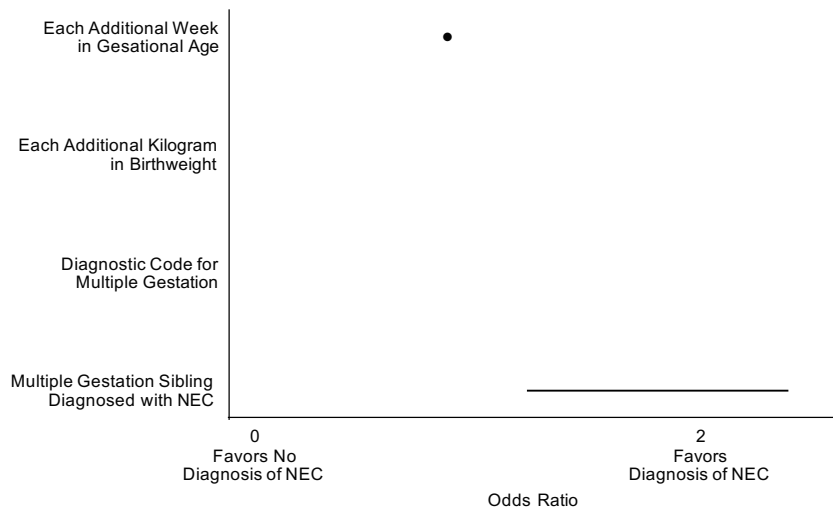
There were 253,577 NICU infants included, and 11,396 individuals (4.49%, 4,011 groupings) with a diagnostic code indicating a multiple gestation pregnancy. Multiples had shorter gestations (32.3 vs 35.8 weeks, $p < 0.01$), lower birthweights (1811.6 vs 2711.4 grams, $p < 0.01$), and developed NEC more frequently (3.9% vs 2.6%, $p < 0.01$) than an uncontrolled cohort of NICU singleton births. However, when controlling for gestational age, birthweight, gender and congenital heart defect, multiples were less likely than singleton births to develop NEC (OR 0.77, 95% CI 0.70-0.85). Nevertheless, if one infant in a set of multiples developed NEC, a second sibling was more likely to develop NEC compared to the general NICU population (16.4% vs 2.6%, $p < 0.01$). This correlation remained significant when controlling for gestational age and average birthweight of the multiple set (OR 1.70, 95%CI 1.22-2.38, Figure 1).

Conclusions:

We conclude that infants born of multiple gestational pregnancies are less likely to develop necrotizing enterocolitis as compared to a cohort of singleton infants admitted to the NICU. However, if one infant in a set of multiples develops necrotizing enterocolitis, there is a significant increase in likelihood that another sibling will develop necrotizing enterocolitis. It is unclear from present data whether this is related to genetic/microbiomic predisposition or hospital infrastructure that groups multiples in proximal rooms/beds subjecting them to similar infectious risks.

Abbreviations: NEC: Necrotizing Enterocolitis

NICU: Neonatal Intensive Care Unit



MECHANISMS OF INTESTINAL ORGANOID TRANSPLANTATION IN ENHANCING EPITHELIAL REGENERATION DURING EXPERIMENTAL NECROTIZING ENTEROCOLITIS

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Abstract: Purpose: Necrotizing enterocolitis (NEC) poses a significant threat to preterm infants, often resulting in severe intestinal damage. Restoring intestinal regeneration is crucial in the treatment of NEC. Intestinal organoids, capable of representing diverse epithelial cell types and suitable for transplantation, offer a promising approach for regenerative therapy. Our study investigates the therapeutic potential of intestinal organoid transplantation (OT) in repairing NEC-induced intestinal damage and aims to understand the molecular and cellular mechanisms underlying these transplantation effects.

Methods: Experimental NEC was induced in mice using a hyperosmolar formula, lipopolysaccharide, and hypoxia from postnatal days 5-9. Fluorescently tagged organoids derived from healthy mouse ileum were transplanted into 6-day-old recipient mice via enema. Bulk RNA sequencing and single-nucleus RNA sequencing (snRNA-seq) were performed on intestinal tissues collected from all groups at postnatal day 9. Data analysis focused on identifying cell populations, epigenetic profiles, and regulatory pathways affected by organoid transplantation in NEC.

Results: OT significantly reduced intestinal inflammation and improved survival by postnatal day 9. Transplanted organoids integrated into injured intestinal crypts but did not directly repopulate the intestinal epithelium. scRNA-seq revealed increased enterocyte and transit-amplifying populations post-transplantation. Mellon algorithm analysis (Figure 1A) highlighted stabilized secretory lineage cells and enhanced differentiation potential in NEC following OT. Bulk RNA-seq (Figure 1B) identified molecular changes, including activation of lipid metabolism and immune pathways in NEC, contrasting with restored cell junction assembly and neuronal migration pathways post-transplantation. Differential gene expression analysis identified distinct clusters, emphasizing restoration of innate defenses and antimicrobial responses post-treatment.

Conclusions: Organoid transplantation significantly improved outcome of NEC. This study provides a comprehensive molecular and cellular characterization of organoid transplantation effects in NEC, highlighting improvements in epithelial composition, activation of therapeutic pathways, and dynamics of stem cell responses. These findings underscore organoid transplantation's potential as a therapeutic strategy for restoring intestinal health in NEC.

Abbreviations:

A



CHANGES IN GLIA ACTIVATION STATES IN PYRAMIDAL REGION OF THE HIPPOCAMPUS DURING NECROTIZING ENTEROCOLITIS

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Abstract: Purpose

Necrotizing enterocolitis (NEC) is an intestinal disease that results in neurodevelopmental impairments in 40% of survivors. Previous research has identified neuroinflammation and memory dysfunction in NEC, but the specific brain regions and cell types involved in memory impairment remains unclear. We utilized spatial transcriptomics to map immune, vascular, and plasticity-associated cell interactions in histological brain sections from control and NEC mice. This study specifically aimed to characterize glial (microglia and astrocyte) activation states in the hippocampus.

Methods

NEC was induced in postnatal day 5 (P5) mice using a combination of hypoxia, hyperosmolar formula feeding, and oral lipopolysaccharide (4 mg/kg). Breastfed P9 pups served as controls. Spatial transcriptomics was performed using multiplexed error-robust fluorescence in situ hybridization (MERFISH) to detect over 500 mRNA transcripts at high resolution. UMAP dimensional reduction and differential gene expression (DGE) analyses were applied to identify distinct cell types and characterize glial transcriptomic changes in the hippocampus of control and NEC mice.

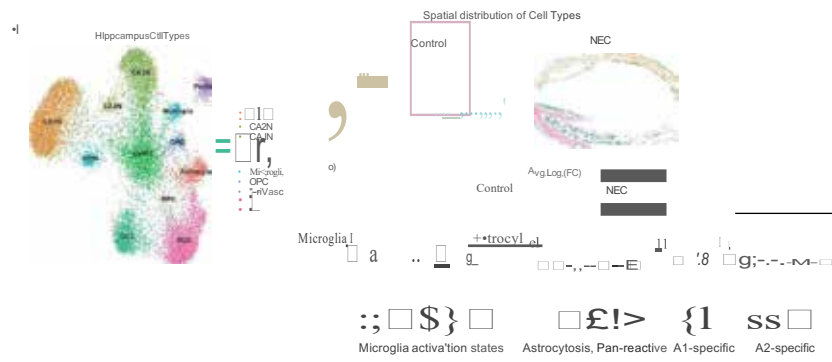
Results

UMAP analysis identified distinct populations of neurons, including pyramidal neurons (CA1-3), inhibitory neurons (InhN), and immune cells such as microglia and astrocytes. Progenitor cells, including glia-neuron precursors (ExN11) and oligodendrocyte progenitors (OPC), along with dentate gyrus progenitors (SGZ, GCL, RPC), were also found in both NEC and control hippocampi. These cell types were distributed along the hippocampal formation in the CA1-3 regions and dentate gyrus (Fig. 1a-b). Interestingly, compared to controls, DGE analysis revealed that NEC hippocampus exhibited increased expression of pro-inflammatory microglial markers TMEM119 and Sirp1a (purple dots) and reduced homeostatic microglia markers (green dots). NEC hippocampi also showed higher expression of the injury-associated astrocyte marker Cd14 and a decrease in homeostatic astrocyte markers (Fig. c). These cellular changes contribute to the memory impairment observed experimentally in our behavioral studies.

Conclusions

Spatial transcriptomics provides a comprehensive view of region-specific brain injury in NEC, revealing alterations in glial activation states in the hippocampus. These findings suggest that glial cells play a crucial role in NEC-related brain injury and may contribute to the impaired memory function observed in survivors. Future research will focus on glia-neuron interactions to further elucidate the neurodevelopmental consequences of NEC.

Abbreviations:



Friday, May 9, 2025

Scientific Session 12 - Global

2:00 PM – 3:30 PM

S31

RISK PREDICATION MODEL FOR PEDIATRIC SURGICAL OUTCOMES IN RESOURCE-CONSTRAINED SETTINGS

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Abstract: Purpose

The applicability of quality improvement programs in low- and middle-income countries (LMICs) is unknown. Understanding the risks associated with mortality and reviewing outcomes over time can tailor initiatives to reduce death from surgically treatable disease. We sought to develop a predictive model for pediatric surgical mortality for resource-constrained settings based on a limited number of variables to assist providers in counseling families and benchmarking outcomes.

Methods

The American College of Surgeons National Surgical Quality Improvement Program-Pediatric (ACS NSQIP-P) annual databases from 2012-2017 were combined and used to derive and internally validate a multivariate model for inpatient mortality. Only NSQIP variables relevant and feasible to collect in low-resource settings were used. Multivariable logistic regression using the Least Absolute Shrinkage and Selection Operator penalty (LASSO) identified the predictor variables with the highest discriminatory ability for inpatient mortality as assessed by the Area Under the Receiver Operating Characteristics (AUROC) curve. Two-thirds of the data was used in the derivation cohort and one-third in the validation cohort. A complete case analysis was performed.

Results

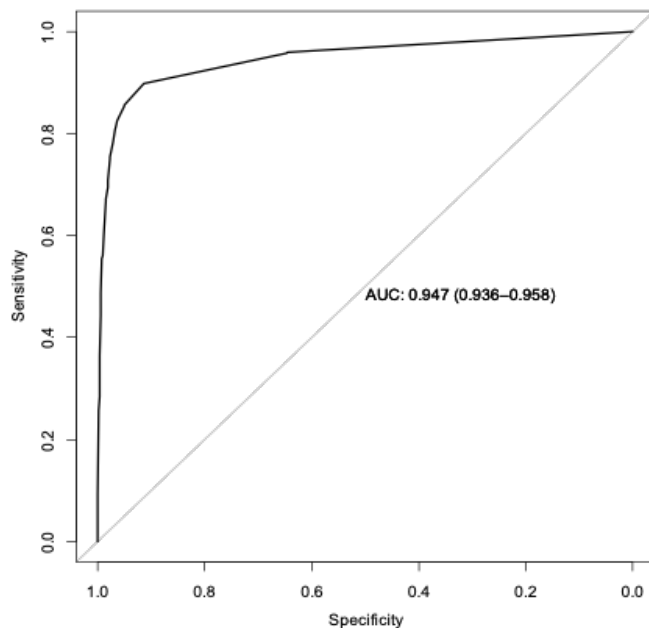
There were 475,769 total cases for which the inpatient mortality rate was 0.2%. There were 303,851 patients in the derivation cohort and 151,926 in the validation cohort. Of the selected variables for low resource settings, age (OR 0.86, $p < 0.001$, 95% CI: 0.84-0.87), weight at surgery (OR 0.97, $p < 0.001$, 95% CI: 0.97-0.98), congenital malformation and infant weight less than 1550 grams (OR 15.6, $p < 0.001$, 95% CI: 0.936-24.4), congenital malformation and infant greater than 1550 grams (OR 1.71, $p < 0.001$, 95% CI: 1.49-1.95), and urgent case status (OR 2.35, $p < 0.001$, 95% CI: 1.92-2.86) were associated with mortality on univariate analysis. On multivariate analysis, inpatient vs outpatient status, requiring oxygen or nutritional support, blood transfusion within 48 hours of surgery, admission from home or clinic and life-threatening ASA classification showed the

best discriminative ability for inpatient mortality with an AUROC for inpatient death of 0.95 (95% CI 0.94-0.96, Figure 1).

Conclusion

Assessing presurgical risk reliably using prognostic models for resource-constrained settings can aid in clinical decision-making and help prevent failure to rescue. We developed a model to risk-adjust pediatric mortality with excellent accuracy.

Abbreviations:



SURGICAL RISK PREDICTION MODEL AND RISK CALCULATOR FOR NEONATES IN LOW RESOURCE SETTINGS

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Abstract: Purpose

Surgical risk calculators can help identify high risk patients quickly and efficiently. Few have been developed to help determine surgical risk in low-resource settings. We sought to develop a predictive model and risk calculator for neonatal surgical mortality in resource-constrained settings based on a limited number of variables to aid in clinical management.

Methods

The American College of Surgeons National Surgical Quality Improvement Program-Pediatric (ACS NSQIP-P) annual databases from 2012-2017 were combined and used to derive and internally validate a multivariate model for neonatal inpatient mortality. Only NSQIP variables relevant and feasible to collect in low-resource settings were used. Multivariable logistic regression using the Least Absolute Shrinkage and Selection Operator penalty (LASSO) was used to identify the predictor variables with the highest discriminatory ability to predict neonatal mortality as assessed by the Area Under the Receiver Operating Characteristics (AUROC) curve. Two-thirds of the data was used in the derivation cohort and one-third in the validation cohort. A complete case analysis was performed.

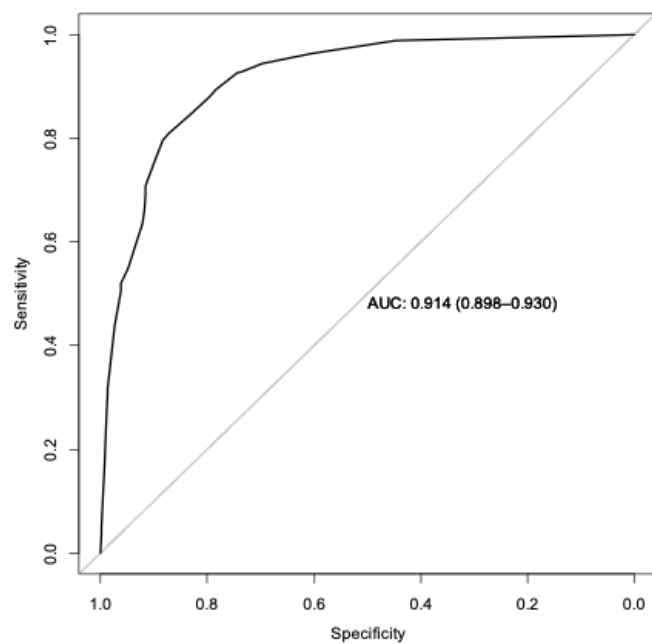
Results

There were 17,589 total neonatal cases for which the inpatient mortality rate was 4.3%. There were 11,673 patients in the derivation cohort and 5,837 in the validation cohort. On multivariate analysis, the final model included seven variables: premature birth, need for oxygen support, blood transfusion or sepsis within 48 hours of surgery, urgent and emergent case status, and life-threatening ASA classification. A risk score using the predicted probabilities for those at low risk (< 10%, 0-15 points), moderate (11-30%), and high risk of death (>30%, 24 or greater points) was created. This model showed the best discriminative ability for neonatal mortality with an area under the receiver operating characteristic curve of 0.91 (95% CI 0.90-0.93, Figure 1).

Conclusion

Our model predicts neonatal mortality with excellent accuracy for low-resource settings. We also derived a risk score using a limited number of perioperative variables to easily identify high-risk neonates to aid in clinical decision-making.

Abbreviations:



UNLOCKING LOCAL FINANCING FOR PEDIATRIC SURGICAL CARE IN A REFUGEE AND RURAL CONTEXT IN TURKANA KENYA

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Abstract: Purpose: Health financing for humanitarian health interventions is on the decline. In Kenya, the National Health Insurance Fund (NHIF) has provided health insurance coverage since the 1960s. Recently, there was a policy change to include refugees in the NHIF. Our objective was to evaluate the feasibility of unlocking NHIF financing for pediatric surgical care in refugee and host children in Turkana and to determine the return on investment of providing health insurance coverage for children in need of surgical services in a rural and refugee context.

Methods: Refugee and host children were registered to the NHIF which covers comprehensive health services including pediatric surgical services. Following activation of health insurance coverage, the nutritional status of patients was optimized, and pre-authorization forms were completed for each patient before surgery. Surgical procedures were done by a team composed of a pediatric surgeon, a general surgeon, and a pediatric clinical officer anesthetist. We calculated frequencies of pediatric surgical conditions, the average health insurance reimbursement amount, the return on investment on every dollar spent on health insurance coverage, and the postoperative complication rate.

