ABSTRACTS

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INTERNATIONAL SOCIETY OF PAEDIATRIC SURGICAL ONCOLOGY
IPSO

APSA-IPSO PROGRAM | MAY 15
ANNUAL MEETING | MAY 16-19

JW Marriott Phoenix Desert Ridge Resort & Spa
Phoenix, Arizona, USA

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Wednesday, May 15, 2024

IPSO Poster Hall
7:30 AM – 5:30 PM

IPSO P 1

A COMPARISON OF RECURRENCE RATES BETWEEN PEDIATRIC HEPATOCELLULAR NEOPLASM NOT OTHERWISE SPECIFIED AND HEPATOBLASTOMA

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Abstract: Purpose:
Hepatocellular Neoplasm Not Otherwise Specified (HC-NOS) is a pediatric liver malignancy distinct from Hepatoblastoma (HB) and Hepatocellular Carcinoma. Prior studies have demonstrated differentiating pathologic and genetic features, but there is limited clinical data reported. This study characterizes the clinical outcomes for HC-NOS in comparison to HB.

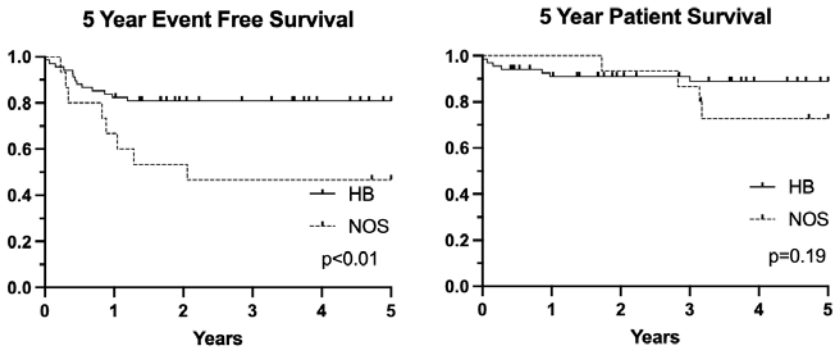
Methods:
A single center, retrospective review of all cases of HB and HC-NOS from 1997-2022 was conducted. Inclusion criteria were pathologic diagnosis of HB or HC-NOS. Exclusion criteria were less than 1 year follow-up, or no treatment pursued. Pretreatment, surgical, and survival clinical data were analyzed. Statistical analysis was performed using Fisher-Exact, Mann-Whitney U tests and Kaplan Meier survival curves with $p< 0.05$ as significant. Clinical events assessed were recurrence or death within 5 years of surgical resection. IRB approval was obtained (2013-15298).

Results:
Sixty-eight HB and 15 HC-NOS patients were identified. Median follow-up time was similar: HC-NOS, 5.5 [3.2-7.4], HB 5.1 [1.8-8.4] median [IQR] years, ($p=0.64$). HC-NOS patients were significantly older at diagnosis (9.5 [5.9-11.7] versus HB 1.5 [0.7-2.5] median [IQR] years, $p< 0.0001$). Alpha fetoprotein (AFP) levels were significantly lower in HC-NOS patients at diagnosis (HC-NOS 35,500 [19,832-272,597], HB 281,720 [56,730-544,715] median [IQR] ng/ml, $p=0.02$). HC-NOS and HB patients had similar median stage of PRETEXT III. Both groups had similar frequencies of metastases at diagnosis (HC-NOS 3/15 [20.0%], HB 16/68 [23.5%], $p=0.99$). Neoadjuvant chemotherapy was used less frequently in HC-NOS patients (HC-NOS 7/15 [46.7%], HB 56/68 [82.4%], $p< 0.01$). Incidence of primary liver transplantation was similar in both groups (HC-NOS 3/15 [20.0%], HB 11/68 [16.2%], $p=0.71$). The proportion of patients who were followed for at least 5 years was equal in each group (HC-NOS 13/15, HB 41/68, $p=0.7$). The 5-year event free survival in the HC-NOS cohort was significantly lower compared to HB (Figure, $p< 0.01$) but five-year overall survival was similar between the groups (Figure, $p=0.19$).

Conclusion:
In this large case-series reporting on clinical outcomes, HC-NOS patients are older at diagnosis, present with lower AFP levels, and have similar PRETEXT scores and rates of metastasis. Disease recurrence is higher in HC-NOS, but long-term survival is similar to that seen in HB patients.

Abbreviations: HB: Hepatoblastoma
HC-NOS: Hepatocellular Neoplasm Not Otherwise Specified
AFP: Alpha Fetoprotein

Five Year Event Free and Patient Survival for Hepatoblastoma and Hepatocellular-NOS



IPSO P 2

SOCIAL DETERMINANTS OF HEALTH INFLUENCE SURVIVAL IN COMMON PEDIATRIC SOLID TUMORS

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Abstract: Purpose: While social determinants of health (SDOH) impact pediatric outcomes, the influence of SDOH on outcomes in pediatric solid tumors remains understudied. This study aimed to elucidate the influence of socioeconomic status (SES) on survival in Wilms tumor, hepatoblastoma, and neuroblastoma.

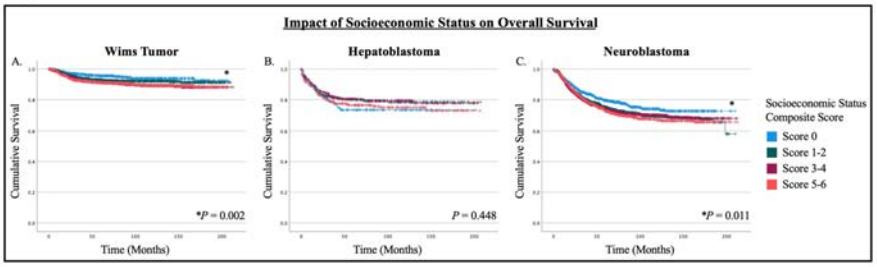
Methods: The National Cancer Database was queried from 2004-2020 for pediatric patients (ages 0-18 years) with Wilms tumor, hepatoblastoma, and neuroblastoma. A SES composite score was created by combining quartiles for median household income and percent no high school degree (higher scores reflecting greater disadvantage). Kaplan-Meier analyses were performed to determine the survival influence of SES composite score, and Cox regressions were performed to identify all influencers on overall survival, with significant variables included in a multivariate model.

Results: The study cohort included 5218 patients with Wilms tumor, 1311 with hepatoblastoma, and 5851 with neuroblastoma. Fifteen percent of Wilms tumor, 15.0% of hepatoblastoma, and 18.2% of neuroblastoma patients had the lowest SES composite score, whereas 21.8% of Wilms tumor, 22.2% of hepatoblastoma, and 18.2% of neuroblastoma patients had the highest SES composite score. The distribution of race for Wilms tumor, hepatoblastoma and neuroblastoma patients were 72.5%, 73.6% and 77.2% White, and 18.4%, 12.0%, and 12.1% Black, respectively. In multivariate analysis of children with Wilms tumor, age, higher SES score, comorbid conditions, tumor size, and bilateral and metastatic disease were associated with worse survival. For hepatoblastoma, age, comorbidity, and metastatic disease were associated with worse survival. For neuroblastoma, age, urbanicity, higher SES score, Black race, tumor size, metastatic disease, and chemotherapy were associated with worse survival. Kaplan-Meier analyses with stratification by SES composite revealed disparate outcomes with lower scores having better survival for Wilms tumor and neuroblastoma; however, survival curves by SES did not differ for hepatoblastoma (Figure 1).

Conclusion: After controlling for patient and tumor characteristics, there are significant associations between SDOH and worse survival for patients with Wilms tumor and neuroblastoma, highlighting that determinants in addition to disease biology may influence mortality. Identification of social risk factors is critical for closing equity gaps and improving outcomes for all patients with pediatric solid tumors.

Abbreviations: SDOH, Social Determinants of Health; SES, socioeconomic status

Figure 1



IPSO P 3

A COMPARISON OF COMMONLY UTILIZED DIAGNOSTIC BIOPSY TECHNIQUES FOR PEDIATRIC PATIENTS WITH CANCER: A SYSTEMATIC REVIEW BY THE APSA CANCER COMMITTEE

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Abstract: Background: Diagnostic surgical biopsy for pediatric tumors has been considered necessary due to the requirement of adequate tissue for complete histologic and molecular characterization. Refinements in less invasive biopsy techniques such as core needle biopsy (CNB) have allowed for successful pathologic diagnosis with improved morbidity. However, data regarding the safety and efficacy of CNB in pediatric patients is limited. This study assessed the accuracy and safety of CNB compared to surgical biopsy in children with cancer.

Methods: A PRISMA-P-compliant systematic review was performed in MEDLINE using PubMed, Embase, and CINAHL database searches from 2010-2023. Studies were included based on relevance to the following clinical question: For children with concern for malignancy requiring biopsy for diagnosis, how does CNB compare to open or laparoscopic/thoracoscopic surgical biopsy in terms of safety and efficacy? Data for patients ≤ 21 years requiring biopsy for diagnosis for liver tumors, neuroblastoma, soft tissue sarcoma, and lymphoma were included.

Results: Twenty-seven studies including 2477 patients met inclusion criteria, with 2065 having CNB and 412 surgical biopsy. Of the 2477 patients, 518 patients had neuroblastoma, 274 liver tumors, 33 soft tissue sarcoma, 57 lymphoma, and 1595 had mixed diagnoses (Table 1). Average complication rate for CNB was 6.6% compared to 19.0% for surgical biopsies ($p< 0.001$). Bleeding was the most commonly described complication in both groups, but was higher after surgical biopsy (11.5% vs 3.1%) ($p< 0.001$). CNB was diagnostic in 92.0% of patients compared to 98.2% for surgical biopsies ($p< 0.001$). After CNB, 3.2% of patients required a second procedure for diagnostic purposes compared to 0.6% of patients after surgical biopsy ($p=0.07$).

Conclusions: Rates of successful diagnosis are comparable between CNB and surgical biopsy with low rates of second procedures needed in either group. Complication rates were three times higher after surgical biopsy compared to CNB. CNB is a useful diagnostic tool for pediatric patients with cancer. Research focused on technique optimization and standardization of the number of cores obtained may improve diagnostic accuracy and reduce the need for additional procedures after CNB.

Abbreviations: Core Needle Biopsy (CNB)

IPSO P 4

PANCREATIC INVOLVEMENT IN PATIENTS WITH NEUROBLASTOMA: A SINGLE-INSTITUTION RETROSPECTIVE REVIEW

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Abstract: Objective: Involvement of the pancreas is rare in neuroblastoma but may prevent gross total resection. This report documenting feasibility, complications, local control, and survival updates our previous series of 5 patients to a total of 19.
Methods: After IRB waiver, we retrospectively reviewed neuroblastoma patients undergoing pancreatic resection between January 2005 and February 2023. Demographics, genetics, surgical procedure, complications, pathology reports, and outcomes were reviewed. Statistical analysis was done with R 4.3.
Results: Nineteen patients were identified with a median age of 4 years (1-16 years). Ten (53%) were male. Two (11%) were INSS stage III, and 17 (89%) stage IV. Eighteen (95%) patients had high-risk neuroblastoma and one (5%) intermediate risk. Eleven (58%) patients presented with pancreatic disease at diagnosis, and 8 (42%) were diagnosed at relapse. Tumor involved the head of the pancreas in 9(47%), and the tail in 10(53%). There were 12 distal pancreatectomies, 5 pancreaticoduodenectomies, 1 uncinate resection, and 1 biopsy. The average blood loss was 580 mL (range 100-1300 mL). One patient developed diabetes 12 years after her operation. Four patients were managed with pancreatic enzymes for symptoms of pancreatic insufficiency. The average number of PICU days was 4 (range 0-21 visits). There were no pancreatic fistulas.
Final pathology was neuroblastoma in 16(84%), and ganglioneuroblastoma in 3(16%). Three patients had MYCN amplification. No patient had evidence of local recurrence in the pancreas or pancreatic bed. Of the 5 patients (26.3%) who had distant recurrence, sites of recurrence were as follows: brain, 1 (20%); iliac bone, 1 (20%); lung, 1 (20%); retroperitoneal lymph nodes, 1 (20%). Five-year overall survival for the group was 83.6%.

Conclusions: Pancreatic resection for neuroblastoma is feasible and associated with acceptable morbidity. In our experience they provide good local control and long-term survival.

Abbreviations:

IPSO P 5

SURVIVORSHIP AFTER CHILDHOOD UROLOGIC CANCER – WHAT IS CAUSING DEATH AND WHEN?

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Abstract: Purpose:
Despite improved outcomes after childhood cancer, it remains unclear whether pediatric cancer survivors are at risk of early death, and if there are any modifiable causes of death. The objective of this study was to determine the cause-specific mortality among patients < 40 years-old after successful treatment for renal or testicular cancers (germ cell tumor, GCT).

Methods:
Patient information for those who died after a diagnosis of renal (n=1,323) or testicular (n=1,900) cancer was retrieved from the Surveillance, Epidemiology, and End Results (SEER) 2000-2020 incidence database. Standardized mortality ratios (SMR) and 95% confidence intervals for causes of death were calculated against controls matched for sex, race, age and year of death for the US population and stratified by time from diagnosis.

Results:
Overall, the highest adjusted risk of death at any time was the primary cancer (SMR 1,457.7, 95%CI: 1,379.9-1,579.4 for kidney cancers, SMR 800.9, 95%CI: 751.6-852.6 for testicular GCT), followed by secondary malignancies (SMR 4.85, 95%CI: 4.02-5.80 for kidney cancers and SMR 4.14, 95%CI = 3.68-4.66 for testicular GCT). Figure 1 summarizes the largest significant results for non-oncologic causes of death for both cancers. Patients with kidney cancers were at a higher overall risk of non-oncologic death compared to matched controls, whereas this risk was significant only within the first 2 years after diagnosis of testicular GCT. Compared to matched controls, kidney cancer survivors experienced an increased risk of death due to nephrotic/nephritic pathologies, peripartum and gestational complications, and congenital abnormalities. Septicemia had increased risk for both groups within the first year, however for those with GCT, septicemia and other infectious pathologies within the first 2 years provide a higher risk of death than matched controls.

Conclusion:
For childhood kidney and testicular cancer survivors, there are shifting mortality patterns over time. Early post-diagnosis periods are marked by infectious and cancer death, whereas long-term survivors, particularly for those with kidney cancers, there is increased mortality due to non-cancer causes. These findings illustrate the importance of tailored survivorship strategies to address oncologic and non-oncologic aspects. Ongoing monitoring and intervention efforts should consider the evolving risks associated with different phases of survivorship.