Results: To date, 300 children aged 4 days to 13 years old have been registered to NHIF. The most common diagnoses were hernias and hydroceles (28.4%). In the neonatal period, the most common diagnoses were anorectal malformations (60%). Thirty pediatric surgical procedures including hernia repairs and posterior sagittal anorectoplasties (PSARPs) have been completed and 6 reimbursements have been received. The average reimbursement amount was \$1036.43 dollars and the return on investment on every dollar spent was \$22.3 dollars. Our postoperative complication rate was (3.33%); there was one premature removal of a urinary catheter following a PSARP which required a cystoscopy and replacement of the catheter.

Conclusion: It is feasible to unlock health insurance financing for pediatric surgical care in a rural and refugee context; the return on investment is significant, and this approach could be a sustainable mechanism for financing pediatric surgical interventions in rural and refugee contexts. Surgical complications were rare and were linked to a need for optimizing postoperative nursing care.

Abbreviations:

EFFECT OF DISTANCE TO CARE ON PEDIATRIC TRAUMA OUTCOMES IN CENTRAL MALAWI

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Abstract: Purpose: To characterize the effect of distance to a tertiary care center on pediatric trauma outcomes in Malawi.

Methods: A retrospective review of pediatric trauma admissions to a tertiary referral center was conducted from January 2018 to December 2021. Children ≤ 18 years admitted for traumatic injury were included. Burn injuries were excluded. Distance from location of injury was calculated using district-level centroid to care center measurement in ArcGIS. The Malawi Trauma Score (MTS) – an injury severity score comprised of age, gender, radial pulse, anatomical location, and responsiveness – was calculated for each admission. Multivariable logistic regression was conducted to predict in-hospital mortality for a complete case cohort. Statistical significance was set at $p < 0.05$.

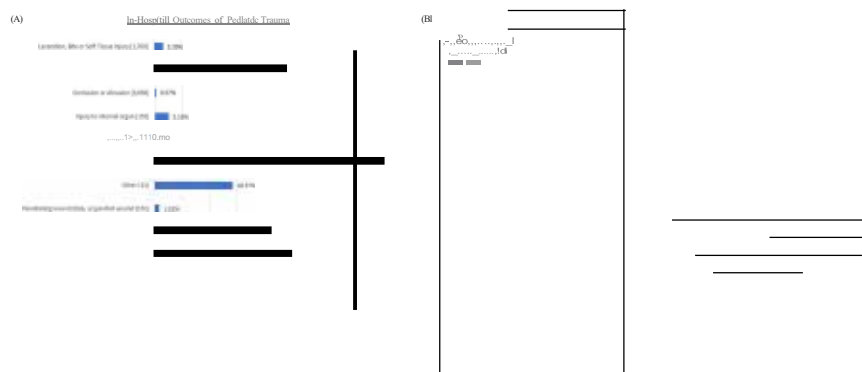
Results: 11,146 patients were included. The average age of presentation for the overall population was 8.3 years (SD: 4.7), with a male preponderance (69.8%). Overall, in-hospital mortality was 1.41% ($n=143$). Lacerations/bites/soft tissue injuries accounted for the majority of in-hospital deaths ($n=60$; 43.2%) (Figure 1A). Hanging resulted in the highest relative mortality (83.3%) of all injury types; however, only 6 cases were observed. Most lacerations/bites/soft tissue injuries ($n=1,052$; 54.3%) were to the head and neck region. The mean distance traveled to care was 18.5 km (SD: 24.0). On multivariable logistic regression, each additional 50 km to care conferred significantly higher odds of in-hospital mortality (OR=1.89, $p < 0.001$) (Figure 1B).

Laceration/bite/soft tissue (OR=3.33, $p < 0.001$), penetrating/stab/gunshot (OR=6.59, $p < 0.01$), internal organ injury (9.26, $p < 0.001$), drowning (52.92, $p < 0.001$), electrocution (OR=528.64, $p < 0.001$), and other (septic joint, hemarthrosis etc.) (OR=20.31, $p=0.02$) had significantly higher odds of in-hospital death compared to contusions/abrasions. An increasing MTS predicted higher odds of death (OR=1.79, $p < 0.001$).

Conclusions: Lacerations/bites/soft tissue injuries were most commonly associated with death for pediatric trauma admissions in this population. Though rare, hanging injuries were the deadliest etiology. After adjusting for injury severity, type, and need for operative management, each additional 50km to care incurred a 1.89-fold increase in odds of in-hospital death. This geographical disparity highlights the need for strategic placement of trauma infrastructure, educational outreach to community health facilities and strengthening transport services to emergency pediatric surgical care.

Abbreviations: OR=odds ratio
MTS= Malawi Trauma Score

Figure 1: Distribution and Predictors of Pediatric Trauma Mortality. (A) In-hospital outcomes of pediatric patients presenting with traumatic injury. Type of injury and number of cases seen are denoted on the vertical axis. Injury types are designated by order of most to least common cause of death within the observed population. Mortality rate specific to injury type is displayed by bars on the horizontal axis. (B) Adjusted odds ratios (OR) from multivariable regression results of mortality are shown (n:9,439) with 95% CI on a logarithmic scale. *MTS includes age,gender,responsivenessonarrival,presenceofradial pulseandanatomicallocationofinjury. *p<0.05.



UTILITY OF PAEDIATRIC DAYCASE SURGERY IN A RURAL SETUP IN SUB SAHARAN AFRICA

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Abstract: Introduction

The practice of day-case surgery (DCS) has increased in the past 40 years with oversight guidelines from various bodies to maintain patient safety. Whereas up to 80% of elective pediatric surgical case load is suitable for DCS, its uptake in Sub-Saharan Africa (SSA) lags behind due to patient, institutional and socioeconomic factors. A contextualized implementation of DCS in this setup has the potential to address these barriers to the benefit of the patient and healthcare systems involved.

Methods

A descriptive retrospective study was conducted with two arms: pre- and post-adoption of day-case surgery (DCS). DCS was introduced in our institution in May 2021. The post- DCS adoption period was taken from June 2021 till May 2022. The pre-DCS adoption period of June 2020 to May 2021 was used as the comparator. A total of 506 cases were included.

Results

Each arm had 253 cases. Overall, the median patient age was 4 years. Orchidopexy was the most common surgery performed overall, followed by hypospadias in pre- DCS adoption arm and gastrointestinal related procedures in the post-DCS adoption arm. Majority of the cases were done under general anesthesia. The median waiting time from time of clinic visit to date of operation between the two groups was similar.

The median duration of stay in the post anesthesia care unit (PACU) was lower in the post-DCS adoption group (95 minutes) compared to the pre- DCS adoption group (141 minutes) ($p=0.0008$). The unplanned admission rate was 9.1% ($n=23$), with 65% of these being due to social reasons. The 30-day post-operative complication rate was similar in both arms ($p=0.1441$). The median cost of care was lower in the post-DCS adoption group (Ksh. 61, 633) compared to the pre-DCS adoption group (Ksh. 68, 606) ($p=0.004$), even after adjusting for 6.5% average inflation rate as per national statistics.

Conclusion

Implementation of DCS in a rural setup in SSA is feasible, resulting in better utilization of hospital resources and cost saving for the patient without adverse clinical outcomes. Addressing social concerns is an area for improvement in the quality of DCS offered to our patients.

Abbreviations: DCS- Day case surgery, SSA- Sub Saharan Africa, PACU- Post-anesthesia care unit, Ksh- Kenyan Shilling

CAPACITY STRENGTHENING INTERVENTIONS TO IMPROVE ACCESS TO PEDIATRIC SURGERY IN LOW-MIDDLE INCOME COUNTRIES: A SYSTEMATIC REVIEW

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Abstract: Background:

85% of children in low-middle income countries (LMICs) have surgically treatable conditions, yet only 3.5% of the 200 million surgeries taking place annually, take place in LMICs. Pediatric surgery accessibility barriers in LMICs include insufficient number of pediatric surgeons, poor/limited training, and high cost/travel for patients. In the past, implementation of health programs in LMICs relied on philanthropy. However, this was recognized as creating power imbalances and leading to a dependency on foreign support, rather than creating sustainable improvements. Thus, there has been a shift to capacity building projects, which are defined as developing/strengthening the skills, abilities and resources that communities need to survive and thrive. There is limited literature that provides strategies to improve pediatric surgical services in LMICs. The aim of this review is to synthesize the literature to identify all undertaken projects, their impact, and their limitations/barriers.

Methods:

This systematic review adhered to recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guidelines. MEDLINE, EMBASE, Cochrane, and Web of Science were searched from inception until May 5, 2023.

Eligibility criteria was: 1) pediatric surgery patients; 2) capacity building interventions; 3) improved access defined through 6 Lancet Commission on Global Surgery Indicators (access to timely essential surgery, surgical workforce density, surgical volume, perioperative mortality rate, and protection against impoverishing/catastrophic expenditure); 4) LMIC defined by the World Bank. Two independent reviewers conducted screening, extraction, and quality assessment.

Results

80 studies met inclusion criteria. Interventions were implemented in 77 LMICs. 103,350 children were supported, most children had complex needs. 11 studies served children from rural/remote communities, 19 studies provided free surgeries to low-income children/families. Capacity building interventions included international surgical missions, training programs, international partnerships between high-income and LMICs, mobile clinics/camps, new centers, and telemedicine. 1,357,077 pediatric surgeries were performed through these interventions.

Conclusions:

This review outlines 19 methods of capacity-building strategies and their limitations/barriers. Most capacity-building interventions prioritized training surgical providers in their own countries for long-term sustainability. The most common barrier to overcome was inadequate equipment/infrastructure. We hope that this review will prove helpful to improve access to pediatric surgery in LMICs.

Abbreviations: Low-middle income countries (LMICs)

COMPARISON OF PSI, RPSI AND SIPA IN TRIAGING INJURED CHILDREN WITHIN A RESOURCE-SCARCE LMIC SETTING

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Abstract: Purpose: Low- and middle-income countries (LMICs) bear a disproportionately high burden of injury, with pediatric trauma contributing to 40% of childhood deaths. Inappropriate triage of children consumes scarce resources. We compared the Pediatric Shock Index (PSI), rapid Pediatric Shock Index (rPSI), and Shock Index, Pediatric Age-Adjusted (SIPA) as triage tools for predicting the need for higher care in an LMIC setting.

Methods: This study included children (age 1-18 years) admitted to a trauma center in South Africa from December 2012 to July 2024. We excluded patients with missing vital signs. We compared PSI and rPSI to SIPA as predictors of need for higher level care using a composite outcome (blood transfusion, ICU admission, or surgery). Sensitivity, specificity, and positive likelihood ratios were compared with subgroup analyses by age (1-7, 8-12, >12 years). McNemar's test and Z-test were applied to check for statistical significance, with a level of significance at 0.05.

Results: Of 2636 injured patients, 1,348 (51%) met inclusion criteria. The median age was 8 (IQR: 5-11) and 68% were male. Of the patients, 1035 (76%) had blunt trauma and 313 (23%) had penetrating trauma. 476 (35.3%) patients needed higher level care. There were 623 (46%) patients aged 1-7, 518 (38%) aged 8-12 and 315 (23%) aged > 12 years. Overall, the specificity of PSI (83%, 95%CI, 80-85%) and rPSI (79%, 95%CI, 76-82%) was statistically higher than SIPA (72%, 95%CI, 69-75%). However, SIPA achieved higher sensitivity than PSI and rPSI. This was anticipated given the higher cutoffs of rPSI and PSI for most ages. For the whole cohort, PSI demonstrated a statistically greater positive likelihood ratio (2.1, 95%CI, 1.7-2.5) than SIPA (1.6, 95% CI, 1.4-1.9). PSI, rPSI, and SIPA have identical cutoffs for patients aged 13 and older, suggesting that older children can be assessed with the established adult shock index cutoffs.

Conclusion: We conclude that PSI and rPSI may be promising for risk stratification for pediatric trauma patients in an LMIC context, especially for children aged 12 or younger. The empiric age-based cutoffs of PSI may better represent the injured child's initial hemodynamic state as compared to SIPA.

Abbreviations: Low- and middle-income countries (LMICs)

Pediatric Shock Index (PSI)

Pediatric Shock Index (rPSI)

Shock Index, Pediatric Age-Adjusted (SIPA)

Confidence Interval (CI)

Table I. Sensitivity, Specificity, and Positive Likelihood Ratios of Pediatric Trauma Scales

Patient Age	Need for Higher Level Care	Pediatric Shock Index (PSI)	Rapid Pediatric Shock Index (rPSI)	Shock Index Pediatric Adjusted (SIPA)
All Patients (n= 1,348)	Sensitivity	0.36 (0.32 - 0.40)	0.40 (0.36 - 0.45)	0.45 (0.40 - 0.50)
	Specificity	0.83 (0.80 - 0.85)	0.79 (0.76-0.82)	0.72 (0.69-0.75)
	Positive Likelihood Ratio	2.1 (1.7 - 2.5)	1.9 (1.6 - 2.3)	1.6 (1.4 - 1.9)
Aged 1-7 (n= 623)	Sensitivity	0.32 (0.26 - 0.39)	0.34 (0.28 - 0.41)	0.49 (0.39 - 0.53)
	Specificity	0.84 (0.80 - 0.87)	0.81 (0.77 - 0.85)	0.67 (0.62-0.71)
	Positive Likelihood Ratio	1.9 (1.4- 2.6)*	1.8 (1.4- 2.4)*	1.4 (1.1 - 1.7)*
Aged 8-12 (n= 518)	Sensitivity	0.35 (0.28 - 0.42)	0.44 (0.37 - 0.51)	0.44 (0.37 - 0.51)
	Specificity	0.82 (0.77 - 0.86)	0.74 (0.69-0.79)	0.74 (0.69-0.79)
	Positive Likelihood Ratio	1.9 (1.4- 2.6)*	1.7 (1.3 - 2.2)*	1.7 (1.3 - 2.2)*

* $p > 0.05$ on pairwise comparison.

Pairwise statistical comparisons within rows were performed and significant ($p < 0.05$) unless otherwise indicated

GAPS IN CAPACITY FOR CHILDREN'S SURGICAL CARE AT DISTRICT HOSPITALS IN SUB SAHARAN AFRICA

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Abstract: Background

Significant gaps in children's surgical care persist in low- and middle-income countries (LMICs), despite growing advocacy. District hospitals, often the first point of contact in underserved areas, are critical for addressing these gaps. This study evaluated the capacity of district hospitals in Sub-Saharan Africa to provide essential children's surgical care. The findings will provide a reference point as well as guide for implementation of mitigating solutions.

Methods

A modified and validated World Health Organization Hospital Assessment Tool was used to evaluate 601 district hospitals (20% of district hospitals in each country) across 32 of the 47 WHO AFRO countries. Key domains assessed included infrastructure, service delivery, workforce, and financing.

Results

Of 601 hospitals assessed, only 12% of surgical beds were allocated to children. Ten countries lacked a dedicated children's hospital. Pediatric surgeon density was low at 0.13 per 100,000 children, with 79% of hospitals relying on non-specialist physicians for surgical care. Pediatric anesthesiologist density was 0.03 per 100,000 children, and safe pediatric general anesthesia was consistently available in only 18% of hospitals. Herniotomy, colostomy, and emergency laparotomy were provided in 98%, 32%, and 50.1% of hospitals, respectively. Safe pediatric general anesthesia was always available in 18% of hospitals and more than 50% of the hospitals had a nurse to patient ratio of 1 to >10 patients on the pediatric surgical ward during the day and night. Although 68.8% of countries had healthcare insurance, median population coverage was only 7.5%, and 36% of hospitals reported that none of their patients were insured.

Conclusion

There are critical deficiencies in children's surgical care in the region. Targeted interventions, collaborative efforts between countries as well as global partnerships and strong government commitments are necessary to address the gaps.

Abbreviations: LMICs: low- and middle-income countries

Paediatric Surgeon Density

0.13 per 100000 population < 15 years

Surgical volume

234 per 100000 children < 15 years

Paediatric

AFRICA CHILDREN'S SURGERY DASHBOARD

Anaesthesiologist Density

0.03 per 100,000 children < 15 years

Paediatric Nursing Workforce

Daytime: 1 Nurse to >10 patients in 51% of hospitals

Nighttime: 1 Nurse to >10 patients in 55.1% of hospitals



Health Insurance

1/3 of district hospitals reported ALL patients have no insurance

Risk of CHE

Exceeds 10% GDP/capita threshold

Laparotomy

Colostomy

No Risk of CHE: Hemiotomy

GDP per capita

10% Threshold: \$140.42

CHE:calmtrngfndH0lthcfaExpendb.n
GCMW:GhouDe-T,atidProcl.d

Friday, May 9, 2025

Scientific Session 13 - Oncology

4:00 PM – 5:30 PM

S46

BILATERAL WILMS TUMOR: MULTI-INSTITUTIONAL ANALYSIS OF NEPHRON-SPARING SURGERY AT HIGHER VOLUME CENTERS

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Abstract: Purpose:

Published rates of bilateral partial nephrectomy (BPNx) for children with bilateral Wilms tumor (BWT) are variable and sparsely reported. We investigated the rate of BPNx versus unilateral partial with contralateral radical nephrectomy (UPNx/URNx) in children with BWT during the same period as the most recent COG study for BWT (AREN0534). We hypothesize the rate of BPNx at higher-volume institutions is greater than the rate of 35-39% reported on AREN0534.

Methods:

We identified the top 10 enrolling institutions on the COG Renal Tumor Banking Study

(AREN03B2) while AREN0534 was open and before it was published. Five institutions agreed to participate. Among these sites, we performed a multi-institutional retrospective cross-sectional study (COMIRB 21-4455) of children with BWT presenting from 01/2009 to 12/2017. This study period was selected to account for change in practice patterns that would have resulted after releasing AREN0534 data. All patients with BWT from these institutions during this period were included and we reported data on the index surgery performed for each kidney. Children with incomplete data were excluded. We estimated the BPNx rate was 65%. Statistical analysis prior to starting study accrual identified that 50 cases would produce a two-sided 95% confidence interval around a 65%-point estimate with a lower-bound above 50% since a goal of AREN0534 was 50% BPNx rate.

Results:

A total of 51 children were included. The majority, 45/51 (88%, 95% CI [76, 96]), underwent BPNx. 6/51 (12%) underwent UPNx/URNx and no child (0%) underwent BRNx. There was no statistically significant difference in the rate of BPNx based on the institution. Most were treated with synchronous, bilateral surgery during the same laparotomy (91% BPNx and 83% UPNx/URNx, $p=0.5$). Additional details about surgical timing and local stage are outlined in table 1.

Conclusion:

We observed a higher-than-expected rate of BPNx for BWT at these higher-volume institutions that was likely due to increased experience among the operating surgeons and multidisciplinary oncology teams. These data provide justification for a follow-up study of children with BWT with an aim to increase the rate of BPNx.

Abbreviations: BPNx: bilateral partial nephrectomy

BWT: bilateral Wilms tumor

UPNx/URNx: unilateral partial with contralateral radical nephrectomy

BRNx: bilateral radical nephrectomy

COG: Children's Oncology Group

Table 1. Clinical Characteristics and Demographics Table by Type of Nephrectomy

		Bilateral Partial Nephrectomy, N = 45 ^a		Unilateral Radical Nephrectomy and Unilateral Partial Nephrectomy, N = 6 ^a		p-value ^b
Median age at surgery (IQR), mo n=51		30	(15, 46)	33	(25, 50)	0.6
Cycle Surgery was Performed After, No (%) n=51	Cycle 1	8	(18%)	0	(0%)	0.3
	Cycle 2	9	(20%)	3	(50%)	
	Cycle 3	2	(4.4%)	1	(17%)	
	Cycle 4	23	(51%)	2	(33%)	
	Cycle >4	3	(6.7%)	0	(0%)	
Highest local stage, No (%) n=48	Nephrogenic Rest	4	(9.5%)	0	(0%)	0.8
	I	9	(21%)	1	(17%)	
	II	7	(17%)	2	(33%)	
	III	22	(52%)	3	(50%)	

^a n (%); Median (IQR)

^b Fisher's exact test; Wilcoxon rank sum test

DEVELOPING A ROADMAP FOR PATIENT CENTERED OUTCOMES RESEARCH (PCOR): A REPORT FROM THE PATIENT-CENTERED OUTCOME RESEARCH INSTITUTE (PCORI) AND PEDIATRIC SURGICAL ONCOLOGY RESEARCH CONSORTIUM (PSORC)

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Abstract: Objective: There is sparse knowledge regarding PCORs for cancer surgery in children. To meet this need, the aim of this study was to develop an evidence based PCOR research agenda for children with solid tumors.

Methods: Between 9/2021 and 10/2022, the PSORC advocacy group, comprised of physicians and 25 non-medical patient/parent stakeholders, developed a research agenda culminating in an in-person meeting. Stakeholders included parents of children treated for solid tumors, survivors of childhood cancers, patient advocates, and pediatric oncology providers. A multisource four-component framework was used to develop the roadmap. This included: 1) Topic generation, 2) Gap Analysis in Systematic Review, 3) Value of information (VOI) analysis, and 4) Peer Review. (Fig1) Topic generation involved both physician and stakeholder meetings, focus groups, word clouds and a survey sent to 48 solid tumor disease and advocacy support groups representing over 1000 families. VOI analysis and peer review were done in person with 50 participants (25 stakeholders/25 physicians). Descriptive and thematic results are presented.

Results: Systematic review identified only a single surgical PCOR report addressing pediatric solid tumors. Gap analysis demonstrated that surgeons' goals focused more on improving surgical outcomes whereas stakeholder concerns focused on surgeon skill/expertise, second opinion, pain, healing, and communication. The word cloud session identified lack of family resources, pain, enhanced recovery, and communication as key issues. Important thematic PCOR questions from the survey focused on patient/family lack of knowledge, overwhelming predicament, immediate surgical treatment options and shared decision making between families and surgeons. VOI analysis, peer review and voting identified the primary PCOR agenda should; develop a question aid for families/caregivers that increases parent knowledge, engagement, and comfort with cancer surgery and test the impact of shared decision making for second opinions to increase parent comfort and participation in the child's cancer treatment.

Conclusions: Surgical PCOR is lacking and needed to enhance the interactions between surgeons and patient/families with pediatric solid tumors. There is a significant discrepancy in the topics and prioritization of PCOR between pediatric surgeons and families. A mixed methods evidence-based approach is being utilized to identify, understand, and develop research to address these knowledge gaps.

Abbreviations: PCOR- PATIENT CENTERED OUTCOMES RESEARCH
PCORI- PATIENT-CENTERED OUTCOME RESEARCH INSTITUTE

PSORC- PEDIATRIC SURGICAL ONCOLOGY RESEARCH CONSORTIUM
VOI-Value of information analysis



AGE-RELATED VARIATIONS IN PRESENTATION AND OUTCOMES OF PEDIATRIC ADRENOCORTICAL CARCINOMA: A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

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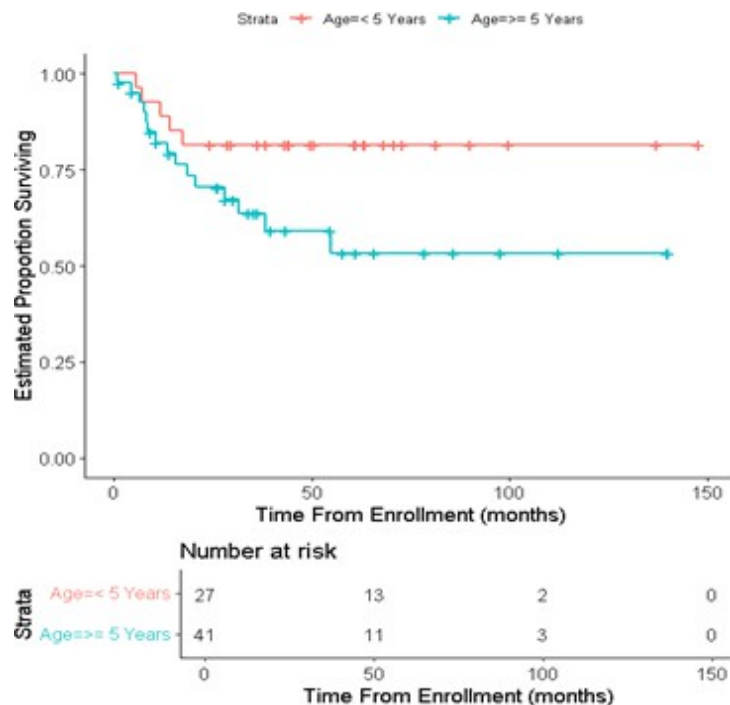
Abstract: Introduction: Adrenocortical carcinoma (ACC) is a rare malignancy with distinct clinical behavior and outcomes based on patient age. This study aims to investigate the differences in presentation, operative characteristics, and postoperative outcomes in patients diagnosed with ACC, stratified by age.

Methods: Patients < 18 years with ACC were identified among 22 Pediatric Surgical Oncology

Research Collaborative (PSORC) institutions. Based on a review of bimodal age distribution, patients were stratified by age into two cohorts: < 5 years and ≥5 years. Data on clinical presentation, tumor characteristics, and postoperative outcomes were collected and compared. Results: Among 69 patients included in the study, 27 were < 5 years, and 42 were ≥5. The proportion of symptomatic patients was not different between younger (70.4%) and older (78.6%) groups ($p=0.57$). Virilization was the most common presentation in both groups (63% < 5, 57% >5). Li-Fraumeni syndrome was more prevalent in younger children (44% vs. 17%, $p=0.025$). Younger children were more likely to present with stage 1 disease (44% < 5 vs. 17%, $p < 0.001$) and less likely to have metastatic disease at presentation (52% vs. 81%, $p = 0.028$). Tumors were smaller in the younger cohort (median size 6.7 cm vs. 10.0 cm, $p = 0.006$). Vascular invasion was more common in older children (33% vs. 7.4%, $p = 0.028$). Younger children had a higher rate of achieving no evidence of disease status (81% vs. 46%, $p = 0.011$). Median follow-up duration was 60.0 months for < 5 and 35.3 months for ≥5 ($p=0.049$). No significant differences were found in five-year overall survival (OS) or event-free survival (EFS) between the groups, though survival probability was lower for the ≥5 group (OS: 79.56 months [95% CI: 63.46-95.66 vs. 56.33 months [95% CI: 38.87 -73.78].

Discussion: This study highlights key differences in the presentation and outcomes of ACC based on age. Younger children are more likely to present with localized disease and achieve complete remission following surgery. In contrast, older children often present with advanced disease, larger tumors, and higher rates of metastasis, resulting in poorer postoperative outcomes.

Abbreviations: ACC – Adrenocortical carcinoma
PSORC – Pediatric Surgical Oncology Research Collaborative
OS – Overall survival
EFS – Event-free survival
CI – Confidence interval



SURGICAL APPROACH AND OUTCOMES FOR PEDIATRIC ADRENOCORTICAL CARCINOMA: A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

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Abstract: Introduction: Pediatric adrenocortical carcinoma (ACC) is rare with limited data guiding the optimal surgical approach. Minimally invasive surgery (MIS) is often avoided in these patients due to concerns about safe and complete removal without spillage, yet the benefits of a minimally invasive approach are well known. We sought to evaluate the outcomes of MIS compared to open surgery for children with ACC.

Methods: A retrospective analysis included patients aged 0-18 diagnosed with ACC between 2012-

2022 at 22 institutions participating in the Pediatric Surgical Oncology Research Collaborative. Patients were stratified based on surgical approach, open (n = 55) or MIS (n = 11). Data collected included patient demographics, tumor characteristics, intraoperative findings, and postoperative outcomes. Statistical analyses were performed using the Wilcoxon rank-sum test for continuous variables and Chi-squared tests for categorical variables.

Results: The study included 66 patients with a median age of 8.92 years. Median tumor size and weight were significantly smaller in the MIS group (4.4cm, 38g) compared to the open group (9.6cm, 246g) ($p < 0.001$). Capsular invasion rates were different but not statistically significant between groups (22% MIS, 49% open, $p = 0.257$), and there were no intraoperative spills in the MIS group vs. 22% (n=12) in the open group ($p = 0.087$). No lymph nodes were excised in the MIS group compared to a mean of 2.96 lymph nodes in the open group ($p=0.008$). Five-year overall survival rates were not different between groups (MIS 87.24%, 95% Confidence Interval [CI]: 63.76-100; open 66.67%, 95% CI: 52.58-80.49). Five-year event-free survival rates were also not different between groups for all stages (MIS 64.3%, 95% CI: 31.8-96.81; open 56.01%, 95% CI: 41.84-70.18) (Hazard Ratio [HR] 0.76, $p=0.66$).

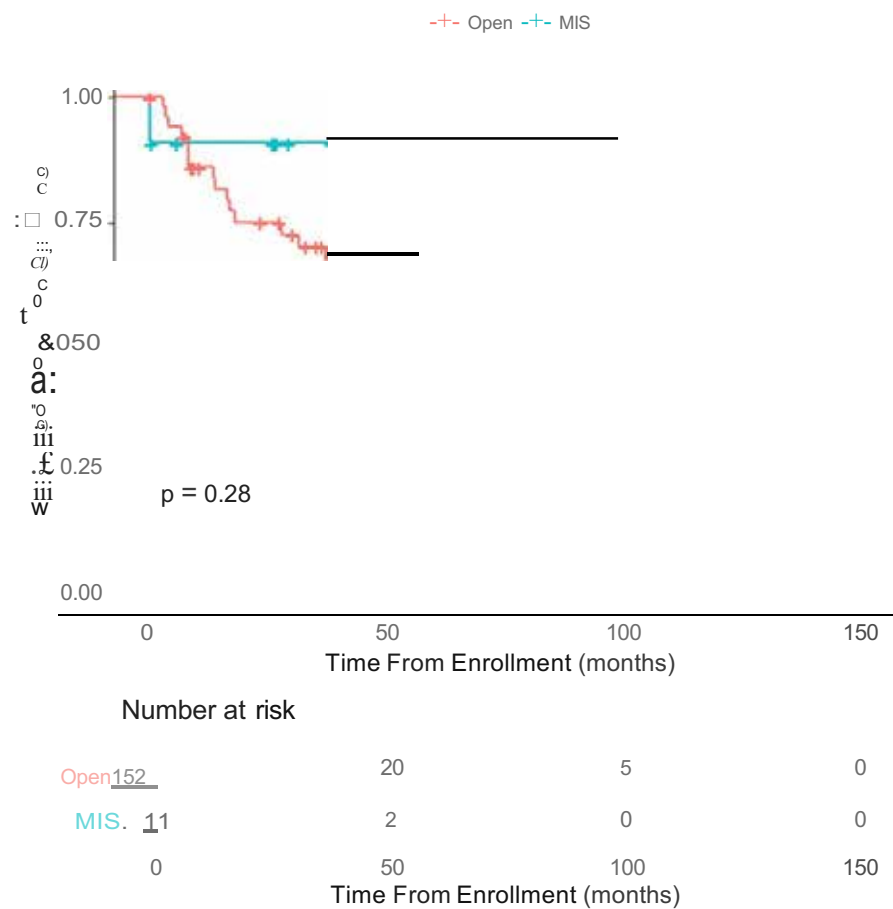
Conclusions: MIS appears to be a safe and effective option for pediatric patients with small, localized ACC. The findings suggest that MIS does not increase the risk of tumor spillage or compromise oncologic outcomes compared to open surgery, supporting its use in carefully selected cases. Lymph node sampling should be performed with either approach. Prospective studies are necessary to confirm these findings and establish guidelines for the surgical management of pediatric ACC.

Abbreviations: ACC - Adrenocortical Carcinoma

MIS - Minimally Invasive Surgery

CI - Confidence Interval

HR - Hazard Ratio



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SOCIAL DEPRIVATION INFLUENCES NEUROBLASTOMA PROGRESSION VIA PI3K/AKT/MTOR ACTIVATION

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Abstract: Introduction:

A recent landmark study by the Children's Oncology Group identified an independent association between poverty and increased mortality in children with neuroblastoma, beyond known biological, access, or treatment variables. Social determinants of health (SDOH) are increasingly recognized as critical drivers of disease outcomes, including cancer. Limited research exists on how SDOH and other social stressors may impact neuroblastoma progression and underlying molecular mechanisms. Our pilot studies on social deprivation in neuroblastoma identified food insecurity as a chronic stressor affecting tumor progression. We investigated the PI3K/AKT/mTOR pathway and downstream biomarkers related to tumor proliferation, DNA damage, and angiogenesis. We hypothesized that food insecurity-induced insulin resistance promotes neuroblastoma pathogenesis through PI3K/AKT/mTOR pathway activation.

Methods:

We employed an established high-risk neuroblastoma mouse model using IMR32 cells implanted into the left adrenal gland of NSG mice (n=10) via ultrasound-guided percutaneous injection. Mice were randomized into two groups: ad libitum food access (n=5) and variable food access (n=5), following published food insecurity protocols. Serum glucose and VEGF levels were measured as markers for insulin resistance and tumor angiogenesis, respectively. Western blot analysis was performed to assess protein expression within the PI3K/Akt/mTOR pathway and DNA damage response.

Results:

Mice subjected to food insecurity developed significantly larger tumors compared to those with ad libitum food access. Elevated serum glucose levels in the food-insecure group suggested insulin resistance, with VEGF levels also markedly higher, indicating enhanced angiogenesis. Western blot analysis showed increased activation of the mTORC1 pathway, and elevated expression of DNA ligase 3, an enzyme implicated in defective DNA repair mechanisms, further suggesting an enhanced pro-tumorigenic environment.