Abbreviations: Germ Cell Tumor (GCT)
Surveillance, Epidemiology, and End Results (SEER)
Standardized Mortality Ratio (SMR)
Confidence Interval (CI)

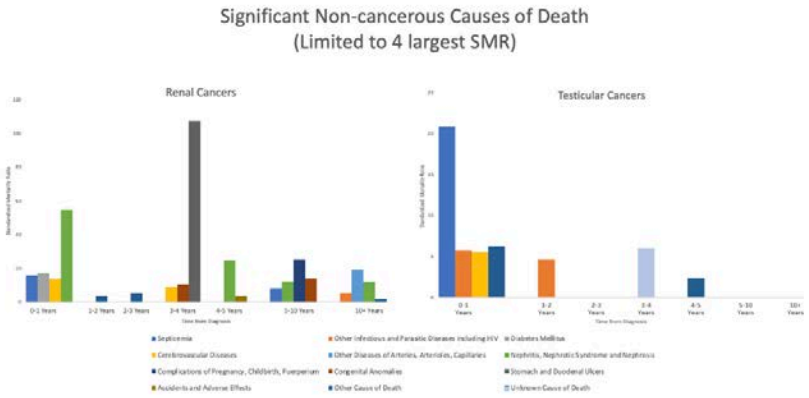

Figure 1. Summary of causes of death with a significant standardized mortality ratio for those with a history of kidney cancer and testicular cancer, according to year from diagnosis

IPSO P 6

A SINGLE INSTITUTION ANALYSIS OF SURVEILLANCE PRACTICE FOR LOW RISK NEUROBLASTIC TUMORS

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Abstract: Purpose: Currently, few prospective guidelines exist for the surveillance of children with low-risk neuroblastic tumors (LRNBT), including ganglioneuroma or ganglioneuroblastoma intermixed. This study aims to analyze our institutional approach to LRNBT surveillance following surgical resection. We hypothesize that length of surveillance can be reduced due to low recurrence risk.

Methods: We conducted a retrospective review of patients diagnosed with LRNBT at our institution between January 1, 2010, and December 31, 2020. The majority of patients were followed in our multidisciplinary surgical oncology clinic. We summarized relevant patient data including follow up imaging modalities and recurrences.

Results: 29 patients met inclusion criteria at a median age of diagnosis of 10 years (IQR: 5, 13). All 29 patients underwent surgical resection for tumors located in the posterior mediastinum (n=13), retroperitoneum (n=11), presacral space (n=3), pelvis (n=1), and combined thoracic/retroperitoneal location (n=1). Histopathological results demonstrated 15 cases of ganglioneuroma and 14 cases of ganglioneuroblastoma intermixed. The median duration of post-operative follow-up was 35 months (IQR: 20, 51) with a median of 2.4 clinic visits per year. Surveillance imaging was performed at a median frequency of 2.4 times per year (IQR: 1.5, 2.8), with chest radiographs being the most commonly modality used for thoracic locations (31% of all imaging) and ultrasound used most commonly for abdominal location (26% of all imaging). During surveillance, 1 recurrent/residual ganglioneuroma was identified on MRI at 6.7 months from presacral resection. This patient underwent repeat surgical resection and subsequent surveillance demonstrated no further recurrences.

Conclusions: Recurrence was low in this cohort of LRNBT patients. Optimal surveillance strategies for this low-risk pathology would minimize radiation exposure and burden of healthcare visits to patients. Further multi-institutional studies are warranted to determine the best imaging modality, as well as the frequency and duration of follow-up visits for LRNBT patients. Future studies should evaluate the acceptability of short-term surveillance for those who achieve complete resection.

Abbreviations: LRNBT: Low-risk Neuroblastic Tumors
IQR: Inter-Quartile Range

IPSO P 7

MANAGEMENT AND OUTCOMES OF HEPATOBLASTOMA IN PATIENTS WITH TRISOMY 18: A SYSTEMATIC REVIEW AND POOLED ANALYSIS OF 61 PATIENTS

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Abstract: Purpose: Trisomy 18 (T18) is associated with increased risk for embryonal tumors, with hepatoblastoma being the most common pediatric liver malignancy. Since children with T18 now survive longer, we aimed to systematically review the characteristics, management, and outcomes of children with T18 and hepatoblastoma.
Methods: A systematic review of the PubMed, Embase, Scopus, Web of Science, and Cochrane Library databases was performed according to the PRISMA statement (end-of-search date: 9/9/2023).
Results: Forty-six studies reporting on 61 patients were included. The median age was 12.0 months, 87.8% were female (n=43/49), and 18.2% had mosaic T18 (n=6/33). The majority had congenital heart defects (92.7%, n=51/55), most commonly ventricular septal defect (74.5%, n=38/51), patent ductus arteriosus (50.0%, n=25/50), and pulmonary hypertension (PHTN) (20.8%, n=10/48). Diagnosis was made during symptom workup in 45.2% (n=14/31), incidentally in 22.6% (n=7/31), during surveillance workup in 19.4% (n=6/31), and at autopsy in 12.9% (n=4/31). Most tumors were in the right hemiliver (75.9%; n=22/29), while 30.8% were multifocal (n=12/39). The PRETEXT stage was I in 29.6% (n=8/27), II in 29.6% (n=8/27), III in 18.5% (n=5/27), and IV in 22.2% (n=6/27). The median alpha-fetoprotein level was 22,682.5 ng/mL and the median tumor size was 6.3 cm. The histology was fetal in 71.4% (n=25/35) and metastasis was present in one patient (4.3%; n=1/23). Neoadjuvant chemotherapy was administered in 41.4% (n=24/58) and adjuvant chemotherapy in 27.8% (n=15/54), while surgical treatment was performed in 58.6% (n=34/58). Chemoembolization and microwave ablation were employed in two patients with PHTN; one required resection due to aberrant vascular anatomy and the other demonstrated complete tumor response. Of the remaining 57 patients, overall mortality was 41.5% (n=22/53) over a median follow-up of 10.5 months. Among the 26 deceased patients (including those diagnosed on autopsy), the most common causes of death were tumor progression (30.8%, n=8/26) and cardiac etiology/PHTN (30.8%, n=8/26).
Conclusions: T18 does not preclude resection with curative intent for hepatoblastoma. Combination of surgery and chemotherapy should be considered in children on an individualized basis depending on tumor characteristics and underlying cardiac/pulmonary comorbidities. Locoregional modalities may have a role in the setting of severe PHTN.

Abbreviations: PHTN = pulmonary hypertension; PRETEXT = PRE-Treatment EXTent of tumor; T18 = Trisomy 18

IPSO P 8

CENTRAL HEPATECTOMY FOR PEDIATRIC HEPATOBLASTOMA: A CASE SERIES OF THREE PATIENTS

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Abstract: INTRODUCTION
Hepatoblastoma is the most common hepatic malignancy in children. Centrally located resectable tumors involving segments four, five, and eight are traditionally managed by an extended right or left hepatectomy. These resections sacrifice healthy liver tissue and result in a smaller functional liver remnant, increasing the risk of liver failure or transplantation. Patients with tumor in the central liver segments can undergo central hepatectomies to preserve healthy hepatic parenchyma. However, there are limited reports of this technique being utilized in pediatric patients. We report a case series of three children who underwent central hepatic resection at our institution from 2019 to 2023.
METHODS
A retrospective chart review was performed on all children who underwent central hepatic resection for hepatoblastoma between January 2018 and October 2023. Descriptive statistics was used to analyze the data.
RESULTS
Three children with a median age of 281 days (interquartile range [IQR] 151.5 – 2434.5) were reviewed. No children had metastatic disease at the time of operation, and two underwent neoadjuvant chemotherapy. The median operative time was 374 minutes (IQR 332.5 – 442.5), and blood loss was 350 mL (IQR 250 – 425). One patient developed pneumonia following surgery and all others had routine postoperative courses. The median time to discharge was 6 days (IQR 5 – 7). All had a negative tumor resection margin on histology, with a median minimum resection margin of 0.1 cm (IQR 0.1– 0.2). Since surgery (1140 days [IQR 596, 1259]), none have evidence of disease recurrence or liver failure.
DISCUSSION
Although technically complex, central hepatic resection represents a safe and effective modality for the treatment of resectable hepatoblastoma in liver segments four, five, and eight. Performing central resections spares healthy liver parenchyma and maximizes the functional liver remnant while minimizing the risk of hepatic dysfunction.

Abbreviations:

IPSO P 9

PREVALENCE, CHARACTERISTICS AND MANAGEMENT OF PANCREATIC TUMORS AMONG CHILDREN WITH TUBEROUS SCLEROSIS COMPLEX

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Abstract: Purpose: To investigate the prevalence, characteristics, and management of pancreatic tumors in patients with tuberous sclerosis complex (TSC).
Methods: We performed a retrospective review of electronic medical records to identify pancreatic tumors among all consecutive TSC patients evaluated at a quaternary pediatric hospital between 2005-2022. Relevant demographic and clinical data were collected.
Results: Among 336 TSC patients, 267 had abdominal imaging available for review. Thirteen pancreatic tumors were identified among 11 patients (4.1%) at a median age of 13 (range 8-22) years. Two patients each had two tumors identified at time of diagnosis. No differences in sex, race, or ethnicity were identified among patients with pancreatic tumors compared to those without. A large pancreatic tumor (3.5 cm) with liver metastases was observed in one patient at the time of diagnosis (age 8 years) while no tumor was identified on surveillance abdominal MRI three years prior. Based on assessment of serum hormone levels and clinical symptoms, no functional tumors were identified. Among patients with pancreatic tumors, 45% had at least one elevated serum chromogranin A level. Median tumor size was 1.5 (range 0.1-4.6) cm at diagnosis and 3.2 (range 1.8-4.8) cm at time of surgery. Four patients underwent tumor resection, with three undergoing distal pancreatectomy and one undergoing enucleation of an uncinate process tumor. Pathology for all was consistent with non-functional pancreatic neuroendocrine tumor (pNET). At a mean of 5 (range 2-6) years of follow-up, no patients undergoing surveillance of known pancreatic tumors have developed metastatic disease. No patients treated with surgical resection have developed tumor relapse or new pancreatic tumors.
Conclusion: Compared to an estimated incidence of < 1/100,000 in the general population, pediatric patients with TSC are at increased risk for pancreatic tumors, specifically pNET. Although many of these tumors exhibit benign behavior with stability on imaging over time, development of malignant pNET is possible. These findings underscore the importance of screening for pancreatic tumors in patients with TSC. Additional studies are needed to determine which patients are at risk for developing malignant tumors and to formalize criteria for proceeding with surgical resection.

Abbreviations: tuberous sclerosis complex (TSC)
pancreatic neuroendocrine tumor (pNET)

IPSO P 10

BRIDGING THE GAP: COMPREHENSIVE CHILDHOOD CANCER PATIENT SUPPORT ORGANIZATIONS PROVIDE SIGNIFICANT FINANCIAL RELIEF TO FAMILIES PURSUING CANCER CARE

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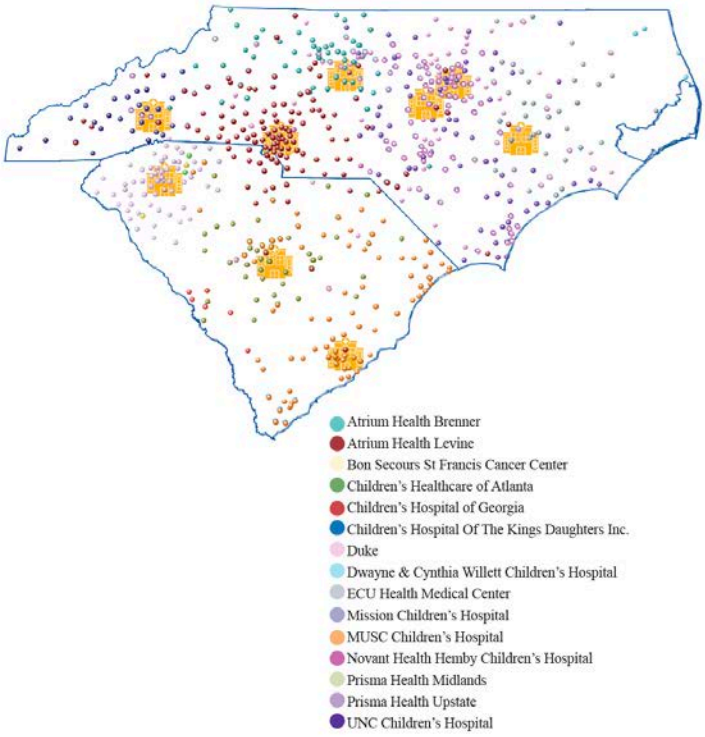
Abstract: Background: A new childhood cancer diagnosis brings significant financial strain for families, often exceeding costs covered by insurance. Financial burden of care extends beyond direct medical expenses to include travel, lodging, food, and other home-related costs often necessary to navigate complex treatment regimens. Nonprofit Comprehensive Childhood Cancer Patient Support Organizations (CCCPSOs) play a crucial role in our healthcare system by providing financial support and resources to families for costs not covered by health insurance. To better understand the financial strain these families face, we collaborated with a regional support organization to detail the financial demands necessary for families to support children through cancer care and recovery.

Methods: We conducted a cross-sectional analysis of financial support for pediatric cancer patients using CCCPSO cost data. We calculated the financial support offered to pediatric cancer patients who received support from one such CCCPSO, Children's Cancer Partners of the Carolinas. Expenditures were classified by request type. Costs per household receiving each benefit were calculated for each expense category.

Results: Over three years (2019-2022), 1378 families received funding in order to support their children through treatment at 15 different treatment centers. The average amount received was $1508 (Range $0-$14,809, IQR $299-$2009). Median age of patients was 10 (IQR 6-15). Hematologic malignancies comprised 47.6% of diagnoses, CNS tumors 9.3%, solid tumors 12.0%, sarcomas 13.1%, germ cell tumors 1.6%, and other diagnoses 11.4%. Direct medical costs accounted for 0.5% of support offered to families. As an organization, the greatest expenditures encountered in supporting families were travel mileage ($777,876.59 total, $630.80 avg household), meals ($556,510.66 total, $542.94 avg), lodging ($219,704.75 total, $947.00 avg), funeral assistance ($151,603.79 total, $1,004.00 avg), parking ($85,407.55 total, $142.58 avg), and flights ($66,533.79 total, $1,705.99 avg).

Conclusion: As families support children through cancer treatment, they encounter significant indirect financial costs. CCCPSOs play a crucial role in addressing financial barriers to completing children's cancer treatment. Clinician awareness of the financial barriers to care, as well as optimal utilization of resources such as CCCPSOs, may lead to improved, more accessible childhood cancer care.

Abbreviations: Comprehensive Childhood Cancer Patient Support Organizations (CCCPSOs)



**Note: Not mapped are children who travel out of state to Children's Hopital of Philadelphia, Cincinnati Children's Cancer and Blood Diseases Institute, MD Anderson Cancer Centernd St. Jude.

IPSO P 11

ESSENTIAL KNOWLEDGE AND SKILLS FOR THE PRACTICE OF PEDIATRIC SURGICAL ONCOLOGY: A MODIFIED DELPHI CONSENSUS STUDY BY THE APSA CANCER COMMITTEE

Elisabeth (Lisa) Tracy, MD[1], Abigail Engwall-Gill[2], Erin G. Brown, MD[3], Raphael Sun, MD[4], Catherine Beckhorn, B.A.[5], Ashley Walther, MD[6], David H. Rothstein, MD, MS[7], Dave R. Lal, MD[8], Jonathan Roach, MD[9], Nicholas Cost, MD[10], Barrie S. Rich, MD[11], Peter Ehrlich, MD[12], Jennifer H. Aldrink, MD[13], David Rodeberg, MD[14]

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Abstract: Purpose: Surgical care of children with cancer has become increasingly complex. Since most children are cared for at institutions where the exclusive practice of pediatric surgical oncology is not feasible, identifying the key elements necessary for delivering optimal care is important. The American Pediatric Surgical Association (APSA) Cancer Committee conducted a modified Delphi study to reach a national consensus on the knowledge, skills, and institutional settings essential for pediatric surgeons caring for children with cancer.

Methods: After developing initial statements, the APSA Cancer Committee conducted a modified Delphi process using an expert panel consisting of: pediatric surgical oncologists, pediatric medical oncologists, pediatric surgery fellowship program directors, pediatric surgeons in general and rural practice, and recent pediatric surgery graduates. There were 35 panelists from 24 institutions across 17 U.S. states and Canada. The initial 169 statements comprised eight domains: renal tumors, adrenal tumors, liver tumors, rhabdomyosarcoma and soft tissue sarcomas, germ cell tumors, rare tumors, pulmonary metastases, and institutional resources. Over three Delphi rounds, statements were added, modified, or removed in an iterative process until consensus was achieved. Consensus was defined a priori as a Cronbach's alpha > 0.8 and greater than 80% panel agreement.

Results: Consensus was achieved for 177 statements. Internal consistency was excellent (Cronbach's alpha: first round 0.989; second round 0.987; third round 0.987). Thirty-two statements were added and 72 statements were modified during the Delphi rounds. Twenty-four statements did not reach consensus, including a statement highlighting the importance of understanding social determinants of health. The final statements emphasized the importance of multidisciplinary care (11/177), including multidisciplinary surgical teams for complex resections (16/177), and knowledge of current tumor-specific treatment protocols (53/177).

Conclusion: This study represents the first national consensus study of the knowledge and skills essential for pediatric surgical oncology. Multidisciplinary care is thought to be essential, as is access to multi-specialty surgical teams. Given the impact of social determinants of health on patient outcomes, further investigation of its importance is warranted. These results should guide ongoing efforts and discussions on optimal matching of children with cancer to the surgeons equipped to care for them.

Abbreviations: APSA - American Pediatric Surgical Association

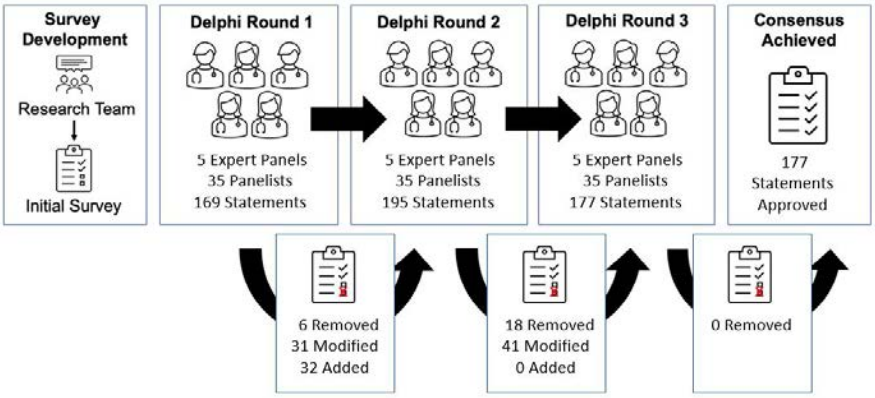


Figure: Flow Diagram of modified Delphi Consensus Process

IPSO P 12

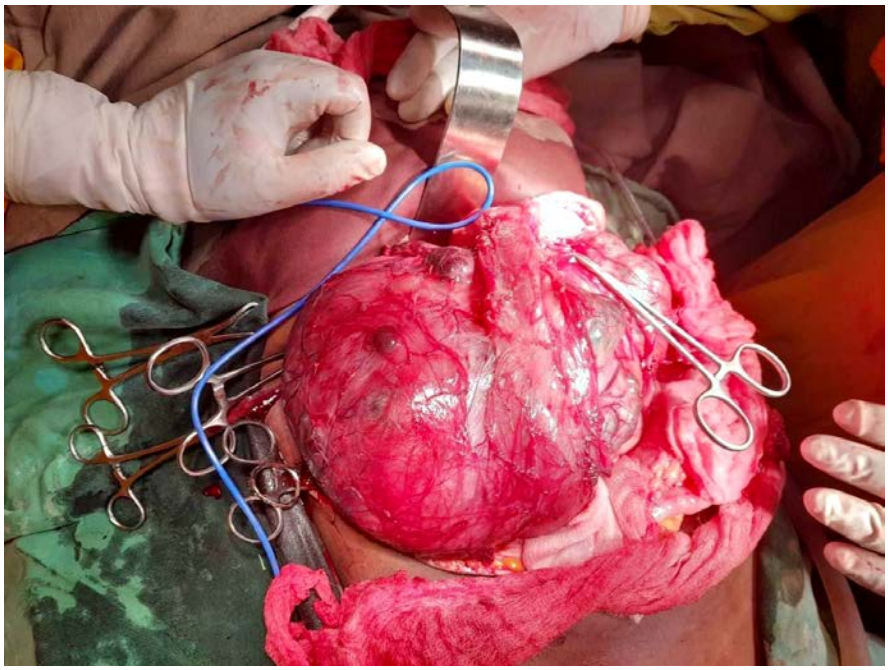
A SUCCESSFUL WHIPPLE PROCEDURE IN A PEDIATRIC PATIENT WITH SOLID PSEUDO–PAPILLARY NEOPLASM OF THE PANCREAS, THE FIRST CASE REPORT FROM AFRICA

Workye Molla, Yoseph Bedore, Dagmawi Dagne

St.Peter Specialized Hospital., Addis Ababa, Adis Abeba, Ethiopia

Abstract: Solid pseudopapillary tumor (SPT) of the pancreas is a rare primary pancreatic neoplasm , which represents only about 1% of all tumors of the pancreas.This rare tumor typically affects young women, with mean age of presentation is 22 years. Although most SPTs exhibit benign behavior, malignancy can occur in about 15% of cases, manifesting as metastases or invasion of adjacent structures.
Whipple's pancreaticoduodenectomy (WPD) is rarely required in children. However, it is the only option when pathologies like solid papillary tumor SPT) involving the head of the pancreas requiring surgical excision. We here report a 12 years old female pediatric patient with solid pseudo pancreatic tumor of the pancreas presented with progressively enlarged huge abdominal mass and dull aching abdominal pain associated with early satiety. After the CT scan image showed heterogenous mass involving the head of the pancreas, a successful whipple procedure was done, and patient had smooth postoperative followup with better outcome.

Abbreviations: SPT--solid pseudopapillary tumor
CT---computed tomography
WPD...Whipple pancreaticoduodenectomy



IPSO Oral Abstract Session I

7:45 AM – 9:15 AM

IPSO 1

TRAINING AUTOLOGOUS TUMOR SPECIFIC T-CELLS FOR EFFECTIVE IMMUNOTHERAPY OF NEUROBLASTOMA

Sarah L. Wright, MD[1], Xiaofang Wu, PhD[2], Mousumi Basu[2], Mikael Petrosyan, MD[3], Anthony Sandler, MD[3]

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Abstract: Purpose

Pediatric solid tumor continues to be a leading cause of morbidity and mortality and in many tumors like neuroblastoma, traditional treatment suffers from substantial limitations and failures. Adoptive immunotherapy, which involves transplanting expanded immune cells into the recipient, has shown promise in preclinical models. Isolating, training, modifying and/or expanding T-cells ex vivo before reintroducing them into patients is an appealing opportunity for exploiting the natural power of immunity. We describe a novel method of training autologous T-cells to become cytotoxic killers of established low immunogenicity tumors in patients with neuroblastoma.

Methods

An Institutional Review Board (IRB)-approved protocol was established to harvest tumor and peripheral blood mononuclear cells (PBMC) from patients undergoing biopsy or resection of neuroblastoma (n=10). Tumor cell lines were established and phenotyped with Phox2b and synaptophysin staining. Autologous PBMCs were co-cultured with irradiated tumor cells treated with MYC small molecule inhibitors in order to train the PBMCs against the tumor cells. Immunogenicity of treated tumor cells was evaluated with interferon gamma (IFNg) enzyme-linked immunosorbent assay (ELISA) analysis. Trained PBMCs were co-cultured with wild-type primary neuroblastoma tumor cells and cytotoxicity was evaluated with an Incucyte assay.

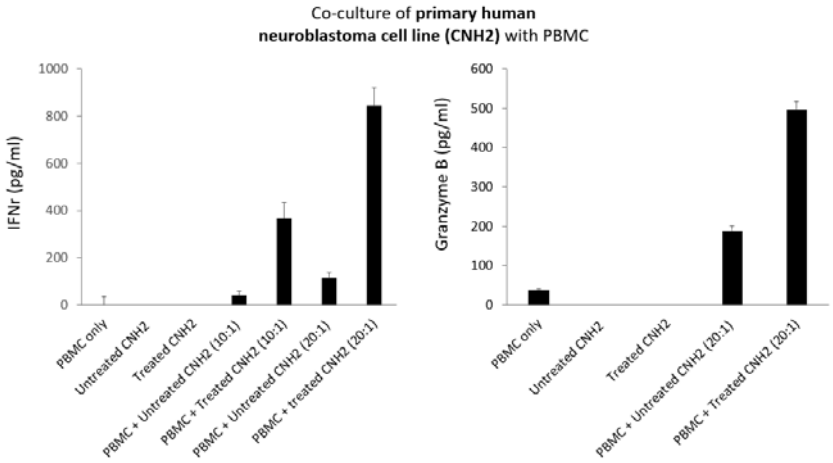
Results

Targeting MYC with small molecule inhibitors in vitro induces an immunogenic tumor cell phenotype. Immunogenicity was quantified by profound IFNg and granzyme B secretion in co-culture with PBMCs (see Figure). These immunogenic tumor cells can then be used to train and expand autologous PBMC derived cytotoxic T-cells in vitro. Over 95% of the PBMC cell product is CD8 and CD4 T cells as determined by flow cytometry. Trained PBMCs from patients showed remarkable tumor specific cytotoxicity against neuroblastoma as determined by Incucyte assay.

Conclusions

Autologous trained and expanded PBMCs in vitro resulted in an effective tumor-specific cytotoxic T-cell product. These findings provide proof-of-concept for training autologous PBMC-based cellular immunotherapy in the treatment of neuroblastoma and potentially other solid tumors.

Abbreviations: Institutional Review Board (IRB)
peripheral blood mononuclear cells (PBMC)
interferon gamma (IFNg)
enzyme-linked immunosorbent assay (ELISA)


Co-culture of primary human neuroblastoma cell line (CNH2) with PBMC
IFNr (pg/ml)
1000
800
600
400
200
0
PBMC only
Untreated CNH2
Treated CNH2
PBMC + Untreated CNH2 (10:1)
PBMC + Treated CNH2 (10:1)
PBMC + Untreated CNH2 (20:1)
PBMC + treated CNH2 (20:1)
Granzyme B (pg/ml)
600
500
400
300
200
100
0
PBMC only
Untreated CNH2
Treated CNH2
PBMC + Untreated CNH2 (20:1)
PBMC + Treated CNH2 (20:1)

IPSO 2

IDENTIFYING NOVEL GENETIC MARKERS IN PEDIATRIC RHABDOMYOSARCOMA

Sathyaprasad Burjonrappa, MD, MS, MBA, FRCS(Ed), FACS[1], **Joyce Xu**[2], Theodore Wang[3]

[1]Rutgers RWJMS Medical School, New Brunswick, NJ, USA, [2]Rutgers Robert Wood Johnson Medical School, Holmdel, NJ, USA, [3]Rutgers Robert Wood Johnson Medical School, Piscataway, NJ, USA

Abstract: Purpose:

Rhabdomyosarcoma risk stratification is traditionally determined by tumor staging and clinical group classifications. Recent studies revealed the importance of genetic markers, such as FOXO1 fusion status, in predicting prognosis. We investigated prognosis by age of onset and mutation incidence in rhabdomyosarcoma tumors using the NCI Oncogenomics database.

Methods:

We retrospectively extracted clinical and genomic data for rhabdomyosarcoma patients from the NCI Oncogenomics Clinomics dataset (n=641). Inclusion criteria was tumors with at least one gene of interest (genes with >5% mutation incidence). Exclusion criteria were undetermined risk category, < 5% mutation incidence, and unknown age of onset. Statistical analysis was performed using R with ANOVA ($p< 0.05$) and Tukey's range test to compare mutation incidence, event-free survival (EFS), and overall survival (OS) among age groups.

Results:

Among 641 patients with rhabdomyosarcoma, 8 of 39 screened genes had >5% mutation incidence: NRAS (14%), BCOR (13%), NF1 (12%), TP53 (12%), FGFR4 (10%), KRAS (7%), HRAS (7%), and CTNNB1 (5%). The final cohort consisted of 370 patients with at least one gene of interest: 51 (14%) 0-2 years, 140 (38%) 2-5 years, 112 (30%) 5-12 years, and 67 (18%) 12+ years. Later age of onset is associated with higher incidence of BCOR and HRAS mutations ($p=0.003$, $p< 0.001$) and lower EFS and OS ($p=0.023$, $p< 0.001$). In patients with BCOR mutations, later age of onset is associated with lower EFS and OS ($p< 0.005$, $p=0.009$). In patients with HRAS mutations, age of onset is not associated with EFS or OS ($p=0.317$, $p=0.231$). NF1 is equally distributed among age groups ($p=0.816$), but later age of onset is associated with lower EFS and OS ($p< 0.005$, $p< 0.001$).

Conclusion:

In rhabdomyosarcoma with at least one mutation in NRAS, BCOR, NF1, TP53, FGFR4, KRAS, HRAS, or CTNNB1, later age of onset is associated with poorer prognosis. In rhabdomyosarcoma with mutations in tumor suppressors BCOR or NF1, later age of onset is associated with poorer prognosis. These results support incorporating genetic markers into rhabdomyosarcoma risk stratification following further investigation with a larger sample size.

Abbreviations: Event-free survival (EFS); Overall survival (OS)

IPSO 3

SOCIAL DETERMINANTS OF HEALTH IMPACT NEUROBLASTOMA PROGRESSION IN-VIVO

Keyonna Williams, MD[1], Sahiti Chukkapalli, MS[2], Kimber Converso-Baran, RDCS[2], Olivia Tussing[2], Kenneth Resnicow, PhD[3], Erika A. Newman, MD[4]

[1]C.S. Mott Childrens Hospital University of Michigan, Ann Arbor, MI, Ann Arbor, MI, USA, [2]University of Michigan, Ann Arbor, MI, USA, [3]University of Michigan, School of Public Health, Ann Arbor, MI, USA, [4]C. S Mott Children's Hospital, University of Michigan, Ann Arbor, MI, USA

Abstract: Introduction

The underlying causes of disparate health outcomes remain unknown. A recent study from the Children's Oncology Group (COG) found that poverty exposure was independently associated with increased risk of relapse and death among children with neuroblastoma compared to unexposed children. Biologic pathways triggered by social factors that may contribute to disparate outcomes in pediatric cancers have not been studied. We hypothesize that social determinants i.e food insecurity and social isolation have a role in the progression of neuroblastoma, surpassing the impact of the original incidence alone.