Conclusion:

Our study provides evidence for a mechanistic link between food insecurity-induced chronic stress and neuroblastoma pathogenesis via PI3K/AKT/mTOR pathway activation. These findings highlight potential therapeutic targets and underscore the importance of addressing SDOH in neuroblastoma management. Future studies will focus on pharmacological interventions targeting this pathway and assessing their efficacy in mitigating the effects of food insecurity on neuroblastoma progression.

Abbreviations: SDOH-Social Determinants of Health

NSG: NOD scid gamma

VEGF: Vascular Endothelial Growth Factor

IMR32: Cell Line for high-risk neuroblastoma

UPFRONT VERSUS DELAYED RESECTION EQUIVOCAL IN LOCALLY ADVANCED MALIGNANT RHABDOID TUMOR OF THE KIDNEY, A PEDIATRIC SURGICAL ONCOLOGY COLLABORATIVE STUDY

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Abstract: Purpose:

Malignant rhabdoid tumor of the kidney (MRTK) is a rare, aggressive tumor that primarily impacts children in the first few years of life. As most patients present with advanced disease, survival is poor with an estimated 5-year overall survival (OS) and event free survival (EFS) of 26% and 22% respectively. The optimal timing of resection for local stage III tumors is poorly understood. We hypothesize that early resection may improve outcomes.

Methods:

A multicenter retrospective review was performed by 24 institutions participating in the Pediatric Surgical Oncology Research Collaborative. Children < 21 years old with MRTK diagnosed between 2000-2022 were included. Patients were stratified by stage of disease at presentation. Surgical timing and oncologic outcomes were compared by disease stage. Fisher's exact test and student's t-test were used for comparisons, with a p-value < 0.05 considered significant.

Results:

Fifty-nine pediatric patients were identified with MRTK and met inclusion criteria. Median age of diagnosis was 26 months. OS at 1, 5, and 10 years was 48%, 32%, and 19%, respectively, and EFS was 39%, 29%, and 19%. Most (n=45) had stage IV disease. 48 patients (81%) had local stage III tumor, 37 (77%) of which had metastases with overall stage IV disease. 33 patients with local stage III (69%) underwent definitive resection. Patients with locally advanced disease undergoing upfront resection compared to those who had delayed resection after neoadjuvant chemotherapy had a similar OS (1 year = 61.1% vs. 53.3%, p=0.196; 5 year (37.5% vs. 28.6%, p=0.560) and EFS (1 year = 50% vs. 35.8%, p=0.689; 5 year =27.8% vs. 28.6%, p=1.00). Timing of surgery did not significantly impact oncologic outcome regardless of presence of metastasis. The groups were balanced in terms of baseline characteristics including overall stage, length of follow-up, and tumor characteristics (Table 1).

Conclusion:

Malignant rhabdoid tumor of the kidney is a rare, aggressive renal tumor in children associated with a poor prognosis. In patients with local stage III disease, upfront resection was associated with similar overall and event-free survival compared with neoadjuvant chemotherapy. The timing of surgery may not impact oncologic outcomes in patients with locally advanced MRTK.

Abbreviations: Malignant rhabdoid tumor of the kidney (MRTK)

Overall survival (OS)

Event-free survival (EFS)

Table 1: Characteristics of Patients With Locally Advanced Tumors: who ultimately Went Upfront versus Delayed Resection

	Upfront Resection (n=18)	Delayed Resection (n=15)	p-value
Median Follow-up (months)	31.1±5.6	14.6±6.7	0.118
Median Age (years)	78%	SD	1.010
Tumor Size, Grit: Histologic (mm)	9.17±2.3	7.99±1.9	0.317
Tumor Weight (g)	21.1±15.2	21.1±5.4	0.176
Number of lymph nodes	27.1±	6.67±	1.010
Pathologic complete response	33.3%	33.3%	1.010
Overall survival	14.4%	40%	0.142

Characteristics of Patients with Locally Advanced (Local Stage III) who ultimately Went Upfront versus Delayed Resection: median follow-up (months), age (years), descriptive statistics, median tumor size, weight, number of lymph nodes, pathologic complete response, overall survival. Data are presented as mean ± standard deviation. Categorical data compared using Fisher's Exact Test. Continuous data compared using Student's T-test. p-value <0.05 considered significant as a sign of meaningful difference between groups.

Table 1: Characteristics of Patients With Locally Advanced Tumors: who ultimately Went Upfront versus Delayed Resection

	Upfront Resection (n=18)	Delayed Resection (n=15)	p-value
Median Follow-up (months)	43.1±5.6	19.6±6.7	0.118
Median Age (years)	78%	SD	1.010
Tumor Size, Grit: Histologic (mm)	9.17±2.3	7.99±1.9	0.317
Tumor Weight (g)	21.1±15.2	21.1±5.4	0.176
Number of lymph nodes	27.1±	6.67±	1.010
Pathologic complete response	33.3%	33.3%	1.010
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TRAINED TUMOR SPECIFIC T-CELLS FOR MELANOMA IMMUNOTHERAPY

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Abstract: Purpose: Melanoma is the most common skin cancer in children and the leading cause of death from skin cancer. Adoptive immunotherapy for melanoma has demonstrated therapeutic potential in both preclinical and clinical studies. We present an innovative method for educating T-cells to effectively target and treat melanoma.

Methods: Murine B16 tumor cells were treated with small molecule inhibitors (I-BET726, JQ1, and C-170) for four days to induce tumor cell immunogenicity. These B16 melanoma cells were then irradiated, and co-cultured with mouse splenocytes, for five days. The culture also included GM-CSF and CpG A to enhance antigen presentation. The phenotype and function of the trained splenocytes was analyzed using flow cytometry, interferon gamma secretion assay, and Incucyte cytotoxic assay. The therapeutic potential of the trained splenocytes was evaluated in two preclinical melanoma mouse models. In a low tumor burden model, six mice were intra-peritoneally injected with 1×10^4 B16 tumor cells. The same day, three control mice were adoptively transferred 1.5×10^7 untrained splenocytes, while three mice were adoptively transferred 1.5×10^7 trained splenocytes. In a high tumor burden model, ten mice were intra-peritoneally injected with 1×10^5 B16 tumor cells. Five mice served as untreated controls, while five mice were adoptively transferred 1.5×10^7 trained splenocytes seven days following tumor inoculation. Unpaired t-test was used for statistical analysis.

Results: Flow cytometry showed splenocyte phenotype alterations after training, including an increase of CD3+ T-cells among CD45+ lymphocytes with a specific expansion of activated CD8+ T-cells (Table 1). Interferon gamma and Incucyte assays revealed a marked secretion of interferon gamma and potent cytotoxicity of melanoma in co-culture. In the low tumor burden model, all control mice developed intra-abdominal tumors after 19 days, while no tumors formed in the treated mice. In the difficult to treat model, tumor growth was significantly impaired ($p=0.002$) in the treatment group after 19 days. No adverse effects were observed in the mice receiving trained splenocytes.

Conclusion: These findings provide evidence that the use of trained tumor-specific T-cells is a promising approach for adoptive cellular immunotherapy in melanoma.

Abbreviations:

Table I: Flow cytometry results. displaying splenocyte phenotypes before and after training

	Untrained Splenocytes (%)	Trained Splenocytes (%)
CD3+/CD45+	20.27±2.17	75.77±1.89
CD4+/CD3+	59.47±0.29	6.58±0.56
CD8+/CD3+	29.8±0.60	68.47±1.00
Double Negative CD3+/CD3+	8.88±0.65	21.03±0.42
CD25+/CD4+/CD4	10.53±0.42	48.2±3.04
TIGIT+/CD8+	3.03±0.69	38.43±6.64
Lag3+Tim3+/CD8+	0.10±0.02	51.67±0.42
TIGIT+/Double Negative CD3+	5.55±0.32	40.30±4.52
Lag3+Tim3+/Double Negative CD3+	0.33±0.09	54.67±1.15

IMPACT OF DIAGNOSTIC BIOPSY TECHNIQUE ON THE ADEQUACY OF BIOLOGIC DATA REQUIRED TO RISK-STRATIFY PATIENTS WITH NON-HIGH-RISK NEUROBLASTOMA: A REPORT FROM THE CHILDREN'S ONCOLOGY GROUP

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Abstract: Purpose: Adequate diagnostic tissue sampling is crucial for patients with neuroblastoma, as tumor biologic data are utilized for risk stratification, treatment planning, and trial eligibility. There has been a shift from open biopsies to less invasive techniques. Our objective was to assess whether less invasive techniques provide adequate tissue sampling in the Children's Oncology Group (COG) non-high-risk neuroblastoma trial ANBL1232.

Methods: Patients < 18 months old enrolled in ANBL1232 with INRGSS stage L2 (Group B) or MS (Group C) neuroblastoma /ganglioneuroblastoma were eligible. Tissue biopsy was mandatory at diagnosis for L2 and asymptomatic MS patients. Satisfactory biologic data (SBD) was defined as sufficient tissue for pathologic diagnosis, MYCN status, DNA index, and segmental chromosome aberration (SCA) analysis. Biopsy technique, primary tumor site, and achievement of SBD were assessed for patients who underwent biopsy. Participants with incomplete results due to uninterpretable histology/SCAs from post-treatment biopsy samples or assay technical failures were considered satisfactory if specimen quality was adequate. Exclusions included missing surgical checklist, upfront resection, and non-biopsied Group C patients. Chi-square and Fisher's exact tests were employed to assess the significance of associations between categorical variables.

Results: Of 160 Group B and C patients enrolled in ANBL1232 between 2014-2023, 128 were included in our analysis (Table 1). There was no significant difference in SBD rates between Group B (n=60) and Group C (n=68) patients (65.0% vs 50.0%, p=0.0871). SBD achievement did not differ by intra-abdominal, thoracic, or cervical tumor sites (56.7% vs 46.2% vs 72.7%, p=0.4378). Percutaneous biopsy had a significantly lower rate of SBD compared to thoracoscopic/laparoscopic and open techniques (21.4% vs 71.9% vs 64.7%, p< 0.0001). Complications were rare, occurring in 1.6% of procedures; none occurred with percutaneous biopsy.

Conclusions: We conclude that in children < 18 months old with non-high-risk neuroblastoma enrolled in COG ANBL1232, percutaneous biopsy was associated with a low rate of SBD compared to other biopsy techniques. Methods are needed to improve the efficacy of percutaneous biopsies for comprehensive neuroblastoma tumor characterization in young children.

Abbreviations: Children's Oncology Group (COG), Satisfactory biologic data (SBD), segmental chromosome aberration (SCA)

Table 1 - Adequacy of biologic data for 128 patients enrolled on COG ANBL1232 who underwent diagnostic tumor biopsy			
	Satisfactory Biologic Data, n (%)	Unsatisfactory Biologic Data, n (%)	p-value
Primary Tumor Site			
Intra-abdominal/pelvic	59 (56.7%)	45 (43.3%)	0.4378
Thoracic	6 (46.2%)	7 (53.8%)	
Cervical	8 (72.7%)	3 (27.3%)	
Biopsy Technique			
Open	44 (64.7%)	24 (35.3%)	<0.0001
Thoracoscopic/Laparoscopic	23 (71.9%)	9 (28.1%)	
Percutaneous	6 (21.4%)	22 (78.6%)	

MANAGEMENT OF TYROSINE KINASE INHIBITOR-RELATED PNEUMOTHORAX IN PATIENTS WITH METASTATIC SARCOMA

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Abstract: Purpose:

Tyrosine kinase inhibitors (TKIs) are a growing class of agents used to treat metastatic sarcoma. A known complication of TKI therapy is spontaneous pneumothorax (PTX). This study aims to describe the management of these complex cases.

Methods:

With IRB approval, we performed a single-center retrospective review of all patients aged 15-39 with osteosarcoma (OS) or synovial sarcoma (SS) having pulmonary metastases who were treated with TKIs (including regorafenib, lenvatinib, cabozantinib, sorafenib, pazopanib, sunitinib, axitinib, and crizotinib) between 2007 and 2023. Patients who developed spontaneous PTX during TKI therapy were included (excluding iatrogenic PTX and spontaneous PTX off TKI therapy).

Results:

We identified 88 patients (41 OS and 47 SS) treated with TKIs. Ten patients (11%) developed spontaneous PTX: 3 OS (7%) and 7 SS (15%). Medical history included pulmonary metastases (n=10), prior spontaneous PTX (n=4), and prior thoracic surgery (n=6). None of the patients had planned metastasectomy while on TKI therapy.

Management of initial spontaneous PTX included observation (n=4) and chest tube placement (n=6). Of the patients requiring a chest tube, one patient ultimately underwent open bronchopleural fistula closure for persistent air-leak, and one patient was discharged with a Heimlich valve. The other eight patients had PTX resolution with their respective initial management.

Five patients had recurrent spontaneous PTX (50%; range: 1 to 4 recurrences per patient). The recurrences were ipsilateral (n=2), contralateral (n=1), and bilateral (n=2). Three (75%) patients initially managed with observation had a recurrence, and 2 (33%) patients initially treated with a chest tube recurred. Recurrences resolved with observation (n=3) and pleurodesis (n=2; one bedside talc pleurodesis and one thoracoscopic mechanical and talc pleurodesis). Both patients who had pleurodesis recurred ipsilaterally.

Four patients had TKI therapy stopped due to pneumothorax-related complications. Nine patients who developed spontaneous PTX died of their disease.

Conclusion:

Spontaneous pneumothorax is a common complication of tyrosine kinase inhibitor therapy. Some cases resolve with conservative management; others require surgical intervention. Recurrence rates are high even among patients who have surgical intervention. Further research is necessary to identify predisposing risk factors for occurrence and treatment failure.

Abbreviations: PTX: pneumothorax

TKI: tyrosine kinase inhibitor

IRB: institutional review board

OS: osteosarcoma

SS: synovial sarcoma

USE OF NICOTINIC ACID TO WIDEN THE THERAPEUTIC INDEX OF NAMPT INHIBITOR FK866 IN NEUROBLASTOMA

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Abstract: Purpose: High-risk and recurrent neuroblastoma continue to carry poor prognoses; thus, new therapeutic strategies are needed. One emerging strategy exploits the observation that rapidly dividing neoplastic cells require increased turnover of nicotinamide adenine dinucleotide (NAD⁺). NAD⁺ is generated via one of three pathways: de novo synthesis, Preiss-Handler and nicotinamide (NAM) salvage. The rate limiting enzymes for the latter two are nicotinate phosphoribosyltransferase (NAPRT), and nicotinamide phosphoribosyltransferase (NAMPT) respectively (Figure 1A). NAMPT inhibitors have been shown to have an anti-tumor effect via depletion of NAD⁺; however, the clinical use of NAMPT inhibitors has been limited by systemic toxicity (e.g. bone marrow, retina). We hypothesize that treatment of neuroblastoma cells with NAMPT inhibitor, FK866, would result in a differential response based on NAPRT status and that nicotinic acid supplementation would rescue NAPRT positive cells via use of the Preiss-Handler pathway to generate NAD⁺.

Methods: We queried The Cancer Dependency Map Project at Broad Institute (DepMap) to report the levels of NAPRT methylation and protein expression across tumor types. We confirmed NAPRT status in four human cell lines: SKNAS, CHP 212, SKNDZ, and SKNBE2. We performed a growth development assay by treating each cell line with serial dilutions of FK866 +/- nicotinic acid supplementation. We used the Promega NAD⁺ assay kit to confirm NAD⁺ depletion in response to FK866 treatment.

Results: NAPRT is both methylated at a higher rate and expressed at a lower rate in neuroblastoma compared to other tumor types (Figure 1B). We confirmed SKNAS and SKNBE2 are NAPRT positive while CHP 212 and SKNDZ are NAPRT negative. Treatment with FK866 is effective in neuroblastoma and cells with intact NAPRT can be rescued with nicotinic acid. NAMPT inhibition with FK866 +/- nicotinic acid showed NAD depletion in response to NAMPT inhibition and cell rescue only if NAPRT is present (Figure 1C).

Conclusion: NAPRT is highly methylated in neuroblastoma and NAPRT negative status confers a synthetic lethality to NAMPT inhibition. Nicotinic acid supplementation can potentially be used to widen the therapeutic index of NAMPT inhibition in NAPRT negative neuroblastoma via rescue of normal, non-tumor cells with functional NAPRT.

Abbreviations: Nicotinamide adenine dinucleotide (NAD⁺)

Nicotinate phosphoribosyltransferase (NAPRT)

Nicotinamide phosphoribosyltransferase (NAMPT)

Nicotinic acid (NA)

Nicotinamide (NAM)

The Cancer Dependency Map Project at Broad Institute (DepMap)

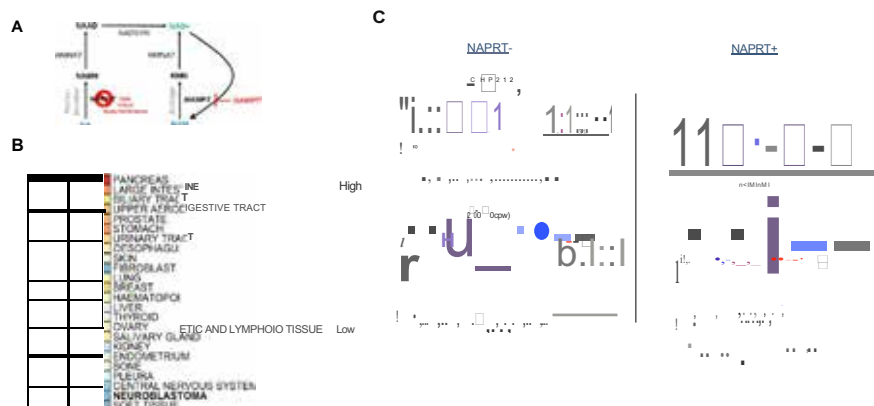


Figure 1: A) Chart of NAD pathways B) Heatmap of average NAPRT methylation fraction and average NAPRT protein expression by tumor type (source DepMap). C) Growth development assays of cell lines treated with NAMPT inhibitor FK866 with and without nicotinic acid (NA) supplementation.

MethylationProtein

Friday, May 9, 2025

Scientific Session 14 - General Pediatric Surgery 3

4:00 PM – 5:30 PM

S50

DISPARITIES IN ENGAGEMENT WITH AN ARTIFICIAL INTELLIGENCE-BASED INTERVENTION POST-APPENDECTOMY

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Abstract: Purpose: Institution-initiated text messaging in post- appendectomy care has been shown to decrease preventable emergency department visits. As the use of digital health grows, it is important to assess the impact of technology-based interventions across patients with diverse backgrounds and socioeconomic risk factors. The purpose of this study was to evaluate feasibility and acceptability of an artificial intelligence (AI) based texting platform for patients with risk factors related to social determinants of health (SDoH).

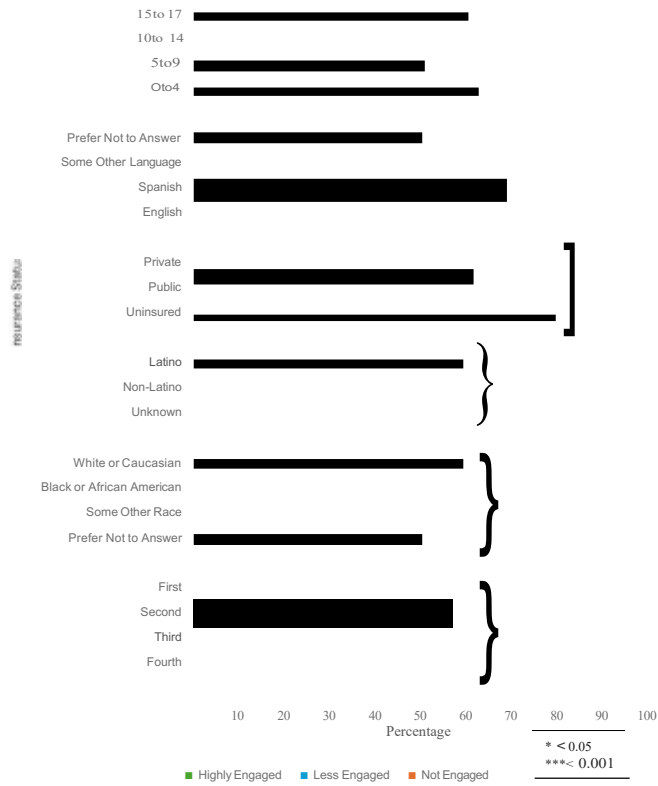
Methods: An AI-based text messaging service for post-operative concerns after appendectomy was initiated from March 2022 to March 2024. Caregiver or child could respond to the chats, and chats were delivered in English or in Spanish according to expressed language preference. Associations were tested between patient demographics (including race, ethnicity, language preference, insurance status and social deprivation index (SDI) quartile) and likelihood of engagement with the chat program. We used chi square analysis to compare rates of patients with and without SDoH-related risk factors who did not engage, engaged once (completed one chat), and were highly engaged (completed 2 or more chats).

Results: 529 out of 1173 eligible patients (45.1%) engaged with the program at least once, and 299 (25.5%) were highly engaged. Patients with no insurance and public insurance and highest quartile of SDI were less likely to be engaged, and non-White and Latino patients were less likely to be engaged than White and non-Latino patients. There were no associations between age or language preference and likelihood of engagement (See Figure).

Conclusion: We observed consistent levels of engagement across language preference groups, but Black and Latino patients, and more vulnerable patients according to SDI and insurance status, were less likely to engage. These are the same groups who may be at higher risk for complications. Future work will focus on strategies to optimize feasibility and accessibility for patients with SDoH-related risk factors, including incorporation of patient and parent stakeholder input to promote equitable care.

Abbreviations: SDoH
SDI

Associations Between SDoH-related Risk Factors and Engagement with Chat Program



#CBCLIPS: THE INTERNATIONAL IMPACT OF A SOCIAL MEDIA-BASED PEDIATRIC SURGERY INTERACTIVE EDUCATIONAL PROGRAM

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Abstract: Background: Despite the transformative influence of social media on connectivity, learning, and networking, its role and impact on surgical education remains undefined. In the current study, we evaluated the international impact of #CBCLIPS (Case Based Clinical Learning in Pediatric Surgery), a unique social media-based pediatric surgery educational program.

Methods: An interactive social media-based pediatric surgery education program was launched in July 2020. At 2–4-week intervals, a clinical scenario was posted, ending with a question on diagnosis and management of the case. After allowing 1-2 weeks for audience interaction, a video commentary, presenting the evidence-based management of the case, was posted. After 47 episodes over approximately 4 years, a descriptive mixed-methods study evaluated the impact of #CBCLIPS, by analyzing social media engagement metrics (likes, shares, comments) across X, Facebook, and LinkedIn. Additionally, an online survey administered on these platforms assessed participants' perceptions of knowledge gained and applied, as well as satisfaction with the program. Descriptive statistics summarized quantitative data, while thematic analysis was applied to qualitative feedback.

Results: #CBCLIPS was highly relevant and appealing to its viewers in all three social media platforms. On X, the episodes boasted an average engagement rate of 8.27%, with a peak of 28.03% for a particularly engaging episode, significantly outperforming typical benchmarks for the platform. Visibility for #CBCLIPS was substantial on both X and LinkedIn, achieving up to 13,810 and 8,282 impressions, respectively. Facebook emerged as the leading platform for interactive engagement, with medians of 63 likes and 13 comments per episode, reinforcing its position as the premier platform for fostering community discussions. The survey was partially or fully completed by 160 individuals from 71 countries. User-reported educational outcomes are shown in the table.

Conclusion: #CBCLIPS is a continuous interactive educational program that significantly engages an international audience, facilitates knowledge acquisition and application, and garners high support among participants. Its reach and success demonstrate the effectiveness of social media-based education in pediatric surgery.

Abbreviations: CBCLIPS: Case Based Clinical Learning in Pediatric Surgery

#CBCLIPS User-Reported Educational Outcomes

Survey Question	Response n/N(%)
Applied knowledge gained from #CBCLIPs to clinical practice	101/158 (64) 113/158 (72)
Rated quality of didactic content of #CBCLIPs as good or excellent	124/140 (88) 122/140 (87)
Overall satisfied or very satisfied with #CBCLIP episodes	117/140 (84)
Satisfied or very satisfied with #CBCLIPs as an educational resource	120/140 (86) 114/140 (81) 130/140 (93)

THE IMPACT OF INTERHOSPITAL TRANSFER ON CHILDREN WITH ACUTE APPENDICITIS IN CALIFORNIA, FLORIDA, AND NEW YORK

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Abstract: Purpose:

Disparate transfer patterns based on race, ethnicity, and socioeconomic status affect pediatric surgical patients across the United States, but their clinical impact is unclear. We aimed to determine if children with acute appendicitis who undergo interhospital transfer experience different clinical outcomes when compared to those who receive definitive care at their index hospital.

Methods:

A retrospective cohort study used data from the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project State Inpatient and Emergency Department Databases from California, Florida, and New York (2019). We included all patients < 18 years who presented with acute appendicitis and underwent appendectomy or percutaneous drainage. The primary outcome was prolonged length of stay (>2 days). Secondary outcomes included ED visit < 30 days after discharge and readmission < 30 days after discharge. We compared patients who received definitive care at their index hospital to those who underwent interhospital transfer using chi-squared tests. Non-perforated and perforated appendicitis groups were determined based on the ICD-10 diagnostic codes and analyzed separately.

Results:

Of 14,027 total patients, 74.6% had non-perforated appendicitis and 25.4% had perforated appendicitis. In the non-perforated appendicitis cohort, a higher proportion of transferred patients were younger, non-white (73% vs 62%), publicly insured (66% vs 55%), and lower income (68% vs 56%), $p < 0.001$ for all. In the non-perforated cohort, transferred patients were more likely to experience a prolonged length of stay (12% vs. 7.6%, $p = .002$), 30-day ED visit (11.8% vs. 3.6%, $p < .001$), and 30-day readmission (3.1% vs. 1.1%, $p = .001$) when compared to non-transferred patients. In the perforated appendicitis cohort, there were no significant demographic differences. Transferred patients with perforated disease were also more likely to experience a prolonged length of stay (78% vs. 71%, $p = .01$), 30-day ED visit (13.9% vs. 3.8%, $p < .001$), and 30-day readmission (8.4% vs. 2.9%, $p = .001$) when compared to non-transferred patients.

Conclusion:

Interhospital transfer is associated with worse outcomes and increased healthcare utilization for pediatric patients with both non-perforated and perforated appendicitis. Efforts to target unnecessary transfers, including standardization of care processes, may reduce care utilization and promote equity in pediatric patients.

Abbreviations: Emergency Department (ED)

Table 1. Clinical outcomes for pediatric patients with acute appendicitis who were transferred vs. not transferred from their index hospital

Non-Perforated Appendicitis (n=10,460)			
Clinical Outcomes	Not Transferred N = 10,079¹	Transferred N = 381¹	p-value²
Prolonged LOS (>2 days)	770(7.6%)	45 (12%)	0.002
30-Day ED Visit	363 (3.6%)	45 (11.8%)	<0.001
30-Day Readmission	111 (1.1%)	12 (3.1%)	0.001
Perforated Appendicitis (n=J,567)			
Clinical Outcomes	Not Transferred N = 3,280¹	Transferred N = 287¹	p-value²
Prolonged LOS (>2 days)	2,334 (71%)	224 (78%)	0.013
30-Day ED Visit	126 (3.8%)	41 (13.9%)	p<.001
30-Day Readmission	88 (2.9%)	24 (8.4%)	p<.001

¹n(%)

² Pearson's chi-squared test

THE IMPACT OF A PEDIATRIC SURGERY FUNDAMENTALS BOOT CAMP ON NEW SURGICAL TRAINEES' PERCEIVED KNOWLEDGE AND CONFIDENCE LEVELS

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Abstract: Background: Transition periods within surgical education are characterized by heightened stress and a sense of under-preparedness. There is little literature on the preparation of surgical residents for pediatric surgical rotations. We evaluated the self-reported knowledge and preparedness of new surgical residents for pediatric rotations, and the impact of a pediatric surgery fundamentals boot camp on these factors.

Methods: An annual full-day pediatric surgery boot camp, consisting of didactic and interactive lectures, was started in 2020 as part of a 4-week surgical boot camp for new residents in general surgery, plastic surgery, neurosurgery, cardiac surgery, urology, orthopedics, otorhinolaryngology, maxillofacial surgery, and obstetrics and gynecology, delivered each July. All topics (Table) focused on pediatric surgical and anesthetic care. After resident feedback, the topic of neurodevelopmental issues in anesthesia was replaced by the pediatric airway. An anonymous on-line evaluation was completed by trainees in 2021, 2022, and 2023, assessing their baseline preparedness for pediatric rotations, their knowledge level in boot camp topics, and the impact of the boot camp on both. Additionally, residents assessed the global utility of the boot camp and evaluated each topic. Quantitative data were summarized and analyzed using descriptive statistics. A research ethics board waiver was approved for retrospective analysis of the data.

Results: Of 114 trainees who attended the boot camp over the three years, 79 (69%) provided evaluations. Trainees characterized their baseline knowledge of pediatric perioperative management as average (46, 58%) or weak/very weak (31, 29%). 68 participants (86%) found the boot camp's topics highly relevant. The program increased the confidence of 57 trainees (72%) for starting their pediatric rotations and improved understanding of both pediatric surgical perioperative and anesthesia issues in 68 (86%) and 64 (81%) participants, respectively. A majority (67, 85%) concurred that the course significantly justified the time invested. Assessment of each of the boot camp components is shown in the Table.

Conclusion: New surgical trainees report baseline average to weak levels of knowledge with respect to perioperative pediatric surgical care. A pediatric surgery fundamentals boot camp was well received by trainees and substantially improved their self-reported knowledge and readiness

for pediatric surgical rotations.

Abbreviations:

Table 1. Educational Impact of Pediatric Surgery Lectures: A Multi-Year Summary (2021-2023)

Topic	Learned New Information No/N (%)	Will Help in Rotations No/N (%)
<i>Pediatric Trauma Fundamentals</i>	73/79 (92.4)	71/79 (89.9)
<i>Pediatric Fluid and Electrolyte Management</i>	75/79 (94.9)	74/79 (93.6)
<i>Neurodevelopmental issues in pediatric anesthesia*</i>	24/33 (72.7)	20/33 (60.6)
<i>Pediatric Airway**</i>	41/46 (82.3)	38/46 (73.4)
<i>Common Pediatric Postoperative Complications</i>	79/79 (100)	79/79 (100)
<i>Common Pediatric Comorbidities</i>	61/79 (76.9)	58/79 (73.1)
<i>Pediatric Shock</i>	70/79 (88.5)	72/79 (91)
<i>Pediatric Communication & Consent</i>	75/79 (94.9)	75/79 (94.9)
<i>Pediatric Postoperative Pain Management</i>	67/79 (84.6)	65/79 (82)

* Lecture delivered only in 2021

** Lecture delivered in 2022 and 2023

PEDIATRIC RARE EARTH MAGNET INGESTION: DEFINING "PROGRESSION" IN SERIAL ABDOMINAL IMAGING

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Abstract: Purpose: Ingestion of rare earth magnets (REMs) results in significant morbidity and mortality in children, typically requiring inpatient monitoring for REM progression. Short of developing peritonitis, criteria for surgery are ill-defined. Our goal was to determine if REMs crossing midline on serial films was associated with decreased risk of surgical intervention.

Methods: A retrospective cohort study was conducted of patients under 18 years admitted to a children's hospital following REM ingestion from 1/1/2013-9/30/2024. Data was collected regarding symptoms, serial radiograph findings, and management. Continuous measures are shown as mean/standard deviation(SD) and categorical as frequencies/percentages. Relative risk was modeled using linear regression.

Results: In total, 31 patients were included. Mean(SD) age was 8.2(4.0) years, ranging 3-14 years, with a male predominance of 1.6:1(61.3%). Mean(SD) hospital stay was 3.1(4.0) days. Mean ingested REMs was 6, ranging 2-68. Most patients (80.6%) presented to the institution's emergency department(ED), 16.7% from a referring ED, and one from a pediatrician's office. In 77.4%, ingestion time was known. Mean(SD) time between ingestion and physician assessment was 10.7(18.8) hours, ranging 0.5-78.5 hours. For 41.9%, patient/guardian was certain REMs were ingested simultaneously while 58.1% were uncertain. Patients had a mean(SD) of 5.1(3.3) abdominal radiographs. Three patients were excluded from imaging analysis due to intervention following only one radiograph: 1 surgical exploration, 2 colonoscopies. 19 patients(59.4%) had an intervention: 16(84.2%) endoscopies, 3 surgeries. 5 patients(26.5%) required a second intervention: 1 colonoscopy and 4 surgeries, all following initial endoscopy. Endoscopic success rate was 58.9%. 65% of patients received a bowel regimen, and it showed no impact on need for intervention(p=0.66). Patients with >1 midline REM crossing on imaging were less likely to require surgery(16.7% v. 81.8%, p < 0.001) with a relative risk of 0.044.

Conclusion: Timing of surgery to minimize morbidity is challenging in magnet ingestion due to a general paucity of initial symptoms. Midline magnet crossing provided an indicator of progression through the gastrointestinal tract with a higher likelihood of passage without surgery. In our series, no patients required surgery if the magnets were observed to cross midline more than once.

Abbreviations: REM: Rare earth magnets

SD: Standard deviation

ED: Emergency department

Midline crossings	Total patients	Surgery N (%)	Mean time to surgery in days (range)	P-value
0	9	5 (83.3%)	3.31 (2.65-4.38)	P < 0.001
1	9	1 (16.7%) [†]	3.00 (*)	
> 1	10	0 (0.0%)	*	

* Unable to calculate due to number of subjects.