Methods

We utilized our established orthotopic neuroblastoma model and studied the biologic impact of food insecurity and social isolation. Neuroblastoma cells (IMR32) were percutaneously implanted into the left adrenal gland of NSG mice using ultrasound. Tumor engraftment and progression were monitored by volume measurements. Experimental conditions for food insecurity and social isolation were induced. For food insecurity: (1) varying levels of food were administered (previously published methods), and 2) control groups were provided ad libitum access. For social isolation: (1) groups housed under normal caging conditions were compared to (2) individually caged groups. By monitoring tumor growth kinetics, conducting comprehensive histopathological analyses, and assessing metastatic potential, we quantitatively evaluated the influence on neuroblastoma growth and progression. Serum stress markers (corticosterone, epinephrine, norepinephrine) and VEGFA levels were measured. Xenografted tumors were harvested, and carcasses sent for full necropsy analysis.

Results

Food insecurity and social isolation experimental groups developed locally invasive tumors that were significantly larger in size and volume compared to the control groups. Additionally, serum stress markers were significantly higher in the experimental groups compared to controls. The food insecure group deviated from normal feeding behavior as early as the first session. Serum VEGFA levels, which are associated with increased tumor angiogenesis and metastasis, measured two times higher in the experimental groups.

Conclusions

Food insecurity and social isolation enhances tumor growth and progression in neuroblastoma xenografts. We propose that critical social determinants impact the severity of neuroblastoma. Future studies to determine potential underlying biologic aberrations and comprehensive treatment strategies to address social inequities are underway.

Abbreviations:

IPSO 4

A COMPARISON OF IN VIVO TUMOR-HOMING ABILITIES OF PLACENTAL-DERIVED AND BONE MARROW-DERIVED MESENCHYMAL STROMAL CELLS IN HIGH-RISK NEUROBLASTOMA

Kathleen E. Doyle, MD[1], Abd-elrahman S. Hassan, MD[2], Monica Rodriguez, BS[3], Maria Sutter, BS[4], Priyadarsini Kumar, PhD[5], Erin G. Brown, MD[5]

[1]UC Davis Medical Center, Sacramento, CA, USA, [2]UC Davis Medical Center, sacramento, CA, USA, [3]University of California Davis, [4]University of California Davis Medical Center, Sacramento, CA, USA, [5]University of California, Davis Medical Center, Sacramento, CA, USA

Abstract: Background:
Neuroblastoma is the most common extracranial malignancy in children less than 5 years old. Survival remains poor in high-risk disease. Mesenchymal stromal cells (MSCs) may represent a novel cellular delivery vehicle due to their innate tumor homing properties. We compared in vivo homing abilities of placental-derived MSCs (PMSCs) and bone marrow-derived MSCs (BM-MSCs) in a cell-derived orthotopic xenograft model of neuroblastoma.

Methods:
Using an orthotopic xenograft model, 26 mice underwent direct implantation of neuroblastoma cells (cell line NB1643) into the adrenal gland. Tumor growth was monitored with ultrasound and mice underwent intraperitoneal injection of 5x106 MSCs (PMSC n=13, BM-MSC n = 13) once tumors were 0.5-1x the size of the ipsilateral kidney. MSCs were labeled with GFP and luciferin gene and MSC migration was monitored with in vivo imaging system (IVIS) at 0, 6, 24, 48, and 72 hours post-MSC injection. 10 mice were euthanized at 72 hours (n=5 for each group), and 16 mice were survived to 7 days (n=8 for each group). Ex vivo imaging was performed on all adrenal masses and select organ tissues. Immunohistochemistry (IHC) was done to confirm presence of MSCs in tumor tissue.

Results:
In vivo imaging demonstrated diffuse signal at first that migrated to the left abdomen. MSC signal persisted at day 7 in all animals although radiance decreased over time. Ex vivo IVIS demonstrated persistent bioluminescent signal in the adrenal tumor but not within other organs. There was no significant difference in average adrenal mass ex vivo radiance between PMSC mice and BM-MSC mice (p=0.74). IHC confirmed presence of both PMSCs and BM-MSCs within the tumor after necropsy.

Conclusion:
Both PMSCs and BM-MSCs successfully migrate to neuroblastoma tumor tissues in vivo without evidence of significant migration to other organs. MSCs migrate within 72 hours and bioluminescent signals indicate that they persist within the tumor for up to 7 days. There was no significant difference between the homing capabilities of PMSCs compared to BM-MSCs, indicating that either cell type has the potential to act as a drug delivery vehicle.

Abbreviations: MSC - mesenchymal stromal cell
PMSC - placental-derived mesenchymal stromal cells
BM-MSC - bone marrow-derived mesenchymal stromal cells
GFP - green fluorescent protein
IVIS - in vivo imaging system
IHC - immunohistochemistry

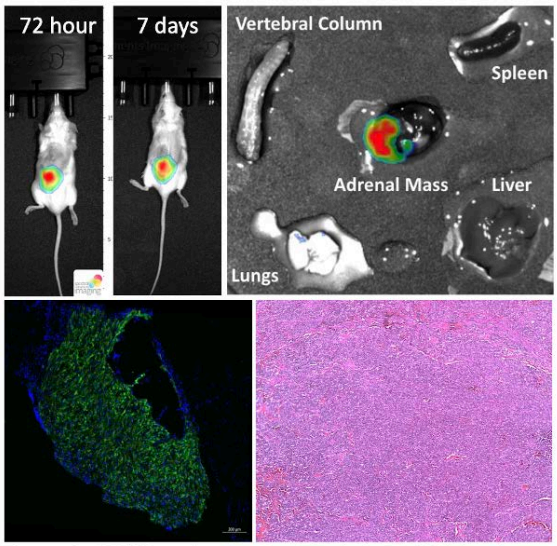


Figure 1: MSC homing results. Top left: IVIS bioluminescence signals *in vivo* at 72 hour and 7 day timepoints. Top right: IVIS ex vivo bioluminescence signals of organ tissues. Bottom left: GFP immunohistochemistry staining of adrenal mass for MSCs demonstrating signal within the tumor. Bottom right: H&E staining of adrenal mass confirming neuroblastoma.

IPSO 5

CHARACTERIZATION OF NEUROBLASTOMA CIRCULATING TUMOR CELLS REVEAL INSIGHTS INTO DISEASE PROGRESSION AND IMMUNE LANDSCAPE

Keyonna Williams, MD[1], Sahiti Chukkapalli, MS[2], Shamileh Fouladdel, BS[2], Sunitha Nagrath, PhD[2], Erika A. Newman, MD[3]

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Abstract: Objective:
Neuroblastoma (NB) is the most common extracranial solid tumor in children. Most patients succumb to high-risk disease refractory to current therapies. Circulating tumor cells (CTCs) have been associated with metastasis, relapse, and therapy resistance in cancer. The mechanisms by which CTCs contribute to disease progression has not been characterized in neuroblastoma. The aim of our study was to isolate neuroblastoma CTCs from high-risk patients and perform single cell RNA sequencing (scRNA-seq) for characterization and monitoring treatment response.

Methods:
Peripheral blood was collected from high-risk NB patients and a healthy control. Blood samples were collected preoperative to local control surgery and after four cycles of chemotherapy per standard Children's Oncology Group (COG) treatment protocols. From the acquired blood samples, CTCs were isolated using a novel labyrinth device and fixed with a 10x genomics fixation kit. The 10x genomics fixed cells were processed with scRNA-seq.

Results:
Bioinformatics analysis of scRNA-seq data identified 25 different types of cells. Clusters containing CD90+, PHOX2B+, CD45-, CD235- were considered NB CTCs. We identified five NB CTC clusters (3, 14, 16, 19 and 23) that were not present in the control sample. Investigation for NB markers revealed that PHOX2B is a more consistent CTC screening marker than TRKB, TH and GD2 in this series. Analysis of differential gene expression revealed that molecular pathways related to proliferation, DNA repair, cell cycle progression, and angiogenesis were upregulated in NB CTCs clusters. These include oncogenic markers KRAS, NRAS, EGFR and BRAF. Immune cell profling of scRNA-seq data revealed that NB patient samples have high numbers of plasmacytoid dendritic cells, progenitor cells and hemoatopoetic stem cells and also decreased CD8+ NKT-like cells and Memory CD4+ T cells which may indicate an immunosuppressive microenvironment.

Conclusion:
These results suggest that CTCs can be accurately isolated and analyzed from peripheral blood samples of NB patients. The observed immune cell alterations suggest a complex interplay between the immune system and NB, potentially influencing disease progression and response to therapy. Further research is needed to fully understand the mechanisms underlying these immune changes and to develop targeted interventions.

Abbreviations: NB=neuroblastoma
CTC=circulating tumor cells
COG=Children Oncology Group
scRNA-seq=single cell RNA sequencing

IPSO 6

THE ROLE OF YAP-1 ON HEPATOBLASTOMA VASCULAR INVASION

Andy F. Espinoza, MD[1], Roma Patel[2], Kalyani Patel[2], Dolores Lopez-Terrada[2], Sarah Woodfield, PhD[2], Sanjeev Vasudevan, MD[3]

[1]Michael E. DeBakey Department of Surgery - Baylor College of Medicine, Houston, TX, USA, [2]Texas Children's Hospital, Houston, TX, USA, [3]Texas Children's Hospital / Baylor College of Medicine, Houston, TX, USA

Abstract: Introduction: Hepatoblastoma (HB) is the most common liver cancer in children with survival rates reported to be 30% less when associated with vascular invasion (VI). One limitation of providing effective therapies for these patients is the lack of understanding of the biology of VI in HB. We sought to find biologic markers that allow HB to invade in the vasculature.
Methods: Using imaging mass cytometry (IMC) we analyzed pre-validated high-risk HB protein targets on formalin-fixed paraffin embedded (FFPE) samples. We validated these results on immunohistochemistry (IHC) on primary HB tumors, VI areas of the primary tumor, and paired metastatic lesions from patients in our center. Migration and scratch assays were performed after shRNA knockdown/upregulation of Yap-1 on HepT1 and HepG2 cells, respectively. Yap-1 upregulated HepG2 cells and parental HepG2 cells were implanted orthotopically, with 8 mice in each group, and tumor growth were monitored utilizing magnetic resonance imaging (MRI). Mice were euthanized when tumor burden was > 1.5 cm3.
Results: Protein expression of YAP-1 increases as the tumor invades vasculature on IMC as shown in Figure 1. VI areas and metastatic HB tumors demonstrated stronger YAP-1 staining compared to paired primary HB tumors. Yap-1 knocked down in HepT1 cells had 30% migrated cells compared to parental, respectively, after 48 hours (p=0.02). In scratch assays, 20% of Yap-1 knocked down HepT1 cells migrated compared to parental at 24 hours (p=0.03). The overall tumor volume, tumor weight, and overall survival between the HepG2 parental and HepG2 YAP-1 overexpressed groups were similar throughout 3 weeks. The mice that had HepG2 YAP-1 overexpressed tumors implanted were found to have metastatic lung HB lesions on histology compared no metastatic lung HB lesions in the HepG2 parental tumors.
Conclusions: YAP-1 increases the invasiveness of HB cells into the vasculature, leading to metastatic lesions. Further investigation of the pathway that leads HB cells to invade due to YAP-1 is warranted.

Abbreviations: HB, VI, FFPE, IHC, MRI

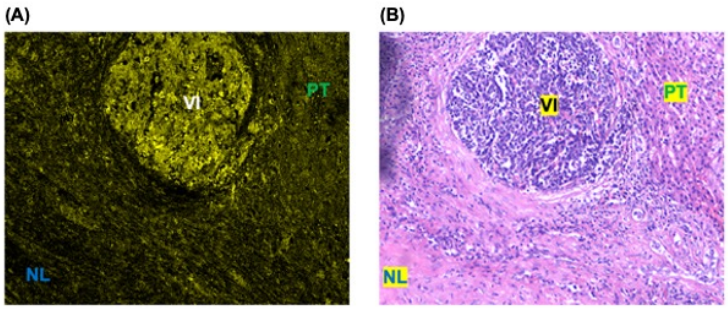

Figure 1A/B. Figure 1A (left) shows imaging mass cytometry with yellow correlating with YAP-1 protein expression. Normal liver (NL), primary tumor, (PT). and vascular invasion (VI). Figure 1B (right) shows 10x H&E of the same area.

IPSO 7

MULTIOME SEQUENCING REVEALS COMMON TRANSCRIPTIONAL CIRCUITRY AND GENE EXPRESSION PATTERNS IN HIGH-RISK NEUROBLASTOMA CELLS REGARDLESS OF MYCN STATUS

Richard A. Guyer, MD, PhD, Jessica Mueller, MD, Allan M. Goldstein, MD

Massachusetts General Hospital, Boston, MA, USA

Abstract: Purpose: Neuroblastoma occurs when normal differentiation of neural crest cells is disrupted, resulting in accumulation of proliferative neuroblasts. MYCN amplification is the most common causative mutation, and is a poor prognostic factor. However, approximately half of high-risk tumors lack MYCN amplification. How MYCN status impacts tumor biology remains incompletely understood. We hypothesize that transcriptional networks and cellular composition differ between neuroblastoma cells with and without this mutation.

Methods: 10X Genomics Single-Cell Multiome ATAC + Gene Expression kits were used to assay chromatin accessibility and gene expression in individual nuclei isolated from neuroblastoma cells. High-risk tumor cell lines used were: MYCN-amplified lines Be(2)-c, SK-N-DZ, and CHP-134, and non-MYCN-amplified lines SH-SY5Y, SK-N-AS, and SK-N-SH. The FigR software package was used to identify transcriptional networks controlling cell identity, and cellular heterogeneity was assessed based on expression of highly variable genes within the datasets. Flow cytometry and immunoflourescence were used to validate sequencing results.

Results: Gene expression in SH-SY5Y, SK-N-AS, and SK-N-SH lines revealed a normal developmental hierarchy, with immature neuronal progenitors and cells expressing mature neuronal markers. The immature cells expressed ITGA2, the gene encoding CD49b, which denotes neuronal progenitors. FigR identified TNC and MICAL2 as fate-determining genes for the immature state in non-MYCN-amplified lines. In contrast, the MYCN-amplified Be(2)-c, SK-N-DZ, and CHP-134 lines were less heterogeneous, with most cells expressing genes associated with mature neurons. ITGA2 had very low transcript abundance in MYCN-amplified cells, which was confirmed by CD49b flow cytometry. Despite expressing mature neuronal genes, the MYCN-amplified lines broadly expressed MICAL2, and some cells transcribed TNC. The transcription factor ID1 was identified as a fate-determining gene for MYCN-amplified cells. Intriguingly, ID1 transcription was also high in immature cells in the non-MYCN-amplified lines.