[†] Taken to the OR for arrest of REM progression. No fistulization or other bowel injury identified.

BRIDGING THE GAP: IDENTIFYING DEPRESSION AND SUICIDALITY IN PEDIATRIC SURGICAL PATIENTS AND THE NEED FOR EARLY SCREENING

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Abstract: Purpose:

Depression rates among adolescents in the United States are rising. At least one depressive episode occurs in 25% of the population by age 18. The US Preventative Services Task Force has published recommendations to screen for depression. Screening for depression has been done for selective diseases, but not universally among pediatric surgery patients. This study aims to address this gap by focusing on the mental health of patients admitted to the pediatric surgery service at a single institution.

Methods:

We retrospectively analyzed de-identified data from inpatient pediatric surgical admissions from January 2016 to November 2023. Inclusion criteria included patients aged 12-17 years who underwent surgical procedures during admission. We used binary logistic regression to assess associations between various factors and outcomes, including Patient Health Questionnaire (PHQ)-2 scores >2, PHQ-9 scores >9, suicidality, psychiatric evaluations during admission, and new mental health diagnoses. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported.

Results:

Among 2389 patients admitted to the pediatric surgery service from January 2016 to November 2023, 513 met the inclusion criteria. The proportion of patients who scored >2 on the PHQ-2 and thus were administered the PHQ-9 was 2.3% (n=12). Of these, 66.7% (n=9) scored >9 on the PHQ-9, indicating at least moderate depression and the same proportion answered positive for suicidal ideation. Female gender and gender dysphoria were associated with moderate depression and suicidality. Eating disorder history and family history of mental illness were associated with the presence of suicidality, but not with depression. Overweight or obese BMI, congenital or chronic disease demonstrated no significant association with the presence of depression and suicidality (Table 1).

Conclusion:

Although depression is uncommon in children admitted to our pediatric surgical service compared to the general population, when it did occur there was at least moderate depression with the majority expressing suicidal ideation. This screening allowed for potentially lifesaving help to be offered to these patients through social work and mental health referrals. Depression screening should be considered in all pediatric surgery patients as it has the potential to detect patients in need of help and save lives.

Abbreviations: Patient Health Questionnaire (PHQ)
Body Mass Index (BMI)

	OR	95%CI	p-value
Gender			
Female	8.16	(1.01, 65.46)	0.03
BMI			
Underweight	0.71	(0.037, 3.46)	0.19
Normal	0.56	(0.15, 2.11)	0.20
Overweight	1.72	(0.28, 10.52)	0.28
Obese	1.70	(0.28, 10.38)	0.28
Medical comorbidities			
Congenital or chronic disease	0.84	(0.10, 6.86)	0.44
Gender Dysphoria	31.37	(2.57, 382.23)	<0.01
Eating Disorder	20.87	(1.95, 222.97)	<0.01
Family history of mental illness	12.81	(2.38, 68.79)	<0.01

TABLE 1: Odds Ratios and 95% CI for Association of Patient Characteristics with Suicidality

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EMS TRANSPORT OF PEDIATRIC TRAUMA PATIENTS DIFFERS BY RACE AND ETHNICITY IN THE UNITED STATES

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Abstract: Purpose

Disparities exist in trauma care, disproportionately affecting minorities. Limited data describe EMS transport patterns for children which may contribute to these disparities. This study aimed to determine whether emergency medical services (EMS) transport of pediatric trauma patients differs by patient race and ethnicity.

Methods

This cross-sectional analysis used a national sample of deidentified EMS electronic health records maintained by ESO for calendar years 2021-2022. Masked trauma scene ZIP codes served as geographic units of analysis; only ZIP codes with at least 10 White and 10 non-White trauma patients were included. The primary outcome measure was the transport destination for each patient. The independent variable was patient race and ethnicity [White, non-Hispanic = "White" vs. all others = "non-White"]. The dissimilarity index (DI) is a widely used method to measure unevenness in the distribution of groups across geographic units. Using DI, we made within-ZIP code comparisons of EMS transport destinations for White vs. non-White pediatric trauma patients.

Results

662 ZIP codes met inclusion criteria encompassing 79,358 total patient transports to 5,642 hospitals. The median number of transports and hospitals per ZIP code were 92 (IQR 46-165) and 10 (IQR 6-16), respectively. The median DI per ZIP code was 2.9%. Over one-quarter (25.6%) of patients originated from ZIP codes with DI>5%, and 6.3% of patients originated from ZIP codes with DI>10%. Median DI was increased in children ages 6-12 years (11.2%) versus those younger than 6 (7.6%) and those 13 years and older (5.8%). It was also increased in those with Hispanic ethnicity (10.0%) versus non-Hispanics (4.0%). Increases in median DI were found with more urgent transports ("lights and sirens used" = 15.3% vs. "no lights and sirens used" = 3.8%); higher level of service ("advanced life support" = 8.7% vs. "basic life support" = 6.0%); and by provider role ("EMT" = 13.5% vs. "paramedic" = 3.5%).

Conclusions

Dissimilarities were noted in the destination hospitals for White and non-White pediatric trauma patients transported by ambulance from trauma scenes within the same ZIP code. This suggests that EMS transport contributes to discordances in where White and non-White pediatric trauma patients receive trauma care.

Abbreviations: EMS: emergency medical services
DI: dissimilarity index

0111,ibution In Olnlmlllrly in DHtinnlton for Wh.11••nd Non-Whit•P•dla1do Traum•
Transport 2021,2022

Characteristics,	Normative	Percentage or IQR
ZIP codes included in the analysis	662	NA
Outlier identification	9.95	Ej 65
„ntile” or 1st ZIP code (median, IQR)	2	
Overall Indicators (DI)		
Of the ZIP code (median, IQR)	0.029	0.016, 0.058
ZIP code with 01 > 0.05 (low percentage)	93	...
Percentile in ZIP codelet with 01 > 0.05 (no. percentile)	9,281	
ZIP codes with 01 > 0.10 (no. percent)	0	111.6
Percentile in the population with 01 > 0.10 (no. percent)	2,333	11.6

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**IDENTIFYING DISPARITIES IN PEDIATRIC SAME-DAY SURGERY CANCELLATIONS:
IMPACT OF RACE AND SOCIOECONOMIC FACTORS IN A PEDIATRIC HEALTH SYSTEM**

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Abstract: Purpose:

Same-day surgery (SDS) cancellations have significant medical, financial, psychological, and systems-wide implications on both patients and hospitals. This study aimed to identify patient, geographic, and system-related factors that impact SDS cancellations across a single pediatric operative network.

Methods:

A case-control retrospective review captured all patients (age < 18) who underwent procedures with same day discharge at a single pediatric hospital system from July 2022 to August 2024. Patients were included if they underwent any procedure at three operative sites. Sites included a primary pediatric academic hospital (PAH) and two pediatric outpatient surgery centers (OSC). Patients whose SDS was cancelled (n = 526) were compared to those whose surgeries proceeded as scheduled (n = 28,119). Patient characteristics and system variables were collected. Patient zip codes were matched to the publicly available Child Opportunity Index (COI) 2.0 ZIP Code data. Statistical analysis was performed in R.

Results:

The overall SDS cancellation rate (CR) was 1.87% (n = 526), with a significantly higher rate (n = 344, 2.5%, $p < 0.001$) observed at the PAH compared to OSC (n = 182, 1.2%). In a direct comparison between cancelled and non-cancelled cases, there was no difference in CR with day of scheduled case or distance from hospital (by zip code). However, patients with cancelled cases were more likely to identify as Black/African American (Table 1) and have the lowest quintile COI across all domains (education, health/environment, social/economic, overall) ($p < 0.001$). In a sub-analysis comparing cancelled cases between operating sites, PAH cancelled patients tended to be Black/African American (28.2% vs 17.0%, $p = 0.018$) and have very low COI (30.1% vs. 17.5%, $p = 0.007$).

Conclusion:

There are inequities amongst SDS cancellation rates in pediatric patients within a single operative network, with higher cancellation rates observed amongst patients who identify as black and live in low opportunity areas. Similar inequities were persistent when comparing surgeries scheduled at an urban PAH versus suburban OSC, suggesting the need for targeted interventions to improve access to surgical care for our vulnerable patients.

Abbreviations: SDS: same day surgery

PAH: pediatric academic hospital

OSC: outpatient surgery centers

Table 1

Variable		Case Performed N = 28,132 ¹	case Cancelled N = 526 ¹	p-value
Age		7.00 (3.00, 13.00)	14.00 [2.00, 9.00)	<0.0012
Race	White	23,023 {81.8%}	361 {68.6%}	<0.001 ³
	Black/African American	3,534 {12.6%}	127 {24.1%}	
	Other	1,575 {5.6%}	38 (7.2%)	
Overall COI, (metro- normed)	Extremely High	4,259 {23.5%}	61 {18.7%}	<0.001 ³
	High	4,637 {25.6%}	62 {19.0%}	
	Moderate	4,004 {22.1%}	76 {23.3%}	
	Low	2,804 {15.5%}	145 {13.8%}	
	Very Low	2,417 {13.3%}	82 (25.2%)	

¹Continuous variables reported as median [Q1, Q3]; Categorical variables reported as n (%)

²Mann-Whitney test

³Pearson's Chi-squared test

SWITCHING LANES: LEAVING BEHIND DISCHARGE ANTIBIOTICS AND LABORATORY TESTING IN PERFORATED APPENDICITIS

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Abstract: Purpose: Appendicitis is the most common surgical emergency in children with approximately 30% of patients presenting with perforation, defined as a hole in the appendix or a fecalith found in the abdomen, at time of surgery. Our previous protocol at time of discharge, with an 11% intra-abdominal abscess (IAA) rate, included checking a white blood cell count (WBC) on day of discharge, with a value ≥ 10 serving as a trigger for additional outpatient oral antibiotics course. Beginning in May 2023 we changed our protocol to no longer obtain WBC or prescribe outpatient antibiotics at time of discharge. The purpose of this study is to determine if the post-discharge IAA rate of patients with perforated appendicitis was impacted with no antibiotics at discharge.

Methods: A prospective observational study of patients < 18 years old who underwent laparoscopic appendectomy for perforated appendicitis between May 1, 2023-May 1, 2024, at a single institution was completed. Patients were treated with antibiotics while inpatient and then discharged without antibiotics once appropriate discharge criteria were met (pain controlled and tolerating regular diet).

Results: A total of 202 patients were managed for perforated appendicitis since the protocol change. The median LOS for the entire cohort was 3.02 days (IQR 2.11, 4.21). 10% of patients (N=20) developed IAA after discharge, 15 (7%) of which were readmitted. Median LOS for these patients was 2.81 days (2.49, 3.32) compared to median LOS of 3.03 days (2.12, 4.22) ($p=0.65$). Eight patients (4%) underwent percutaneous drainage with interventional radiology (IR) and one patient required re-operation and washout. Patients who developed IAA after discharge had longer operative times (52 mins vs 40 mins, $p=0.01$). There was no significant difference in age, BMI, LOS, antibiotic duration, or presenting symptoms for patients that developed IAA compared to those that did not develop IAA. There was no clinical or statistically significant difference in rate of developing IAA after change in protocol ($p=0.63$).

Conclusions: Omission of outpatient antibiotics and pre-discharge laboratory testing did not result in a significant change in post-operative IAA rate after discharge.

Abbreviations: IAA-intraabdominal abscess

LOS-length of stay

WBC- white blood cell

IQR- inter-quartile range

IR-interventional radiology

SMART SILO: GASTROSCHISIS SILO THAT CAN MEASURE ABDOMINAL COMPARTMENT PRESSURE

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Abstract: Smart Silo: Gastroschisis silo that can measure abdominal compartment pressure

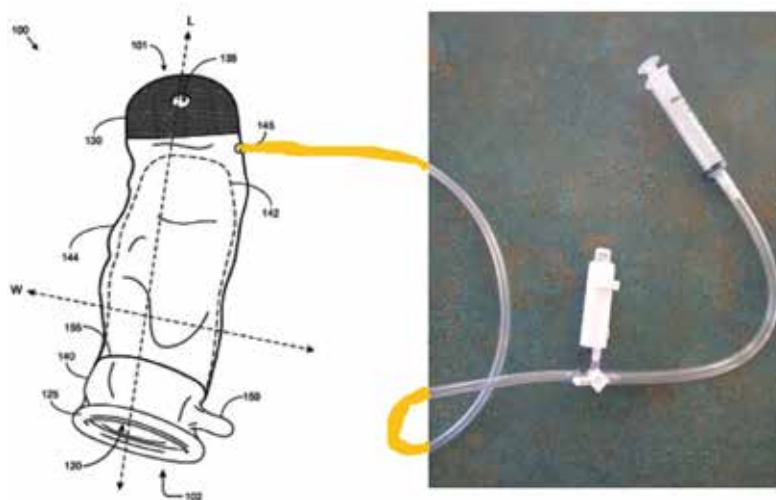
Introduction: Neonates born with gastroschisis need an urgent procedure to protect their eviscerated bowel. If the intestine cannot be placed into the abdomen due to domain discrepancy, the intestine is temporarily placed into a ringed silicone silo bag. Over the course of several days, the intestine is manually squeezed back into the abdomen by applying force on the top portion of the silo bag and using a tie to hold the bowel in position. Smart Silo is an upgraded silo bag that reduces the eviscerated bowel into the abdomen using air pressure, which can be measured.

Unmet need and the solution:

The current silo bag used to contain the eviscerated bowel of neonates born with gastroschisis has only one function, which is to contain bowel. The rate of bowel reduction back into the abdomen is limited by the formation of abdominal compartment syndrome if the reduction is done too rapidly. Presently, there is no good method to measure abdominal pressure to regulate the rate of bowel reduction. We rely on visual inspection to confirm bowel viability. If the abdominal pressure can be measured, bowel reduction can be done safely and efficiently. Smart Silo has a diaphragm membrane within the silo that creates two compartments. The upper compartment side is insufflated with air via a luer lock attachment which is connected to a catheter equipped with a pressure gauge and a three-way stop cock. The three-way stop cock is used to apply air using a syringe. The pressure gauge is used to measure the pressure of the upper chamber of the diaphragm to limit the amount of air insufflation. Since the upper and lower chambers of the silo are in equilibrium, the abdominal compartment pressure can be measured.

Future plans for the device: The current silo bag used and marketed is classified by FDA as a class 1 device, which means Smart Silo is also a class 1 device. Smart Silo can be registered with FDA, thereafter, manufactured and marketed.

Abbreviations:



Friday, May 9, 2025

Scientific Session 15 - CDH ECMO

4:00 PM – 5:30 PM

S60

RECURRENCE AFTER SURGICAL CONGENITAL DIAPHRAGMATIC HERNIA REPAIR, A LARGE, TEN-YEAR SINGLE CENTER REVIEW.

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Abstract: Background: At our institution, recurrence rates after surgical congenital diaphragmatic hernia (CDH) repair, are low (< 5.0%), regardless of whether repaired primarily or with a patch. Recently, we have started performing muscle flap repairs. We herein review recurrence rates per repair type over a longer period of follow-up.

Methods: This is a retrospective review of all patients with posterolateral CDH who underwent surgical repair at the Children's Hospital of Philadelphia between January 2013 and December 2023. Patients with omphalocele or Cantrell's pentalogy were excluded. Patch repairs were performed aiming to construct a tension-free dome-shaped patch, using a polytetrafluoroethylene Gore DualMesh. For muscle flap repairs, transversus abdominis was used. Recurrence was defined as a diagnosis made at a follow up visit.

Results: 445 patients underwent surgical CDH repair. In 174 patients (39.1%) the defect was repaired primarily, in 194 (43.6%) a patch was used, in 75 (16.6%) a muscle flap repair was performed, and in two patients (0.5%) repair consisted of a combination of muscle flap and synthetic patch. Patients in the patch and muscle flap repair groups had a higher proportion of liver herniation (73.5% and 81.3%), NICU mortality rates (respectively 9.3% and 14.7%), ECMO use (35.6% and 30.7%) and D-size defects (7.7% and 21.3%) than the primary repair group. 408 patients had clinical follow-up data available for more than six months. The median duration of follow-up was 31 months [6-123], with longer median follow-up available for primary repair (24, [0-104]) and patch repair (48, [0-117]), than the muscle flap group (12 [0-84]). Recurrence occurred in 31 patients (7.0%), mostly in patients who underwent initial patch repair (22/31, 71.0%) vs flap-repair (3/31, 9.7%) vs primary repair (6/31, 19.4%). Twenty-seven patients underwent surgical repair of their recurrence, and four patients with small recurrence have ongoing clinical surveillance. The median time to recurrence was 19.5 months [0.7-104] after initial repair (Figure).

Conclusion: Recurrence was seen more often in patch and muscle flap repairs, which were performed in patients with increased severity indicators including defect sizes, liver herniation, ECMO and NICU mortality. Long-term follow up is necessary given that late recurrences occur.