Conclusion: High-risk neuroblastoma cells without MYCN amplification display a developmental hierarchy, while MYCN amplified cells are proliferative despite expressing mature neuronal markers. MICAL2, TNC, and ID1 are expressed both in immature non-MYCN-amplified cells and MYCN-amplified cells, but not in mature non-MYCN-amplified cells. Aggressive neuroblastoma cells thus share common biological features regardless of MYCN status, suggesting pathways that may be useful therapeutic targets for all high-risk lesions.

Abbreviations:

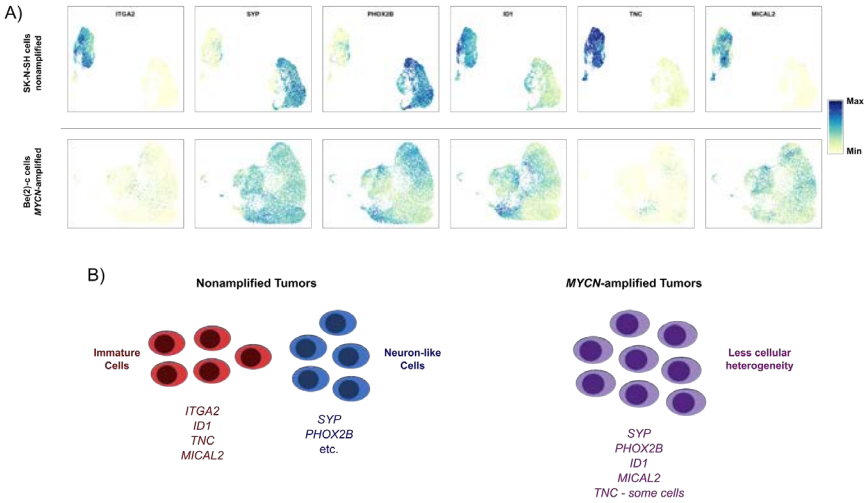

Figure Legend. A) Smoothed RNA transcript abundance for the indicated genes in the *MYCN*-amplified Be(2)-c cell line and the nonamplified SK-N-SH cell line. B) Model of cellular composition in *MYCN*-amplified and nonamplified tumors. Nonamplified tumors contain immature cells with transcriptional programs resembling neuronal progenitors, as well as cells that resemble differentiated neurons. *MYCN*-amplified tumors, in contrast, are more homogeneous, with most cells expressing mature neuronal marker genes. However, the *MYCN*-amplified cells also express genes associated with the immature, nonamplified cells, such as *MICAL2* and *ID1*.

IPSO 8

NOVEL BIOENGINEERED MICRORNA THERAPY FOR HIGH-RISK NEUROBLASTOMA

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Abstract: Introduction:
Neuroblastoma is a common pediatric cancer with poor outcomes for patients with high-risk disease. MicroRNAs (miRs) are small RNAs that control post-transcriptional gene regulation. Dysregulation of miRs is linked to tumorigenesis and treatment resistance in neuroblastoma, and restoration of miR levels has demonstrated potent anti-tumor effects in oncologic models. miR-34a-5p and miR-124-5p have been identified as downregulated miRs in neuroblastoma and are potential targets for therapeutics. We investigated the effects of bioengineered miR-34a-5p and miR-124-5p on neuroblastoma cell viability in vitro.

Methods:
High-risk neuroblastoma (NB) cell lines Be(2)-c and SH-SY5Y were seeded at 12,000 cells/well and transfected with bioengineered miR-34a-5p and miR-124-3p using lipofectamine 3000 (LP) transfection agent. Neuroblastoma cells were treated with 25nM dose of either miR-34a-5p or miR-124-3p. Wells containing NB cells alone and NB cells with LP only served as controls. Cells were monitored for up to 7 days and cell viability was measured using an MTT assay in order to assess the impact of miR treatment on neuroblastoma cell growth.

Results:
Neuroblastoma SH-SY5Y cells treated with bioengineered miR-34a-5p and miR-124-5p demonstrated reduced cell viability of 24.4% and 24.1%, respectively when compared to cells treated with LP only. Neuroblastoma Be(2)-c cells demonstrated 44.5% reduction in cell viability with miR-124 when compared to cells treated with LP alone; however, miR-34a had no effect on cell viability when compared to LP-treated controls. Transfection efficacy of miRs by SH-SY5Y cells was approximately 20%.

Conclusions:
Both bioengineered miR-34a-5p and miR-124-5p demonstrated reduced neuroblastoma cell viability in vitro, supporting the potential of miRs as a therapeutic agent for neuroblastoma treatment. However, results varied by neuroblastoma cell type and only miR-124-5p successfully reduced cell growth in both neuroblastoma cell lines. Low transfection efficiency of neuroblastoma cells may limit miR effectiveness, and methods to improve efficiency are under investigation. Given the marked heterogeneity of neuroblastoma, combination miR therapy may improve miR treatment efficacy across cell types, thereby improving the potential impact of miR therapy for this challenging disease.

Abbreviations: miR - microRNA
LP - lipofectamine 3000
MTT - 3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide

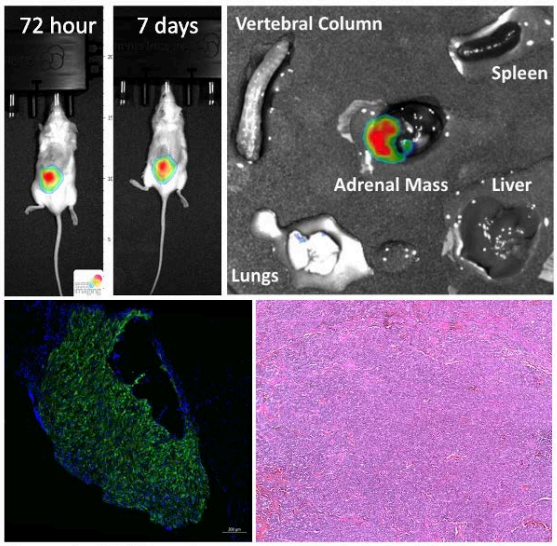

Figure 1: MSC homing results. Top left: IVIS bioluminescence signals *in vivo* at 72 hour and 7 day timepoints. Top right: IVIS ex vivo bioluminescence signals of organ tissues. Bottom left: GFP immunohistochemistry staining of adrenal mass for MSCs demonstrating signal within the tumor. Bottom right: H&E staining of adrenal mass confirming neuroblastoma.

IPSO 9

CO-LOCALIZATION OF TUMOR ASSOCIATED MACROPHAGES AND REGULATORY T CELLS CREATES IMMUNOREGULATORY NICHES IN HUMAN HEPATOBLASTOMA

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Abstract: Purpose: Hepatoblastoma (HB) is the most common liver cancer in infants and children. Its well-known association with inflammation-mediated preterm birth indicates that inflammatory signals in the developing liver may promote HB formation. We have analyzed human HB tumor specimens and have identified a distinct population of tumor associated macrophages (TAMs) that exert immunosuppressive effects in mouse and human tissues. We hypothesize that TAMs cooperate with other regulatory immune populations (e.g. regulatory T cells, Tregs) to establish an immunoregulatory environment that promotes HB formation. To support this hypothesis we questioned whether TAMs and Tregs co-localize in human tissues.

Methods: We used immunohistochemistry to identify CD68+ TAMs and CD4+FoxP3+ Tregs in six HB tumors and adjacent normal liver. Aperio Imagescope was used to annotate sections and identify clusters of TAMs and Tregs. A “cluster” was defined as ≥3 cells that were < 80 micrometers apart from a neighboring cell. We measured the number of cells within a cluster, the size of clusters based on the maximum distance between two cells, and the percentage of TAM and Treg clusters that co-localized with the other cell type. Student’s t-test was used to compare groups and chitest was used to compare percentages. Chitest and p-value < 0.05 were considered to be significant.

Results: We identified 113 distinct clusters in HB tumor specimens of which 30% (34/113) were TAMs and 70% (79/113) were Tregs (a). Of note, no TAM or Treg clusters were identified in adjacent normal liver tissue. TAM clusters were composed of more cells and were bigger in size compared to Treg clusters (b,c). We identified a total of 16 instances where TAM and Treg clusters overlapped. A significantly higher proportion of TAMs co-localized with Tregs (47.1%) compared to the proportion of Tregs clusters that co-localized with TAMs (20.2%) (d).

Conclusions: Clusters of TAMs and Tregs are found in human HB tumor tissue and are not identified in normal liver. Though co-localization of these populations is not uniform, several areas of overlap exist, supporting our hypothesis that immunoregulatory populations may establish niches to suppress immune signals and promote HB.

Abbreviations: Hepatoblastoma- HB
Regulatory T cells- Tregs
TAMs- Tumor associated macrophages

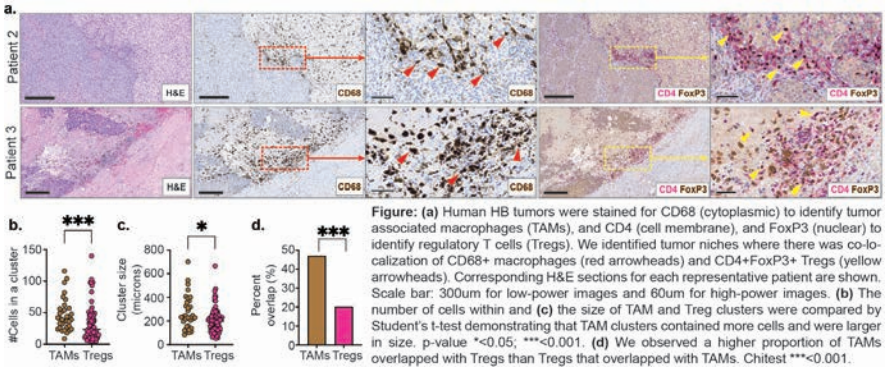

Figure: (a) Human HB tumors were stained for CD68 (cytoplasmic) to identify tumor associated macrophages (TAMs), and CD4 (cell membrane), and FoxP3 (nuclear) to identify regulatory T cells (Tregs). We identified tumor niches where there was co-localization of CD68+ macrophages (red arrowheads) and CD4+FoxP3+ Tregs (yellow arrowheads). Corresponding H&E sections for each representative patient are shown. Scale bar: 300um for low-power images and 60um for high-power images. **(b)** The number of cells within and **(c)** the size of TAM and Treg clusters were compared by Student’s t-test demonstrating that TAM clusters contained more cells and were larger in size. p-value *<0.05; ***<0.001. **(d)** We observed a higher proportion of TAMs overlapped with Tregs than Tregs that overlapped with TAMs. Chitest ***<0.001.

IPSO Lunch/Quick Shots

11:30 AM – 12:45 PM

IPSO QS 1

IMPROVING THE PATIENT AND FAMILY EXPERIENCE IN PEDIATRIC SURGICAL ONCOLOGY - A SURVEY FROM THE PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE (PSORC) FAMILY ADVOCACY COMMITTEE

Barrie S. Rich, MD[1], Janet Panoch, PhD[2], Kimberly Riehle, MD[3], Reto M. Baertschiger, MD, PhD[4], Kelly Trout, BSN, RN[5], Richard D. Glick, MD[1], Dave R. Lal, MD[6], Hau D. Le, MD[7], Roshni Dasgupta, MD, MPH[8], Peter Ehrlich, MD[9]

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Abstract: Purpose

The diagnosis of childhood cancer is profoundly distressing for families, and the need for complex operations may intensify these feelings. However, our understanding of how families navigate the surgical experience in pediatric surgical oncology is limited. To address this knowledge gap, we sought to learn about the lived experience of families making perioperative decisions for their children with cancer. With this insight, we aim to develop meaningful tools to improve patient-centered outcomes.

Methods

A survey developed by the PSORC Family Advocacy Committee was sent to moderators of 48 pediatric cancer family support groups for distribution through social media platforms. Quantitative data were analyzed using descriptive statistics. Qualitative data were analyzed using thematic analysis using axial coding.

Results

There were 165 respondents: 87.9% parents, 6.7% patients, and 5.4% other family members. The median age of treated patients was 8 years (Interquartile Range 2-13). Over 80% were white and 70% had private insurance. Primary diagnoses among the patients were Ewing sarcoma (27.3%), osteosarcoma (25.4%), and hepatoblastoma (16.5%).

Major themes identified included the importance of a clear presentation of surgical options and improved communication. When preparing for surgery, the factors considered as most important in guiding decision-making included: discussions with the surgeon (92.9%), understanding surgical options (61.6%), and timely access to the surgeon (60.0%). Additionally, 86% reported that having trust in the surgeon was critical. A mutual understanding of the objectives of both surgeon and family was deemed essential by 65.6%, and 80% believed they were actively involved in surgical decision-making.

Key family concerns included understanding surgical options, knowing what questions to ask, and obtaining second opinions. Over one-third stated that their surgeon did not discuss multiple surgical options. 30% of families sought a second opinion, 25% felt unsupported in this decision.

Qualitative analysis identified the need for improved communication by surgeons (Table 1).

Conclusion

Our survey identified key factors that enhance families' experience, such as active participation in surgical decision-making and optimizing communication. The development of communication aids and decision support tools may address concerns and improve the patient and family experience in pediatric surgical oncology.

Abbreviations: PSORC: Pediatric Surgical Oncology Research Collaborative

IPSO QS 2

CISPLATIN RESISTANT HIGH-RISK NEUROBLASTOMA TREATED WITH ZIKA VIRAL THERAPY CONFERS A SURVIVAL ADVANTAGE

Joseph Mazar, PhD[1], Emma Sutton, BS[2], Rosa Rosario[2], Jeanne K. Brooks, MS[3], Matt Peloquin, MS[4], Matt Longo, BS[3], Tamarah J. Westmoreland, MD, PhD[5]

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Abstract: Introduction: Neuroblastoma is the most common childhood extracranial tumor and accounts for 15% of all childhood cancer deaths. Although platinum-based chemotherapy agents are often used to treat neuroblastoma, ~15% of patients with high-risk neuroblastoma experience progression through induction therapy, and 40% suffer tumor growth at its completion, resulting in poor overall survival. We recently demonstrated that Zika Virus (ZIKV) is cytotoxic to neuroblastoma tumors using in vivo models. Here we propose to determine the impact of cisplatin resistance on the therapeutic effect of ZIKV. Validation of a survival advantage could offer a prospective new bridge therapy for chemotherapy resistant neuroblastoma patients.

Methods: This study focused on the use of both the MYCN-amplified pre-treatment cell line SMS-KAN and the non-MYCN amplified post-treatment cell line SK-N-AS in which cisplatin-resistance was selected. Both the wild type (WT) and cisplatin resistant (CisR) derivatives of each cell line were injected subcutaneously into athymic nude mice and allowed to engraft, followed by injection of ZIKV directly into the tumor mass (alongside vehicle controls). Both Fold Change and tumor size were measured for tumor surveys and survival studies.

Results: Shortly following the introduction of ZIKV, a significant decrease in tumor mass was identified in both WT & CisR tumor models, with SMS-KAN models losing nearly all tumor mass within of 7 days, and SK-N-AS losing >90 of its mass in 10 days. None of the treated tumors revealed any recurrence of tumor mass, and no new tumors developed within 4 weeks post-treatment. For both studies, a >90% survival advantage was determined after a sole application of ZIKV regardless of cisplatin resistance, even after >10 weeks post-treatment.