Abbreviations: CDH, congenital diaphragmatic hernia
ECMO, extracorporeal membrane oxygenation

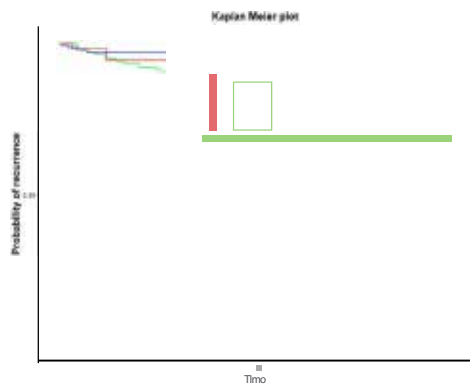


Figure: Kaplan-Meier plot displaying time to recurrence in months.

NOVEL NAPSIN A PROTEIN EXPRESSION IN CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose:

Napsin A aspartic peptidase, Napsin A, is a protease that is present in the epithelial cells of the lungs and kidneys. In the lungs, this protease plays a role in the proteolytic processing of pulmonary surfactant protein B. Napsin A has been identified in normal fetal lungs and in the lung of fetuses with congenital pulmonary conditions, like inflammatory diseases and in particular pulmonary hypoplasia. However, it has never been studied in congenital diaphragmatic hernia (CDH). The aim of this study was to evaluate the expression of Napsin A in human amniotic fluid exosomes (HAFE) of patients with CDH.

Methods:

Through extensive data analysis and prior publications, potential developmental pulmonary proteins were selected via Protein Atlas. Napsin A and other proteins were tested using Western blotting (WB) to assess their expression in fetal rat pulmonary tissue (FRPT), comparing CDH samples to control tissues. Protein levels were compared to a β -Actin loading control and quantified using ImageJ technology. Napsin A was then selected to test on HAFE. To purify exosomes from human amniotic fluid (AF), AF was collected using ExoQuick exosome precipitation solution. Exosome proteins were analyzed using WB technology, with Napsin A levels compared to a β -Actin loading control and quantified using ImageJ technology.

Results:

Protein analyses of both rat and human samples revealed Napsin A levels in control vs CDH samples. For FRPT, the mean quantification value for control protein was 0.47 relative intensity, while CDH protein measured 0.83 relative intensity ($p=0.009$) (Figure A-C). Similarly, WB analysis of HAFE demonstrated a 2.4-fold increase in Napsin A levels in CDH samples compared to controls, with mean quantification values of 1.0 and 2.42 relative intensity, respectively ($p=0.08$) (Figure D-F).

Conclusion:

Both FRPT and HAFE protein were found to have higher amounts of Napsin A levels compared to their controls. These data identify a potential novel indicator protein for detection of CDH via amniotic fluid analysis. The identification of this novel protein may facilitate earlier detection of CDH during pregnancy and improve the accuracy of prenatal severity predictions and risk stratification.

Abbreviations: congenital diaphragmatic hernia = CDH

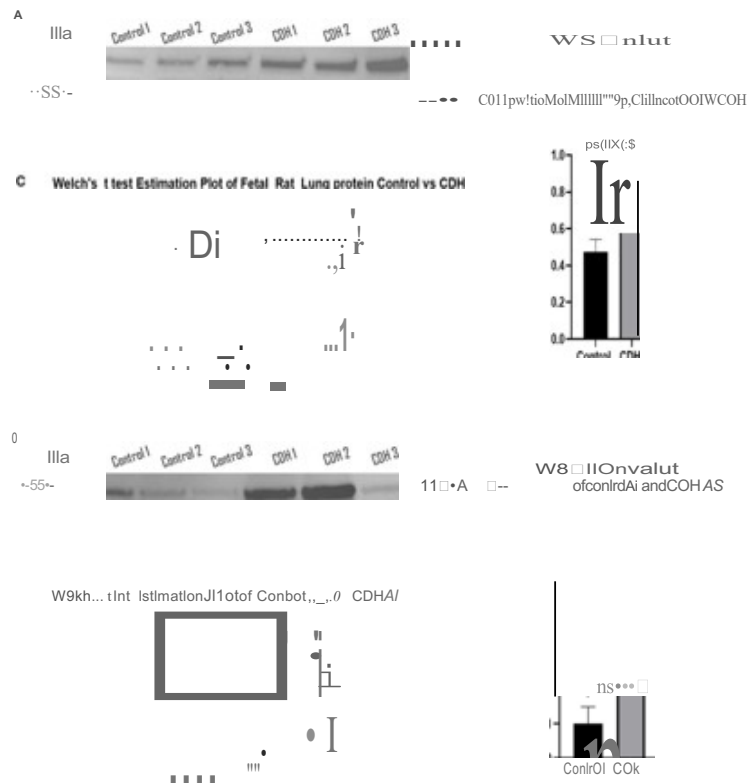
human amniotic fluid exosomes = HAFE

fetal rat pulmonary tissue = FRPT

amniotic fluid = AF

Western blotting = WB

Panels A-C represent analysis for fetal rat pulmonary tissue protein. Panel (A) displays the Western blot membrane comparing protein levels in fetal rat pulmonary tissue from CDH rats to controls, with staining for both Napsin A and β -Actin as loading controls. Panel (B) illustrates the mean quantification for all samples, demonstrating a significant difference as determined by Welch's t-test analysis. Panel (C) presents the results of the Welch's t-test, comparing the data from each well of the Western blot. Panels D-F represent analysis for human amniotic fluid exosome protein. Panel (D) displays the Western blot membrane comparing protein levels in human amniotic fluid exosome protein from CDH patients to controls, with staining for both Napsin A and β -Actin as loading controls. Panel (E) illustrates the mean quantification for all samples, demonstrating a significant difference as determined by Welch's t-test analysis. Panel (F) presents the results of the Welch's t-test, comparing the data from each well of the Western blot.



EVALUATION OF TIMING OF REPAIR OF CONGENITAL DIAPHRAGMATIC HERNIA IN PREMATURE INFANTS

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Abstract: Purpose: Neonates with congenital diaphragmatic hernia (CDH) are a heterogeneous population. Prematurity complicates clinical decision-making due to post-operative candidacy for extracorporeal membrane oxygenation (ECMO) and tissue frailty and healing. We evaluated outcomes of early vs. delayed repair in premature patients.

Methods: The Congenital Diaphragmatic Hernia Study Group (CDHSG) database was queried from 2015 to 2024. Preterm neonates were < 37 weeks estimated gestational age (EGA) at birth. Low birth weight (LBW) was < 2.5kg. Early repair was within 14 days of birth; delayed repair was > 14 days. Baseline characteristics and outcomes were compared using univariate and multivariate regression analyses.

Results Of 4948 neonates, 696 (14.1%) were preterm and of LBW. Almost one-third (189/696; 27.1%) were not repaired. Of those who underwent repair (n=506), 439 (86.8%) underwent early repair at a median of 4 days [IQR 4 – 7], and 65 (12.8%) underwent delayed repair at a median of 23 days [17 – 37] ($p < 0.05$). Neonates in the delayed repair cohort were sicker, with lower BW 1.83 kg [1.41 - 2.19] vs. 2.1 kg [1.85 - 2.3] ($p < 0.05$), younger EGA 33 weeks [31 - 35] vs. 34 [33 - 36] ($p < 0.05$), and increased ECMO requirement – 29.2% vs. 17.6% ($p < 0.05$). Survival was similar (delayed: 73.8% vs. early: 80.6%) ($p=0.273$). On multivariate regression analysis adjusting for BW, EGA, and need for ECMO, hospital length of stay was 1.3 days longer in survivors of delayed repair vs. early repair ($p < 0.05$). More significantly, each kilogram increase in BW resulted in 67 fewer days in the hospital.

Conclusion Delaying the repair of CDH in premature infants may allow for more post-operative rescue options, such as ECMO, and repair of sturdier tissues. Survival was not significantly different between groups, and the length of stay was different only by one day. Further studies are required to inform decision-making on the timing of repair in premature infants with CDH.

Abbreviations: CDH = congenital diaphragmatic hernia
ECMO = extracorporeal membrane oxygenation
CDHSG = congenital diaphragmatic study group
EGA = estimated gestational age
LBW = low birth weight

UNTOLD STORIES: A QUALITATIVE INVESTIGATION OF PATIENT AND FAMILY EXPERIENCES WITH CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Background: Structured, interdisciplinary long-term surveillance is necessary to identify and mitigate CDH survivor morbidity. However, patient/family perspectives on illness impact and support needs are often overlooked, hindering clinicians' understanding of morbidity effects and required interventions. We explored the lived experience of CDH patients/families, including those with neurodevelopmental impairment (NDI), to evaluate the adequacy of support they seek from clinical teams and community resources.

Methods: This cross-sectional study (REB 2023-8964) used qualitative methodology, convening focus groups (FG) to explore CDH patient and primary caregiver experiences within our long-term CDH follow-up clinic. Participants >4 years were recruited between December 2023 and March 2024. FGs were grouped according to language preference, presence of NDI, and clinic graduate status. Virtual FG sessions were recorded, transcribed, translated (as needed), and assessed using inductive thematic analyses.

Results: Twenty-six participants (10 CDH children, 12 primary caregivers, 4 young adult clinic graduates) participated in one of four FGs. Thematic analysis revealed four primary themes: "Experiencing CDH as a Caregiver", "Experiencing CDH as a Child", "Striving for Normalcy", and "Getting the Support We Need" (Table 1). Caregivers reported shock and fear at CDH diagnosis and during initial hospital management. Caregiver isolation and emotional distress were common, particularly when physically separated from their newborn. These memories faded with time, with caregivers revealing minimal long-term effects on their children. Most CDH patients reported minimal impact from their diagnosis, with a few revealing difficulties with visible CDH indicators (e.g. scar, chest wall asymmetry). Both children and caregivers expressed a high quality of life, even in the context of NDI or co-morbidities. While all participants were satisfied with hospital and CDH clinic support, caregivers strongly desired connection with other families and improved emotional/psychological support.

Conclusion: This first study on CDH "lived experiences" demonstrates that most patients and families enjoy a high quality of life, despite early challenges. Caregivers valued structured long-term follow-up to optimize care, particularly the single, expert point of contact. Areas for improvement include increased emotional support for caregivers and fostering connections with other CDH families, particularly at the time of diagnosis, through hospitalization, and into the early post-discharge period.

Abbreviations: Congenital Diaphragmatic Hernia (CDH)
Focus Groups (FG)
Neurodevelopmental Impairment (NDI)

Table 1 – Primary Themes and Representative Quotes

Theme 1: Experiencing CDH as a Caregiver
Psychologically, having had to lose a... fear of losing a child, it's... as I was saying earlier, it took weeks, months. I don't even know if I could say years before...before not thinking about it anymore and being anxious at that level. [FG2, P1b, M]
We came back home, and now we really, you know, we forget sometimes we have to be reminded when we get when we get the, the reminders to go into the follow-up. I think we're, we feel very thankful that things are okay now. [FG3, P3, F]
She's not doing good since she forgets, even in specialised class, she cannot perform. Because when you're with her one with one, she can do it. But you leave, she forgets what she has to do. They're thinking to modify a program but she will never get the high school diploma. So it means I'm still inside this process, I never go out of this issue, this problem. I'm always inside (crying). [FG3, P2, F]
Theme 2: Experiencing CDH as a Child
To be honest, there are no lasting effects. I have...I have a normal life. I...I breathe well, I don't have...I don't have any problems. My life is pretty normal. I can do sports. I run. That's it, my life is normal. [FG2, C1, M]
Like people just ask [about his scar], like they're genuine, curious. Not like there's no, like, bad intentions, obviously. So it doesn't bother me at all. [FG4, C2, M]
Theme 3: Striving for Normalcy
Well, I believe my life has been normal because I do have a twin sister and we do experience the same things. We both dance and are in our sport study program at school, so I believe I've still lived a normal life, if you can call it that. Similar to my sister's. [FG4, C1, F]
But other than that, in terms of quality of life, there's nothing really...nothing really different. There's no special treatment...At first, it's true that we thought maybe in the future, there would be something special for him, he would be deprived of something. But in the end, no. So far, it's increasingly...he's leading a life that's as normal as the others, although he's normal too so far. [FG1, P3, F]
Theme 4: Getting the Support We Need
We have a good family doctor. But they don't know about this, as well as we realize the CDH clinic does. They're specialists, and we had a direct line with people who knew what our child had. And for real, as parents, that aspect is really reassuring...that's what really struck me, to realize how knowledgeable and professional they are, and they're a bit at our disposal. [FG1, P1, F]
I think it would have been really nice to get in touch with other parents. I tried, I remember trying to look for the Facebook groups...there weren't really any local people. So I think that if I had maybe being in touch with even just you, just the people on the call today. It could have been helpful. [FG3, P3, F]
*Focus Group (FG), Parent (P), Child (C), Male (M), Female (F)

THE CRESCENT RA™ VV ECMO CANNULA: AN ANALYSIS OF ASSOCIATED CARDIOVASCULAR INJURIES

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Abstract: Purpose:

The use of VV ECMO in pediatric patients declined in 2018 due to lack of a dual-lumen right atrial (RA) cannula. The Crescent RA™ cannula was developed in 2021: the only dual-lumen VV cannula designed to have its tip in the right atrium. This study aims to assess the incidence of and

risk factors for cardiovascular injuries related to use of the cannula in neonatal and pediatric patients.

Methods:

We performed a multicenter retrospective cohort study of 216 patients under 18 years of age (67 neonatal, 149 pediatric) placed on VV ECMO using the Crescent RA cannula from September 2021 through August 2023 across 23 U.S. children's hospitals. We dichotomized cardiovascular injuries, cardiovascular perforations, and deaths attributable to cannula complication and analyzed them by patient characteristics and risk factors during cannulation and ECMO runs using chi-squared, Wilcoxon rank sum, and Fisher's exact tests. Multivariable logistic regression was utilized to assess risk factors associated with cardiovascular injuries. $p < 0.05$ was deemed statistically significant.

Results:

Twelve (5.6%) patients experienced a cardiovascular injury, ten (4.6%) of which were classified perforations. Four (1.9%) instances of cardiac tamponade occurred without definite evidence of perforation. Mortality in four (1.9%) patients was attributable to a cannula complication. No statistically significant association existed between cardiovascular injuries and sex, day of life at cannulation, neonatal status, weight, cannula size, difficulty advancing the cannula, imaging used during cannulation, flow issues, or cannula repositioning. Cardiovascular injury occurred more frequently in patients who had migration of the cannula tip during the ECMO run (11.9% vs 4.0%) ($p=0.047$). The association did not persist when examining the patients with perforation or death attributable to cannula complication. On multivariate analysis, neither sex, day of life at cannulation, neonatal status, weight, flow issue, cannula migration, nor cannula repositioning were found to significantly affect cardiovascular injury status.

Conclusion:

Cardiovascular cannula complications in neonatal and pediatric patients placed on VV ECMO using the Crescent RA cannula may be associated with migration of the cannula during the ECMO run. Thorough education on proper cannula placement, regular imaging, and constant vigilance are essential to mitigate this risk.

Abbreviations: VV: veno-venous

ECMO: extra-corporeal membrane oxygenation

RA: right atrial

IONIZABLE LIPID NANOPARTICLES FOR GENE EDITING OF THE FETAL LUNG

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Abstract: Background: In cystic fibrosis (CF) there are signs of multiorgan disease affecting the respiratory, gastrointestinal, and reproductive systems present at birth. Prenatal intervention with mRNA-based therapeutics, such as CRISPR-Cas9 gene editing, could potentially allowing for normal organ development and disease improvement. Recently, lipid nanoparticles (LNPs) have emerged as potent vehicles for mRNA delivery, but optimal formulations for fetal lung mRNA delivery have yet to be identified.

Methods: We developed and screened a novel LNP library containing formulations that have improved physicochemical properties, such as enhanced endosomal escape, or favorable organ tropism. The library was screened for mRNA delivery to the lung after systemic LNP administration to E15 murine fetuses. Next, lead formulations identified from this screen were delivered in utero to a Cre reporter mouse model to assess levels of gene editing in the fetal lung as well as cell type specific tropism. Lastly, lead formulations containing base editor mRNA and guide RNA were used to measure the correction efficiency of a disease-causing stop codon mutation in human bronchial epithelial cells.

Results: We identified LNP formulations capable of delivering mRNA to midgestational murine fetal lungs after systemic LNP administration. Lead LNP formulations resulted in up to 40% gene modification in the lung in a reporter mouse model. Gene modification was observed in multiple cell types of interest for the treatment of CF, including epithelial and basal cells, the stem cells of the airway epithelium. Lead formulations were additionally capable of delivering base editor mRNA to human bronchial epithelial cells, which resulted in dose dependent correction of a CF-disease causing mutation.

Conclusion: Ionizable LNPs enable mRNA delivery to the developing fetal lung after systemic administration, which results in clinically relevant levels of gene modification in specific cell types and organs affected by CF, and can be used to correct a CF disease-causing mutation in human airway cells.

Abbreviations: CF - cystic fibrosis
LNP - lipid nanoparticle

FENTANYL UTILIZATION DURING EXTRACORPOREAL MEMBRANE OXYGENATION AND RISK OF METHADONE TREATMENT AMONG PEDIATRIC ECMO SURVIVORS

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Abstract: Purpose: Fentanyl is an opioid analgesic used for periprocedural pain management in critically ill infants and children. However, due to the lipophilic and protein binding properties of fentanyl within the extracorporeal membrane oxygenation (ECMO) circuit, fentanyl use during ECMO is now being questioned. Previous single center studies suggest that utilization of fentanyl during ECMO may be associated with a higher risk of opioid withdrawal. This study evaluated fentanyl exposures during ECMO and risk of subsequent methadone or buprenorphine treatment among pediatric ECMO survivors.

Methods: This retrospective cohort study included children < 18y treated at 41 U.S. children's hospitals in the Pediatric Health Information System between 2013-2023. Patients were excluded if they had prior methadone or buprenorphine exposure, opioid use disorder, or if they expired during their hospitalization. Median ECMO duration and duration of fentanyl exposure while on ECMO was calculated. A multivariable hierarchical logistic regression model was used to assess the relationship between fentanyl exposure and likelihood of receiving methadone or buprenorphine after ECMO, adjusting for clinical and demographic factors and other opioid exposures before and during ECMO.

Results: A total of 4365 children were included in the study (55.5% male, 54.7% white, and 47.9% neonatal). The median duration of ECMO was 5 days (IQR: 3-8). Fentanyl exposure was categorized into four quartiles: 1st quartile (0-1 days), 2nd quartile (2 days), 3rd quartile (3-4 days), and 4th quartile (≥ 5 days) (Table). Children in the 3rd quartile (OR 1.32; 95% CI: 1.05, 1.66, $p=0.017$) and 4th quartile (OR 2.21; 95% CI: 1.71, 2.85, $p < 0.001$) were more likely to receive methadone or buprenorphine after ECMO compared to those in the 1st quartile.

Conclusion: Our study found that as the duration of fentanyl exposure increased, the odds of receiving methadone or buprenorphine after decannulation from extracorporeal membrane oxygenation significantly increased. Thus, children receiving fentanyl during extracorporeal membrane oxygenation demonstrate a higher risk of requiring treatment for opioid withdrawal. Our findings underscore a need for expanded opioid stewardship initiatives to encourage minimizing fentanyl utilization in children undergoing extracorporeal membrane oxygenation.

Abbreviations: ECMO: extracorporeal membrane oxygenation

Table: Hierarchical Logistic Regression Analysis of Fentanyl Quartiles and Post-ECMO Receipt of Methadone or Buprenorphine among Pediatric ECMO Survivors.

Fentanyl Quartiles	Post-ECMO Methadone or Buprenorphine								
	N(n/o)	Unadjusted				*Adjusted			
		OR	95%CI		p-value	OR	95%CI		p-value
1 st =0-1 days	1125 (25.8%)	ref	ref	ref	ref	ref	ref	ref	ref
2 nd =2 days	1221 (28.0%)	0.97	0.79	1.2	0.805	1.01	0.81	1.26	0.919
3 rd =3-4 days	1098 (25.2%)	1.25	1.01	1.55	0.038	1.32	1.05	1.66	0.017
4 th = > 5 days	921 (21.1%)	2.08	1.65	2.64	<0.001	2.21	1.71	2.85	<0.001

*Adjusted for age, race, ethnicity, insurance type, region, comorbidities, and other opioid exposures before and during ECMO

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HOW LOW CAN YOU GO? SURVIVAL IN EXTREME HIGH RISK CDH

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Abstract: Purpose

Congenital diaphragmatic hernia (CDH) is a rare and potentially severe congenital anomaly which presents with respiratory failure, pulmonary hypertension, and cardiac dysfunction. Prenatal prognostication is crucial for counseling and both pre- and postnatal management. Risk stratification is based on the observed to expected lung to head ratio (o/e-LHR), where severe CDH is defined as < 25%. Within this severe group, outcomes for those with o/e-LHR in the teens and single digits is largely unknown but believed to be poor. This study aims to evaluate the morbidity and mortality of patients with high-risk o/e-LHR values < 20%.

Methods

A retrospective analysis was performed using the CDH study group data for patients with o/e-LHR reported from 2015-2022. Demographics, prenatal imaging, and postnatal variables were analyzed. Patients were categorized by o/e-LHR value: < 10%, 10-19%, and 20-25%. Non-parametric tests of comparisons and survival analyses were performed to analyze for outcomes of morbidity and mortality.

Results

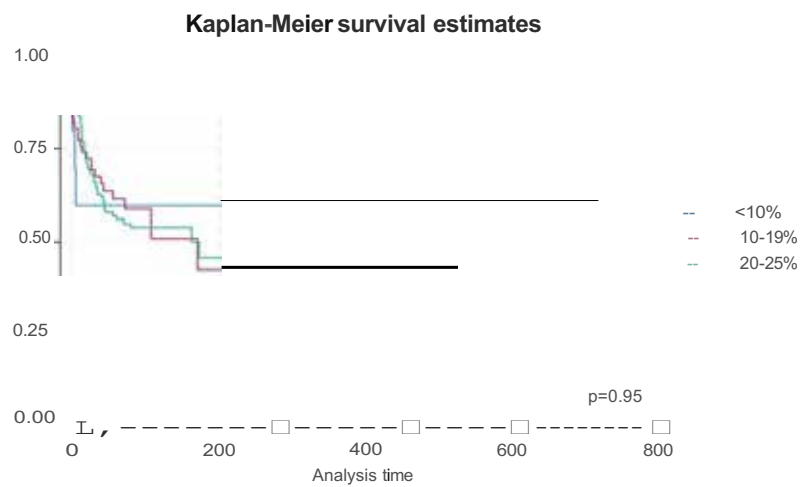
Of 4,923 patients, 1,764 had o/e-LHR reported. 239 had o/e-LHR < 25% (11 had < 10%, 80 had 10-19%, and 148 had 20-25%). For o/e-LHRs < 10%, 10-19%, and 20-25%, the median gestational age and birthweight was similar in the 3 groups. 14.3%, 14.5%, and 11.8% received CPR ($p=0.91$), 27.3%, 15.0%, and 15.5% had concomitant major cardiac anomalies ($p=0.57$). 45.5%, 42.5%, and 52.0% utilized ECLS ($p=0.38$) and 63.6%, 63.7%, and 80.4% underwent repair ($p=0.02$). Median ventilator days were 10, 15.5, and 23.5 days ($p=0.02$), and overall survival was 54.5%, 45.0%, and 50.0% ($p=0.71$). The median length of stay was 35.5, 34, and 42.5 days ($p=0.17$). However, the median time to death was, 3.5, 1, and 14 days ($p=0.005$) (Figure). In a Cox proportional hazard analysis for those with o/e-LHR < 20%, survival was associated with higher birthweights, prolonged intubations, and smaller defect sizes (all $p < 0.05$).

Conclusion

This analysis identified outcomes among subpopulations of the highest risk CDH cohort. These findings reveal the opportunity for survival, even among those with o/e LHR in the single digits and teens.

Abbreviations: Congenital diaphragmatic hernia= CDH
observed to expected lung to head ratio= o/e-LHR
extracorporeal life support = ECLS

kaplan-Meier survival curve depicting the survival among those with o/e-LHRs <10%, 10-19%, and 20-25%. Mantel-Cox log-rank test: $p=0.95$



IMPROVING DECISION-MAKING FOR THE USE OF PEDIATRIC EXTRACORPOREAL CARDIOPULMONARY RESUSCITATION

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Abstract: Purpose: Extracorporeal cardiopulmonary resuscitation (ECPR) is an advanced resuscitation therapy for cardiopulmonary arrest refractory to standard cardiopulmonary resuscitation (CPR). Recommendations for ECPR use are not supported by strong evidence and institutional criteria for its application are rare, leading to challenges in decision-making. This study aimed to better understand how to improve ECPR decision-making by exploring the considerations of providers engaged in those decisions at a quaternary children's hospital.

Methods: Our hospital has a robust ECMO program that offers ECPR in the operating room, emergency department, and all intensive care units. To understand ECPR in each of these areas, we conducted semi-structured interviews with providers from pediatric surgery, cardiothoracic surgery, pediatric, cardiac, and neonatal intensive care, interventional cardiology, and the emergency department. Participants completed a 1-hour virtual interview. Interviews were guided by the Ottawa Decision Support Framework (ODSF) and explored provider experiences with ECPR and their assessment of the decision-making process. We coded transcripts using a consensus method with both deductive codes based on the ODSF and emergent codes from the data. Code queries were summarized, and themes identified to characterize the decision-making process and areas for improvement.

Results: We interviewed 21 provider participants across diverse ECPR decision-making roles. Three overarching themes (subthemes) emerged: 1) Difficulty of decision-making (emergent and high stakes scenarios, emotional burden on care teams, uncertain/poor prognosis of patients); 2) differing perspectives and processes across units (cardiac vs. non-cardiac providers, variability in perspectives of what constitutes a "good outcome"); 3) factors informing assessment of quality for ECPR decisions (standardization, preemptive decision-making, and promoting collaboration/addressing conflict). Supporting quotations are in Table 1.

Conclusion: We identified common experiences in ECPR decision-making related to uncertain or not-well-established effectiveness of ECPR and the gravity of the decision. These include difficulties with decision-making, concerns about the quality of the decision, and challenges integrating various perspectives and processes across hospital units. Suggestions to improve decision-making centered on incorporating pre-emptive decisions on ECMO candidacy in intensive care units and improved standardization of processes and procedures that also include a focus on teamwork and collaboration.

Abbreviations: ECPR: Extracorporeal cardiopulmonary resuscitation
CPR: Cardiopulmonary resuscitation
ODSF: Ottawa Decision Support Framework

Table 1: Identified themes and supporting quotes from semi-structured interviews among providers engaged in ECPR decisions.		
Theme 1: ECPR characteristics lead to difficulties in decision-making!		
Emergent and high stakes scenarios	Emotionally burdensome for care teams	Poor or uncertain patient prognosis
"You're asking a physician to make a decision to deny or avoid a potentially life-saving intervention without giving them the opportunity to consider what that potential is, whether it's high likelihood of survival, and whether it's a low likelihood of survival, and no one has a crystal ball." (Cardiac provider)	"We usually err on the side of offering ECPR. That does affect me because it prolongs the potential suffering of the patient, but certainly of the family as well [...] This is a long way of saying that I really struggle with these patients in general, I offer ECPR and I don't know if it's the right thing to do. It makes me worried that I've caused pain for either the patient or for the family." (ICU provider/	"the hard part about ECPR is if the patient doesn't get return of spontaneous circulation or they don't go on ECMO they're dead. And that for many intensive care doctors, that seems very final for a situation where you may not understand the pathology of the patient and not be able to define that you can't save them." (Cardiac provider)
Theme 2: Provider perspectives on and processes for ECPR differ across units		
Cardiac vs. non-cardiac cause of arrest and corresponding care teams	Variability across units of what providers perceive as a "good" outcome	
"[In Cardiology] we have a team of nurses, nurse educators, physicians, and surgeons who have all worked together to ensure that we have an excellent teamwork set up for ECPR situations as well as resuscitations, and I just think that that really helps. <u>S.a.</u> I think that it's something that if you want to do well, it has to be practiced." (Cardiac provider/	"I think lack of understanding about what a good outcome means for ECPR. I don't think there's consensus on whether a good outcome is just surviving or whether it's surviving with some particular level of disability or not is the goal." (ICU provider)	
Theme 3: Quality of ECPR decisions informed by standardization, preemptive decision-making, and collaboration		
Standardization	Preemptive decision-making!	Collaboration
"For our sickest patients and our highest utilization of resources, the things that are the most expensive, the hardest to use, the most difficult to decide to use, we don't have an algorithm for how we're using it." (Pediatric Surgery provider)	"I think some hospitals, anybody who gets admitted to the ICU, one of their ICU checklists to go through is they decide, is this patient an ECMO candidate or not. We don't do that. Then that leaves you at 3:00 in the morning, the surgeon who stumbles up there, the ICU doctor who happens to be on call that night, the two of you trying to figure out "Do we think this person's an ECMO candidate?" (Pediatric Surgery provider)	"When you have good relationships with those other providers, critical care and/or surgery, I feel like you can really have a high-quality conversation and decision. I think when there is conflict or you don't really know people[...] then it can start to get really challenging." (ED provider)
"I'm always an advocate for, if something can be standardized easily[...] then I support that." (ICU provider)		

LONG-TERM OUTCOMES AFTER MUSCLE FLAP REPAIR IN CONGENITAL DIAPHRAGMATIC HERNIA: A RETROSPECTIVE STUDY AT A SINGLE INSTITUTION

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Abstract: Purpose:

Infants with large congenital diaphragmatic hernia (CDH) defects pose a significant clinical challenge. Despite limited evidence that muscle flap repair (MFR) has lower recurrence rates than patch repair (PR), MFR remains uncommon and understudied. This study evaluated long-term outcomes in CDH patients who underwent MFR compared to PR at a single institution. We hypothesize that patients who underwent MFR will have lower recurrence rates than patients who underwent PR.

Methods:

Using an internal institutional registry, we identified a retrospective cohort of all CDH patients who underwent repair between 1998 and 2024. Patients were stratified based on type of repair, with primary and non-repaired patients excluded. A sub-cohort of patients repaired after 2016, following a significant change in NICU critical care management protocol, was analyzed separately. Long-term follow-up was obtained through our institutional pulmonary hypoplasia clinic and retrospective chart review. Primary and secondary outcome variables were analyzed using bivariate comparisons.

Results:

A retrospective cohort of 448 patients with CDH from 1998-2024 was identified. 70 patients were not repaired (54/70 before 2016), and 234 underwent primary repair. 134 patients underwent complex repair: 103 MFR and 31 PR. In the contemporary sub-cohort of patients repaired after 2016, 137 CDH patients were identified: 16 were unrepaired, 69 had primary repairs, and 52 underwent MFR. No PR was performed. The average follow-up time was 6.6 years. Demographics were similar across cohorts. Of the patients who underwent repair after 2016, 92% of MFR survived to discharge. In the total MFR group, 6/103 (6.98%) had a recurrence within the study follow-up period, as compared to 8 (30.77%) in the patch group ($p=.004$). The rate of bowel obstruction and hernia were similar across groups. Scoliosis and chest wall deformity rates were similar, with 5 patients requiring operative intervention for scoliosis and 1 requiring Nuss procedure.

Conclusion:

This is the largest cohort of MFR in known literature. MFR is a viable treatment option for large CDH defects and has a lower recurrence rate than PR. In this long-term follow-up study, MFR did not result in a higher rate of bowel obstruction, hernia, chest wall deformity, or scoliosis.

Abbreviations: CDH = congenital diaphragmatic hernia

MFR = muscle flap repair

PR = patch repair

NICU = neonatal intensive care unit

ECMO = extracorporeal membranous oxygenation

DC = discharge

		<i>Prosthetic Patch</i>	<i>Muscle Flap</i>	<i>P value</i>
<i>N (total)</i>		31	103	-
<i>Sex</i>	<i>Female</i>	11 (35.5%)	41 (39.8%)	0.82
	<i>Male</i>	20 (64.5%)	62 (60.2%)	
<i>Sidedness</i>	<i>Left</i>	21 (67.7%)	93 (90.3%)	0.004
	<i>Right</i>	10 (32%)	10 (9.7%)	
<i>Defect Type</i>	<i>B</i>	2 (6.9%)	4 (3.9%)	0.17
	<i>C</i>	22 (75.9%)	63 (61.2%)	
	<i>D</i>	5 (17.2%)	36 (34.6%)	
<i>Recurrence ECMO</i>		8 (30.77%)	6 (6.98%)	0.004
	<i>All</i>	20 (64.52%)	38 (36.89%)	
<i>Repair on ECMO</i>	<i>After 2016</i>	N/A	9 (18%)	0.0039
	<i>All</i>	13 (41.94%)	16 (15.53%)	
<i>Survival to DC</i>	<i>After 2016</i>	N/A	2 (4.0%)	0.0063
	<i>All</i>	18 (58.06%)	86 (83.5%)	
<i>Survival to DC after 2016</i>		N/A	46 (92%)	0.7043
		12 (38.71%)	46 (44.66%)	
<i>Delayed Abdominal Closure</i>		6 (19.35%)	6 (5.83%)	0.0507
<i>Massive Bleeding Event After Repair Hernia (any)</i>		3 (12.0%)	13 (15.12%)	0.9466
<i>Bowel Obstruction (Requiring operation)</i>		2 (8.0%)	12 (13.64%)	0.6811
<i>Chest Wall Abnormality</i>		4 (16.0%)	20 (23.53%)	0.599
<i>Scoliosis</i>		2 (8.0%)	13 (15.66%)	0.5213