Conclusion: The effectiveness of ZIKV therapy on cisplatin-resistant in vivo human neuroblastoma tumors was revealed to be fast and comprehensive. Tumor mass diminishes quickly, leaving no evidence of recurrence, dramatically improving the survival of the hosts. These advantages were confirmed in both a MYCN-amplified and non-amplified model, regardless of chemotherapy resistance, suggesting that ZIKV could act as a novel bridge therapy to improve the survival of patients with high-risk neuroblastoma who fail induction chemotherapy.

Abbreviations: ZIKV
WT
CisR

IPSO QS 3

CHARACTERIZING RENAL SARCOMAS IN CHILDREN IN A LARGE NORTH AMERICAN COHORT – A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

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Abstract: Purpose: Pediatric renal sarcomas are rare, histologically diverse, and clinically variable, limiting potential clinical trial design to optimize outcomes. Molecular analysis has recently emerged as a valuable diagnostic tool to classify specific sarcoma types and reveal actionable mutations that guide therapies. We aim to investigate molecular characteristics and oncologic outcomes of renal sarcomas in a national multicenter cohort.
Methods: A multicenter, retrospective cohort study of patients < 21 years diagnosed with renal sarcoma between 2000-2022 was performed at 32 Pediatric Surgical Oncology Research Collaborative

institutions. The primary objectives were to characterize the clinical presentation and tumor characteristics, including molecular analysis, treatment, and survival. Descriptive statistics were calculated for each sarcoma type.
Results: Among 159 children with renal sarcoma, clear cell sarcoma of the kidney (CCSK; n=94) and Ewing sarcoma (n=33) were the most prevalent histologies (Table). Most patients (n=130; 81.8%) underwent upfront resection, while 17 (10.7%) received neoadjuvant chemotherapy followed by delayed resection. R0 resection was achieved in 108 (67.9%) patients. R0 resection was least successful in rhabdomyosarcoma (28.6%), infantile fibrosarcoma (33.3%), and synovial sarcoma (50%). Definitive resections were rarely completed laparoscopically (n=3; 1.9%) or with partial nephrectomy (n=2; 1.3%). Molecular analysis was performed on 82 (52.2%) of the tumors. Median [Q1-Q3] follow-up for the cohort was 5.22 [2.33 - 9.87] years. At the end of the follow-up period, 80.3% (118/147) had no evidence of disease and survival was 87.1% (128/147). Survival was significantly different based on histology (p=0.021); rhabdomyosarcoma, desmoplastic small round cell tumor, and infantile fibrosarcoma had poorest survival. Children with early-stage (Stage I-II) disease had significantly improved survival over those with later-stage (Stage III-IV) disease (p=0.0011). The most common molecular alterations were EWS-FLI1 fusion (Ewing sarcoma) (n=26), internal tandem duplications in the last exon of BCOR (CCSK) (n=9), and BCOR-CCNB3 translocations (CCSK) (n=4).
Conclusion: Pediatric renal sarcomas are a heterogenous group of mesenchymal tumors with differing presentations, genetic alterations, and survival. Complete resection with negative microscopic margins was achieved in two-thirds of children, and survival varied by sarcoma type and stage. Utilizing molecular analysis may reveal targeted therapies to optimize survival in future patients.

Abbreviations: -BCOR-CCNB3 = Fusion protein of the BCOR and CCNB3 genes
-CCSK = Clear cell sarcoma of the kidney
-DICER-1 = DICER1 genetic syndrome
-EWS-FLI1 = Fusion protein of the EWS and FLI1 genes due to the t(11;22)(q24;q12) translocation
-NOS = Not otherwise specified
-PECOMA - Perivascular epithelioid cell tumor
-Q1 = Quartile 1
-Q3 = Quartile 3
-R0 = Microscopically margin-negative resection, with no residual gross or microscopic tumor in the primary tumor bed
-R1 = All macroscopic disease is resected, but microscopic margins remain positive for tumor

Definitions of R0 and R1 adapted from: Biondi A, Persiani R, Cananzi F, et al. R0 resection in the treatment of gastric cancer: room for improvement. World J Gastroenterol. 2010;16(27):3358-3370. doi:10.3748/wjg.v16.i27.3358

IPSO QS 4

EARLY REMOVAL OF INDWELLING URINARY CATHETERS IN CHILDREN UNDERGOING ABDOMINAL TUMOR RESECTION WITH EPIDURAL ANALGESIA

Shachi Srivatsa, MD[1], Jennifer H. Aldrink, MD[2], Dana Michelle Schwartz, MD[3], Grant J. Heydinger, M.D.[4], Andrew M. Davidoff, MD[5], Andrew J. Murphy[5], Kyle Rove[6], Sara Mansfield, MD[7]

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Abstract: Purpose: Epidural analgesia (EA) is commonly employed for postoperative pain management in children undergoing abdominal tumor resection. Indwelling urinary catheters (IUCs) often remain for the duration of EA administration due to concerns about urinary retention. This study aims to assess whether early removal of IUCs following abdominal tumor resections in pediatric patients with appropriate EA coverage can be performed with minimal risk of reinsertion due to urinary retention, thereby contributing to enhanced recovery efforts.

Methods: A retrospective review of children who underwent abdominal tumor resections with EA between 2015 and 2023 at two institutions was conducted. Data were summarized, and rates of post-operative urinary retention requiring catheter reinsertion and catheter-associated urinary tract infections (CAUTIs) were compared between patients with early and delayed IUC removal using Fisher's exact testing. Early was defined as IUC removal with EA in place and delayed as IUC removal after or concurrent with EA discontinuation.

Results: A total of 229 children underwent abdominal tumor resections with EA. Of these, 104 had early and 125 had late IUC removal. The average postoperative day (POD) of IUC removal in the early group was 1.1±0.5 days and 2.9±1.1 days in the late group. EA was at T10 level or higher in 94 patients (90.4%) in the early group, and 50 (40.3%) in the late group ($p< 0.001$). EA contained opioid in 28 (26.9%) in the early group, and 54 (44.3%) in the late group ($p=0.005$). There were 6 (5.8%) children in the early group and 1 (0.8%) in the late group requiring re-catheterization ($p = 0.048$). For those requiring re-catheterization, the EA level was T7-8 in 5 patients, T10-11 in 1 patient, and T4 in 1 patient (late). There was 1 (1.0%) patient with a CAUTI in the early group, and 3 (2.4%) patients in the late group ($p = 0.63$).

Conclusions: Early removal of indwelling urinary catheters in the setting of thoracic epidural analgesia is associated with a small risk of urinary retention necessitating catheter re-insertion. Balancing need for IUCs with this possibility, patient comfort, and infectious risk should inform decision-making to best align with enhanced recovery efforts.

Abbreviations: EA: Epidural analgesia
IUC: Indwelling urinary catheters
CAUTI: Catheter-associated urinary tract infection
POD: Post-operative day

IPSO QS 5

CHARACTERIZING CONGENITAL MESOBLASTIC NEPHROMA IN CHILDREN – A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

Harold J. Leraas, MD, MSPHS, MHS, MA[1], Catie Beckhorn, BS[2], Jonathan Roach, MD[3], Julia Debertin[4], David W. Hoyt, BS[5], Timothy B. Lautz, MD[6], Sara Mansfield, MD[7], Lindsay J. Talbot, MD[8], Nelson Piche[9], Barrett Cromeens, DO, PhD[10], Shannon L. Castle, MD[11], Eugene S. Kim, MD[12], Joseph Murphy, MD[13], Erika A. Newman, MD[14], Peter Mattei, MD[15], Dave R. Lal, MD[16], Bhargava Mullapudi, MD[17], Joshua Short, MD, PhD[18], Robin T. Petroze, MD, MPH[19], David H. Rothstein, MD, MS[20], Barrie S. Rich, MD[21], Brian Arrinza Coakley, MD, FACS, FAAP, Dipl ABOM[22], Danielle Cameron, MD, MPH[23], Mary T. Austin, MD, MPH[24], Christa Grant, MD, MPH[25], Elizabeth A. Fialkowski, MD, MA[26], Tamer M. Ahmed, MD[27], Erin G. Brown, MD[28], Hau D. Le, MD[29], Roshni Dasgupta, MD, MPH[30], Joseph Brungardt, MD[31], John Lundstedt, BS[32], Chloe Boehmer, BS, BA[31], Marcus M. Malek[33], Hannah Rinehardt, MD[34], Bo Lovvorn, III, Doctor of Medicine[35], Hernan Correa, MD[36], Katlyn G. McKay, MD[36], Nelly-Ange T. Kontchou, MD, MBA[36], Elisabeth (Lisa) Tracy, MD[1]

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Abstract: Background: Congenital mesoblastic nephroma (CMN) is a rare renal tumor of infants, and roughly 15% are discovered prenatally. Although most children with classic CMN experience excellent survival, those with the cellular variant, or infantile fibrosarcoma, suffer inferior outcomes. We aimed to describe the presentation, treatment, and outcomes of the histologic subtypes of this rare infantile tumor. Methods: A multicenter retrospective study of patients < 21 years with renal tumors diagnosed between 2000-2022 was performed at 32 Pediatric Surgical Oncology Research Collaborative institutions. Renal tumors other than CMN were excluded. Data were analyzed using descriptive statistics.

Results: From a cohort of 2228 children with renal tumors, 91 (4%) CMNs were identified: 32 cellular, 31 classic, 1 mixed, and 17 other variants (Not specified as classic, celllar, or mixed). Males accounted for 56% of the cohort; 81.3% of patients were Caucasian. Median follow up time for CMN was 48.5 months (IQR 17.7-93.9). Twenty (22.0%) CMN were discovered prenatally, 54 (59.3%) presented postnatally with symptoms, and 13 (14.3%) were diagnosed incidentally on imaging. Molecular alterations were identified commonly in those with cellular variant (15/32, 46.9%) but rarely in other CMN types including classic and mixed types (n=2, 3.3%). Most tumors were completely resected at diagnosis postnatally (88/91, 96.7%). Two patients with cellular CMN received neoadjuvant chemotherapy followed by delayed nephrectomy. While sixteen patients demonstrated aberrant fusion at NTRK3, only one child received targeted therapy with an NTRK inhibitor. Relapse occurred in 4 patients with cellular CMN (6.6%) and two other type CMNs. Half of patients with recurrence demonstrated a molecular rearrangement. In the non-relapsed group, 19% showed rearrangement at NTRK3. Overall, 1- and 5- year survival was excellent at 98.8% and 97.6%, respectively. Both children who died had cellular-type CMN.
Conclusion: CMN is a rare renal tumor with excellent prognosis for most children having the classic type. Although survival is excellent, patients with cellular variant CMN and those with molecular rearrangements have increased rates of relapse and death. Identification of children who would benefit most from adjuvant chemotherapy and targeted immunotherapy should be an area of future study.

Abbreviations: CMN: Congenital Mesoblastic Nephroma

IPSO QS 6

BLOOD TRANSFUSION DURING SURGICAL RESECTION OF HEPATOBLASTOMA IS INDEPENDENTLY ASSOCIATED WITH POORER OVERALL SURVIVAL- A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE (PSORC) STUDY

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Abstract: Purpose: Intraoperative blood transfusion (IBT) is associated with inferior oncologic outcomes in adults with solid tumors. Children with hepatoblastoma (HB) frequently undergo IBT, but the impact on oncologic outcomes is unknown with scant data to guide transfusion in this population. This study tests the hypothesis that IBT is associated with worse survival in children with HB.
Methods: A multi-center retrospective study of patients < 18 years of age with HB who underwent primary tumor resection, including liver transplantation, from 2010-2019 was performed at 19 PSORC institutions. Propensity score weighting using logistic regression adjusted for non-random assignment of IBT and confounding of survival. Multiple imputation estimated missing covariates. The association of IBT with disease-free (DFS) and overall survival (OS) was determined by Kaplan Meier and weighted, multivariable Cox proportional hazards regression analyses. P<.05 was significant.
Results: Of 338 patients, 176 (52%) were PRETEXT III-IV, 67 (20%) had pulmonary metastases at diagnosis, 260 (77%) received neoadjuvant therapy. 257 (76%) received IBT, including 253 patients (98%) who received packed red blood cells (pRBC), 84 (33%) who received plasma, and 28 (11%) who received platelets. Factors associated with the likelihood of receiving IBT included: higher PRETEXT,

presence of annotation factors (+VPEFR), and complex resections (all p<.05). Patients who received IBT had lower median (IQR) preoperative hemoglobin(g/dL) (10 (9-11) vs. 11 (10-12), p<.001), lower intraoperative hemoglobin (8 (7-9) vs. 9 (8-10), p< 0.001), higher maximal intraoperative INR (1.6 (1.3-2.5) vs. 1.4 (1.2-1.7), p=.030), lower minimum intraoperative platelet count (per microliter) (163 (81-250) vs. 232 (180-258), p=.033), and higher postoperative hemoglobin (10 (8-11) vs. 9 (8-10), p=.013). Based on a median follow-up of 4.4 (2.0-8.3) years, IBT was associated with decreased OS and similar DFS. This persisted after accounting for age, PRETEXT, +VPEFR, extent of resection, and metastatic disease (OS: HR=0.46, 95% CI:0.21-0.99; DFS: HR=1.18, 95% CI:0.65-2.13).
Conclusion: IBT was associated with poorer OS after accounting for non-random assignment and disease severity. Intra- and postoperative lab values suggest avoidable transfusions. Development of optimal transfusion strategies for children with HB is needed and may mitigate inferior outcomes in transfused patients.

Abbreviations: PSORC = Pediatric Surgical Oncology Research Collaborative
IBT = Intraoperative blood transfusion
OS = Overall survival
DFS = Disease-free survival
pRBC = Packed red blood cells

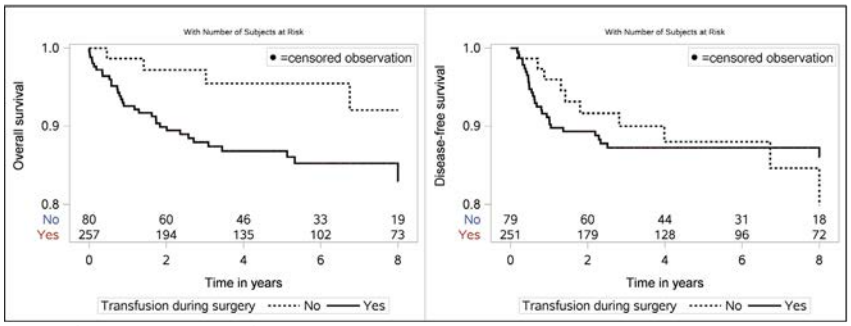

Figure. Overall and disease-free survival in children with hepatoblastoma who received intraoperative blood transfusion vs. those who did not.

IPSO QS 7

TEXTBOOK OUTCOME: A NOVEL QUALITY MEASURE FOR SURGICAL MANAGEMENT OF NEUROBLASTOMA WITH IMAGE-DEFINED RISK FACTORS

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Abstract: Background: The concept of "Textbook Outcome" (TO) presents a unique composite quality measure that encompasses specific postoperative endpoints, capturing the optimal and expected surgical outcome for complex procedures. TO has gained traction and has been adapted to evaluate various adult surgical specialties, all with the overarching goal of facilitating standardized reporting of surgical outcomes. This study endeavors to evaluate the attainment of TO for neuroblastoma resections involving image-defined risk factors (IDRFs).
Methods : The experience of children with neuroblastoma with one or more IDRF's who underwent resection at our institution between 2012 and 2022 was reviewed. A TO was defined as the absence of surgical complications, 30-day hospital readmission, a length of stay (LOS) surpassing the 75th percentile, mortality, while achieving a resection rate exceeding 90%.
Results: Among the 248 neuroblastoma resections performed during this 10-year time period, 69 (27.8%) cases had at least one IDRF, with 32 of them (46.4%) successfully achieving a TO. The presence of certain IDRFs demonstrated a negative impact on the likelihood of achieving a TO, including tumor infiltration of the duodenopancreatic block ($p < 0.001$), porta hepatis infiltration ($p=0.001$), vena cava encasement ($p=0.01$), and the existence of more than three IDRFs ($p=0.007$). Additionally, patients with high-risk neuroblastoma exhibited a heightened risk of not achieving a TO ($p=0.002$). Of the variables that prevented achieving TO, post-operative complications (30) stood out as the most prevalent factor (81.1%), with 7 out of 30 (23%), classified as Clavien-Dindo 3 and 2 patients with a grade 4 complication (6.7%), followed by readmissions (32.4%). Median LOS was 7.00 days (with a range from 4.00 to 73 days), and no intraoperative mortality occurred.
Conclusions : The attainment of TO for neuroblastoma resection at our institution in the presence of IDRFs was less than 50%. Moreover, it highlights specific areas warranting improvement, including the surgical management of those IDRFs associated with worse TO. TO may offer healthcare providers and patients' families new perspectives on the quality of care provided by pediatric cancer centers. As an objective measure of quality, assessing the TO for neuroblastoma could be implemented and examined across various institutions.

Abbreviations: TO: Textbook outcome
IDRFs: Image-defined risk factors
LOS: Length of stay

IPSO QS 8

PERIOPERATIVE ANTIBIOTIC USE IN PEDIATRIC SOLID TUMOR RESECTION

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Abstract: Purpose: There is no consensus on the perioperative use of antibiotics in pediatric solid tumor resection. This study aims to pool data from two pediatric tertiary centers that utilize perioperative antibiotics to varying degrees in pediatric solid tumor patients to investigate the occurrence of postoperative sepsis and infectious complications.

Methods: A two-institution, retrospective cohort study was performed. Charts of children who underwent solid tumor resection between June 2018 and July 2021 were retrospectively reviewed. Patient characteristics, oncological diagnosis, operative data, perioperative antibiotic use, and postoperative infection/sepsis outcomes within 30 days of surgery were analyzed. The primary outcome was defined as wound infection or systemic sepsis (clinical criteria + positive blood culture) within 30 days of surgery. Chi-square tests were performed to evaluate differences.

Results: 250 patients underwent tumor resection between July 2018 and June 2021 (male = 122, female = 128) at both centers. The median age was 4 years [Range: 0.02 – 28.1]. Seventy-five percent (N = 188) received perioperative antibiotics prophylaxis (AP), while 25% of patients did not receive AP (N = 62). Only one patient in the AP group (0.5%) developed postoperative systemic sepsis, while 12 patients (19.4%) in the non-AP group developed sepsis ($p < 0.0001$). There were 2 superficial surgical site infections in the AP group and none in the non-AP group ($p=1.0$). There were no deep surgical site infections or abscesses in either group. However, there were significant site-wise differences as one center used standardized perioperative antibiotic prophylaxis (AP) protocol antibiotics and the other only administered antibiotics in individual cases at the surgeon's discretion.

Conclusions: The administration of AP in children undergoing solid tumor resection is associated with a reduced rate of postoperative sepsis, but no difference in surgical site infections. This could possibly be related to bacterial translocation during surgery and seeding of indwelling central venous access catheters. Our results support standardized use of AP in children undergoing resection of solid tumors.

Abbreviations: Antibiotics Prophylaxis (AP)

IPSO Oral Abstract Session II

2:30 PM – 4:00 PM

IPSO 10

ASSESSING THE DIAGNOSTIC ACCURACY OF TI-RADS IN PEDIATRIC THYROID NODULES: A MULTI-INSTITUTIONAL REVIEW

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Abstract: Purpose: Thyroid nodules are uncommon in children and adolescents but carry an increased risk of malignancy when present. The Thyroid Imaging Reporting and Data System (TI-RADS) is an adult-validated ultrasound-based risk assessment providing a prediction of malignant potential for thyroid nodules, thereby guiding recommendations for fine needle aspiration biopsy (FNAB). Minimal data exist regarding the applicability of TI-RADS to predict malignancy in pediatric thyroid nodules. This study aims to analyze the performance of TI-RADS for children and adolescents with thyroid nodules, hypothesizing that applying TI-RADS criteria would improve accuracy and reduce the number of recommended FNAB compared to American Thyroid Association (ATA) size criteria alone.

Methods: A multi-institutional retrospective analysis was conducted including patients < 21 years with a thyroid nodule by sonographic thyroid imaging between 2015-2020. TI-RADS scores were assigned at each institution by a pediatric radiologist trained in thyroid imaging and TI-RADS criteria. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of TI-RADS scoring was compared to existing ATA size-based recommendation for performing a FNAB. Accounting for relative size differences between adults and children, a novel PED TI-RADS category was developed and tested, recommending FNAB for thyroid nodules with a TI-RADS 3 and >1.5cm, TI-RADS 4 and >1.0cm, and TI-RADS 5 any feasible size.

Results: 292 nodules from 261 patients (median age 15.0 years, 78.8% female) were assessed using TI-RADS. Applying adult TI-RADS criteria resulted in recommendation of FNAB for 34.9% of nodules, in contrast to 76.7% recommended by ATA guidelines (p<.0001) (Table). Utilizing the adult TI-RADS score ≥ 3 as an FNAB indicator resulted in 100% sensitivity and 28.5% specificity, with 0 cases of missed malignant nodules on pathology. When novel PED TI-RADS criteria were applied, 88 patients would have been spared an unnecessary FNAB with improved sensitivity and accuracy over ATA criteria.

Conclusions: The application of adult and PED TI-RADS scoring to thyroid nodules in pediatric patients

enhances the accuracy of malignancy prediction compared to current American Thyroid Association size criteria alone. The utilization of PED TI-RADS scoring eliminated unnecessary biopsies in many children while not missing a single thyroid malignancy.

Abbreviations: TI-RADS: The Thyroid Imaging Reporting and Data System
FNAB: Fine needle aspiration biopsy
ATA: American Thyroid Association
PPV: Positive predictive value
NPV: Negative predictive value

IPSO 11

INTRAOPERATIVE MOLECULAR IMAGING OF NEUROBLASTOMA WITH DINUTUXIMAB-DTPA[IN-111]-IR800

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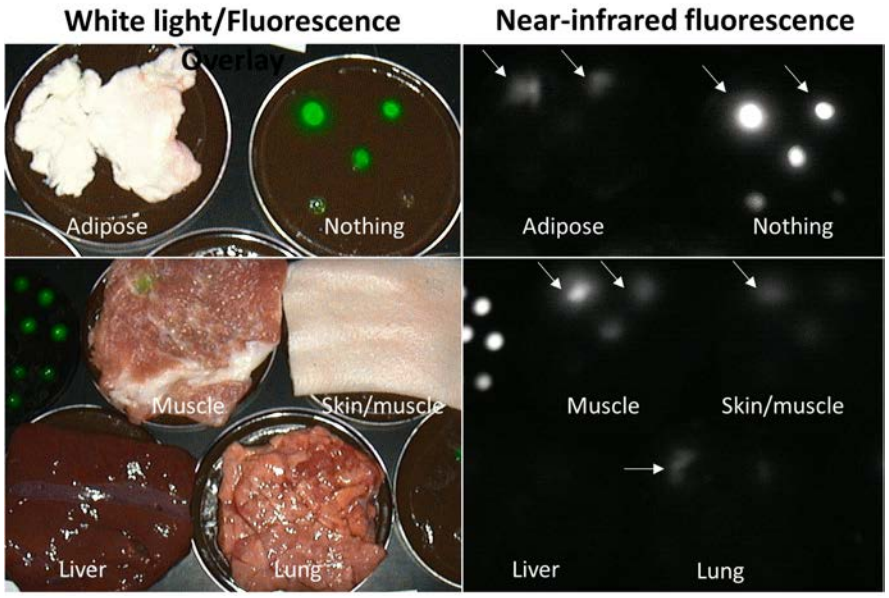
Abstract: Purpose: Surgical resection is critical for treatment of neuroblastoma, the most common extracranial solid malignancy in children, but performing a safe and complete resection presents a significant challenge. Intraoperative molecular imaging with a novel dual-labeled GD2-targeted probe, dinutuximab-DTPA[In-111]-IR800, which can be easily detected and visualized using widely-available systems could assist surgeons in identifying frequently present remote lymph node deposits, and in demonstrating distinct borders between tumor and normal vital structures.

Methods: SK-N-BE(2) human neuroblastoma cells were injected into the left adrenal gland of nude mice or rats and grown for 5.5 weeks to generate orthotopic tumors. DTPA and the near-infrared dye, IRDye800CW-NHS, were conjugated to the anti-GD2 antibody dinutuximab, purified, radiolabeled with In-111 to generate dinutuximab-DTPA[In-111]-IR800 (tracer), and then administered via tail vein at microdose equivalents. A handheld gamma detector (Neoprobe) and near-infrared camera (SPY-PHI) were used to assist in surgical resection of the tumors. Resected neuroblastoma xenografts or tumor-like-inclusions (TLI; dilutions of IR800 or In-111 in gelatin) were then placed within porcine tissues (adipose, lung, liver, and muscle) or gelatin phantoms that included hemoglobin and intralipid (which are known to affect fluorescent signal detection) at various depths (4mm to 5cm) to assess factors that affect tracer detection.

Results: Dinutuximab-DTPA[In-111]-IR800 accumulated in the xenograft neuroblastomas and with the Neoprobe and SPY-PHI aided in surgical resection. While all tumors and TLI were fluorescent, none could be detected through more than 4mm of porcine tissue or gelatin. Gamma decay, which was greater than background in all tumors and TLI, could be detected through as much as 5cm of porcine tissue and gelatin. The gamma detection was very specific, such that angling the probe away from tumors led to a decrease in signal.

Conclusion: We conclude that intraoperative molecular imaging with a novel dual-labeled dinutuximab-based probe, dinutuximab-DTPA[In-111]-IR800, may prove valuable in the surgical resection of neuroblastoma. Near-infrared fluorescence of the IR800 moiety enables excellent visualization of tumor margins but cannot be seen through more than 4mm of tissues, while gamma-decay detection of In-111 enables localization of tumor deposits through up to 5cm of tissue.

Abbreviations: In-111: Indium-111
TLI: Tumor-like inclusion


White light/Fluorescence Overlay
Near-infrared fluorescence
Adipose
Nothing
Adipose
Nothing
Muscle
Skin/muscle
Muscle
Skin/muscle
Liver
Lung
Liver
Lung

IPSO 12

AN ASSESSMENT OF NARRATIVE OPERATIVE REPORTS FOR WILMS TUMOR RESECTION USING CONSENSUS COMPONENT CRITERIA

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Abstract: Purpose: Precision in surgical documentation is essential to avoid miscommunication and errors in patient care. Synoptic operative reports have been found to be more precise than narrative operative reports, however they have not been widely implemented in pediatric surgical oncology. To assess the need for implementation of synoptic operative reports in pediatric surgical oncology, we examined the completeness of narrative operative reports in patients undergoing resection of Wilms tumor at a single institution.

Methods: We conducted a single-center retrospective review of all pediatric patients who underwent surgical resection of Wilms tumor at a large tertiary pediatric oncology referral center. The study inclusion period was January 2022 through July 2023. A review of narrative operative reports was conducted. Data collected included the presence or absence of 12 key components of a previously published standardized pediatric oncology operative report. Inclusion rates were calculated as simple percentages for each component. Unilateral and bilateral operations were considered separately and together. This study was exempt from IRB approval.

Results: Thirty-five (35) Wilms tumor resections were performed during the study period. Narrative operative reports were available for all included patients. The most consistently documented operative report components were estimated blood loss, indication for surgery, intraoperative complications, and specimen naming (all with 100% documentation rates). Documentation of lymph node sampling was present in 94.3% of narrative operative reports. The least consistently reported documentation components for unilateral and bilateral operations were assessment of intraoperative tumor spillage, completeness of resection, metastatic disease, assessment of vascular involvement, and resection of additional organ(s) (each with ≤ 40% documentation rates). All 12 key components were documented in only one operative report. Two operative reports documented only five of the 12 components.

Conclusion: Even at a large tertiary pediatric oncology referral center, narrative operative reports for pediatric Wilms tumor resection were found to be frequently missing several essential components of good surgical documentation. Utilization of synoptic operative reports may be able to fill this important gap.

Abbreviations:

IPSO 13

PERFORMANCE OF A NOVEL PEDIATRIC EXTRACRANIAL SOLID TUMOR FERTILITY LOSS RISK ASSESSMENT TOOL ON IDENTIFICATION OF CHILDREN AT HIGH-RISK FOR TREATMENT-RELATED FERTILITY LOSS

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Abstract: Purpose: Treatment for pediatric extracranial solid tumors (pECSTs) can be highly gonadotoxic putting patients at high-risk for treatment-related fertility loss. These children are candidates for fertility preservation. The current process for risk identification is cumbersome and relies on provider awareness of risk leaving room for error, bias, and missed opportunities. The complex care of pECSTs further compounds these challenges. Currently, no standardized tool for infertility risk assessment exists. We developed a novel pECST fertility loss risk tool to simplify and standardize risk stratification. We tested performance of our tool against the expected and observed fertility loss risk of study patients.
Methods: A single-institution retrospective cohort of pECSTs treated from 2017-2022 was utilized. Tool input included pECST diagnosis, COG study details, pubertal status, sex, and radiation location. Tool output included high, moderate, or low risk of infertility. Current infertility risk assessment metrics were used to assign risk at the time of diagnosis (expected) and after therapy completion (observed). Tool performance was assessed for identification of children at high-risk of future fertility loss. Pearson's correlation was calculated to determine agreement between the current risk metrics and our tool. Positive and negative predictive values were estimated for metastatic diagnosis, relapse, and protocol change.
Results: The tool was assessed utilizing 240 pECST diagnoses of which 95 (39.6%) and 120 (50.0%) were at high-risk for fertility loss at diagnosis (expected) and after therapy completion (observed), respectively. For expected risk, the tool sensitivity and specificity were 99.0 % [95% CI:96.9-100.0%] and 100% [95% CI: 100.0-100.0]. For observed risk, the tool sensitivity and specificity were 97.0% [95% CI: 93.4-100.0%] and 81.2% [95% CI: 74.9-87.6%]. Reduced performance of the tool was seen when compared to the observed risk of children with metastatic and relapsed disease, and children who underwent a protocol change during their treatment. (Table 1)
Conclusion: We conclude that the pECST fertility loss risk tool correctly risk stratifies patients at time of diagnosis but has reduced performance in accurately assessing risk at completion of therapy. Re-engagement of the tool may be necessary to re-examine risk when treatment plans change. Future work includes prospective tool validation.

Abbreviations: pECSTs = pediatric extracranial solid tumors

IPSO 14

ENHANCED RECOVERY AFTER SURGERY FOR PEDIATRIC ABDOMINAL TUMOR RESECTIONS SHORTENS HOSPITALIZATION AND DECREASES OPIOID USE: A PROSPECTIVE MULTI-INSTITUTIONAL STUDY

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Abstract: Background: Enhanced recovery after surgery (ERAS) protocols are multi-disciplinary approaches to standardize perioperative care. Limiting opioid use is a key component and is associated with improved outcomes. This is the first prospective, multi-institutional study to evaluate ERAS in pediatric patients undergoing resection of abdominal tumors. Here we report the initial results of the Pediatric Oncology Recovery after Tumor Surgery (PORTS) study.

Methods: After IRB approval, all patients >1 month old undergoing resection of abdominal tumors at one of three children's hospitals between 2020–2022 were offered enrollment. ERAS counseling was performed, and informed consent obtained. A standardized ERAS protocol (Table) was utilized at all institutions. We compared the prospective cohort to a propensity-matched historical cohort (2014–2020) from each institution utilizing 16 variables. Demographic and oncology details, length of stay (LOS), intra- and post-operative opioid use (milligram morphine equivalents), and data pertinent to remaining protocol elements were recorded. Categorical variables were compared using McNemar's and Stuart-Maxwell testing as appropriate. Continuous data was compared using logistic regression.

Results: A total of 96 patients in the prospective cohort, and 96 in the historic cohort were enrolled. There were no differences in age, sex, race, or preoperative chemotherapy between groups. The types of surgery (i.e., organ/type of tumor resected) were the same between groups. ERAS patients had a shorter median LOS (4.0 days, IQR 3.0-6.0) compared to historic controls (5.0 days, 4.0–7.0, p=0.041). Intraoperative opioid use decreased in ERAS cohort (0.15 mg/kg, 0.00–0.22) compared to historic (0.61, 0.36–0.92, p< 0.001). Use of regional anesthesia was similar between groups (82.3% ERAS vs 72.9% historic, p=1.00). Postoperative opioids decreased from 0.23 mg/kg/day (IQR 0.12–0.52) to 0.08 mg/kg/day (IQR 0.03–0.16) with the introduction of ERAS (p=0.034). ERAS patients experienced more median opioid-free days 25% vs 0% (p< 0.001).

Conclusion: ERAS protocols are feasible in pediatric patients undergoing abdominal tumor resections. Use of an ERAS protocol significantly reduced opioid consumption and LOS. Our multicenter collaborative is collecting patient-reported outcome measures, complications, fluid management, and other important oncology metrics that we plan to analyze and present in the future.

Abbreviations: Enhanced Recovery after Surgery (ERAS)
Length of Stay (LOS)
Post-operative day (POD)

IPSO 15

POSTOPERATIVE FEVER IN PEDIATRIC ONCOLOGY PATIENTS UNDERGOING SOLID TUMOR RESECTION

John Lundstedt, BS[1], Emily Vore, MD[2], Meera Kotagal, MD, MPH[2], Joseph Brungardt, MD[2], Todd M. Jenkins, PhD, MPH[2], Roshni Dasgupta, MD, MPH[3]

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Abstract: Background: Postoperative fever is a common occurrence in patients undergoing surgery for cancer. Patients commonly undergo an extensive and costly fever workup. However, there is scarce literature examining postoperative fever in pediatric surgical oncology patients.

Purposes: Determine the incidence and risk factors for developing postoperative fever in patients undergoing surgery for cancer and determine the utility of tests ordered for this population.

Methods: A single institution retrospective chart review was performed to determine demographics, diagnosis, treatment, and outcome variables of patients undergoing a resection between June 2018 and June 2023. Patients with a fever (temperature ≥ 38.0 °C) within the first 3 postoperative days were identified. Variables identified included administration of antibiotics, preoperative chemotherapy, presence of central lines, operation type, bowel resection, length of surgery, wound class, intraoperative hypothermia (< 35 °C), transfusion, hyperglycemia (>180 mg/dL), and neutrophil count. Workup for fever included urinalysis, urine culture, blood cultures, chest x-ray, respiratory viral panel, and sputum. A generalized linear mixed model was used to evaluate statistical predictors of fever.

Results: Two hundred and twenty-two patients met the inclusion criteria. There were 95 males and 127 females, aged 0.01 to 40.35 years (mean 8.73, SD = 8.32). Ninety-four patients (42%) had a fever within 72 hours following surgery. Thirty-four of the febrile patients (36%) were put on empiric antibiotics. Sixty-nine of the febrile patients (73.4%) underwent workup for their fever, with an average cost of $455. Only three patients had positive findings from a fever workup. Factors predictive of developing early postoperative fever included male sex ($p = 0.032$), intraoperative transfusion ($p = 0.032$), postoperative transfusion ($p = 0.032$), foley catheter ($p = < 0.001$), neutropenia ($p = 0.001$), and sarcoma histology ($p = 0.006$).

Conclusions: Postoperative fever is common in pediatric cancer patients undergoing surgery. Infectious etiology is rare, workup is costly, and patients are often treated empirically. Fever alone should not warrant a workup within 72 hours following solid tumor resection. Testing for febrile postoperative oncology patients should be reserved for patients with significant symptomatology or risk factors.

Abbreviations:

IPSO 16

EVALUATION OF IMAGE-DEFINED RISK FACTOR ASSESSMENT IN PATIENTS WITH INTERMEDIATE-RISK NEUROBLASTOMA: A REPORT FROM THE CHILDREN'S ONCOLOGY GROUP STUDY ANBL0531

Erin G. Brown, MD[1], Elijah S. Adkins, MD[2], Peter Mattei, MD[3], Fredric A. Hoffer, MD[4], Wendy B. London, PhD[5], Arlene Naranjo, Ph.D.[6], Mary Schmidt, MD[7], Michael D. Hogarty, MD[8], Meredith Irwin[9], Susan Cohn, MD[10], Julie Park, MD[11], John M. Maris, MD[12], Rochelle Bagatell, MD[3], Clare Twist, MD[13], Jed Nuchtern, MD[14], Andrew M. Davidoff, MD[11], Erika A. Newman, MD[15], Dave R. Lal, MD[16]

[1]University of California, Davis Medical Center, Sacramento, CA, USA, [2]Prisma Health, Columbia, SC, USA, [3]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [4]University of Washington, Bainbridge Island, WA, USA, [5]Dana-Farber Cancer Institute and Boston Children's Hospital, Boston, MA, USA, [6]University of Florida Children's Oncology Group Statistics & Data Center, Gainesville, FL, USA, [7]University of Illinois Cancer Center, Chicago, IL, USA, [8]The Children's Hospital of Philadelphia/University of Pennsylvania SOM, Philadelphiia, PA, USA, [9]The Hospital for Sick Children, [10]University of Chicago, Chicago, IL, USA, [11]St. Jude Children's Research Hospital, Memphis, TN, USA, [12]CHOP, Philadelphia, PA, USA, [13]Roswell Park Comprehensive Cancer CEnter, Buffalo, NY, USA, [14]Texas Children's Hospital, Houston, TX, USA, [15]C. S Mott Children's Hospital, University of Michigan, Ann Arbor, MI, USA, [16]Children's Wisconsin, Milwaukee, WI, USA

Abstract: Background: The International Neuroblastoma Risk Group (INRG) classifier utilizes a staging system based on pretreatment imaging criteria in which image-defined risk factors (IDRFs) are used to evaluate the extent of locoregional disease and assess the risk of primary tumor resection. Accurate assessment of IDRFs is essential for the revised Children's Oncology Group (COG) risk classification system and treatment assignment. The COG study ANBL0531 prospectively examined institutional determination of the presence or absence of IDRFs and compared that to the results of a standardized central review.

Methods: Between September 2009 and June 2011, 211 newly diagnosed intermediate risk neuroblastoma patients were enrolled on ANBL0531 and had assessment of IDRF performed at their treating institutions. IDRF status and INRG staging were not used prospectively for treatment assignment. After study closure, paired COG pediatric surgeons and radiologists performed blinded central review of diagnostic imaging for the presence or absence of IDRFs. A second blinded review was performed in cases of discordance. Comparison of local and central review was performed using the Kappa coefficient to determine concordance in the assessment of IDRF.

Results: Imaging from 211 patients enrolled in ANBL0531 underwent IDRF assessment; 3 patients were excluded due to poor image quality. Central reviewer pairs agreed on the presence or absence of any IDRF in 170/208 (81.7%; κ=0.48) cases. Only 13 (6.3%) cases could not be adjudicated after a second blinded review. Radiologists were more likely to identify IRDFs as present than the surgeons ($p< 0.001$). Local institution and central reviewers agreed on the presence or absence of any IDRF in only 108/208 (51.9%) cases; concordance was poor (κ=0.06).

Conclusions: Among experienced pediatric surgeons and pediatric radiologists participating in ANBL0531 central review, concordance was only moderate, with agreement regarding the presence or absence of any IDRF in 81.7% of cases. When central review was compared to local institution assessment of IDRFs, concordance was poor. These data indicate that greater standardization, education, technology, and training are needed to improve the assessment of IDRFs in children with neuroblastoma.

Abbreviations: INRG (International Neuroblastoma Risk Group)
COG (Children's Oncology Group)
IDRFs (image-defined risk factors)

IPSO 17

OUTCOME AND RISK FACTORS FOR PATIENTS WITH PERINEAL AND PERIANAL RHABDOMYOSARCOMA- A REPORT FROM THE CHILDREN'S ONCOLOGY GROUP SOFT TISSUE SARCOMA COMMITTEE

Roshni Dasgupta, MD, MPH[1], Wei Xue[2], Andrea Hayes[3], Suzanne L. Wolden, MD[4], Torunn Yock[5], Sheri Spunt[6], Rajkumar Venkatramani[7], **David Rodeberg, MD**[8]

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Abstract: Purpose: To describe clinical features, risk factors, and outcomes of patients with perineal and perianal rhabdomyosarcoma
Methods: The records of 51 patients (38 perineal and 13 perianal) enrolled on Children's Oncology Group clinical trials between 1997 and 2012 were reviewed.
Results: Tumor features in the 51 patients included 47% male, 65% >10 years old) included 76% alveolar histology, 76% >5cm, 84% invasive, 65% regional node positive by imaging, and 49% metastatic. Sixteen percent underwent initial grossly complete resection and 25% had a delayed excision. At a median follow-up of 6.1 years, estimated 5-year event free survival (EFS) was 38% [95%CI:22.17%,53.38%], and overall survival (OS) was 42% [95% CI:26.66%,58.21%]. The rates of local, regional and distant failure were 16%, 14%, 43% respectively; no patients survived disease recurrence. By univariate analysis only age > 10 years was associated with a worse 5-year EFS (p=0.023) and OS (p=0.09); IRS Group also impacted OS (p=0.0413). In a Cox proportional hazards model neither of these variables were significant after adjusting for other factors.
Conclusion: Patients with perineal and perianal rhabdomyosarcoma have a poor overall prognosis, probably related to patient and disease characteristics at presentation such as age and metastatic disease.

Abbreviations: Event free survival EFS
Overall survival OS

IPSO 19

THE IMPACT OF SURGICAL MARGIN IN WIDE LOCAL EXCISION OF PEDIATRIC MELANOMA – AN ARGUMENT FOR A MORE CONSERVATIVE APPROACH

Anthony V. Basta[1], Connor D. Fritz, MS[1], Neha Malik, MD[1], Lily Koscielniak, PA-C, Lauren Mayon, MS, PA-C[2], Cynthia Herzog, MD[1], Mary T. Austin, MD, MPH[3]

[1]MD Anderson Cancer Center, Houston, TX, USA, [2]UT MD Anderson Cancer Center, Houston, TX, USA, [3]McGovern Medical School at the University of Texas Health Science Center at Houston, Houston, TX, USA

Abstract: Purpose: Pediatric melanoma is the most common skin cancer in children. To date, care and treatment for pediatric melanomas has largely been extrapolated from adult guidelines. Achieving surgical margins recommended by the NCCN guidelines for wide local excision (WLE) in melanoma is often challenging especially in small children and/or body regions with less domain. We hypothesize that more conservative surgical margins in WLE of melanoma will not alter postoperative outcomes in children with melanoma.

Methods: After IRB approval (protocol DR08-0413), we performed retrospective review of 59 patients ages 2-21 who were diagnosed with melanoma between 2007 and 2023 and underwent WLE at our institution. Data were collected in REDCap and included sociodemographics, tumor characteristics, surgical procedure(s) and outcomes. Multivariate logistic regression was performed to determine the association between covariates and surgical margin and between surgical margin and outcomes.

Results: The median age at diagnosis was 13 years (range 2-21 years). 54% were male and 86% were non-Hispanic White. Most melanomas were nodular (44.1%) or superficial spreading (30.5%). 27% of melanoma primaries were located on the head/neck, 29% were on the trunk, 44% were on an extremity. Most had a surgical margin < 2 cm (61%). Controlling for patient age, head/neck melanomas were less likely to have margins ≥ 2 cm (OR=0.121, 95% CI 0.022—0.648) and margins that met the NCCN guidelines based on Breslow thickness (OR=0.017, 95% CI 0.002—0.163) when compared to trunk and extremity primaries. 17% of patients experienced postoperative complications following WLE. After controlling for patient age, primary site, and Breslow thickness, there was no difference in the rate of postoperative complications or need for intervention for complication between patients with surgical margin < 2 cm compared to those with >= 2 cm. No patients experienced local recurrence with a median follow-up of 4.33 years (range 0.08 to 15.75 years).

Conclusion: Children undergoing WLE of the head/neck melanoma were more likely to have narrow margins and less likely to meet NCCN criteria. There were no local recurrences; however, complications were common. Our results suggest that more narrow margins may achieve excellent outcomes for children with melanoma.

Abbreviations: WLE: wide local excision
NCCN: national comprehensive cancer network
IRB: institutional review board

IPSO 20

RACIAL AND ETHNIC SURVIVAL DISPARITIES IN PEDIATRIC ONCOLOGY OVER TIME: AN ANALYSIS OF THE SEER REGISTRY

Nicole J. Kus, MD[1], Shalini Sahoo, PhD, MS[1], Theodore Laetsch, MD[2], Gregory Tiao, MD[3], Minerva Mayorga-Carlin, MPH[4], Yelena Yesha, PhD, M. Sc, B. Sc[5], John Sorkin, MD[1], Brajesh Lal, MD[1], Brian Englum, MD, MHS[6]

[1]University of Maryland Medical Center, Baltimore, MD, USA, [2]Children's Hospital of Philadelphia, Philadelphia, PA, USA, [3]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA, [4]University of Maryland Medical Center, Blatimore, MD, USA, [5]University of Maryland, Baltimore, MD, USA, [6]University of Maryland School of Medicine, Baltimore, MD, USA

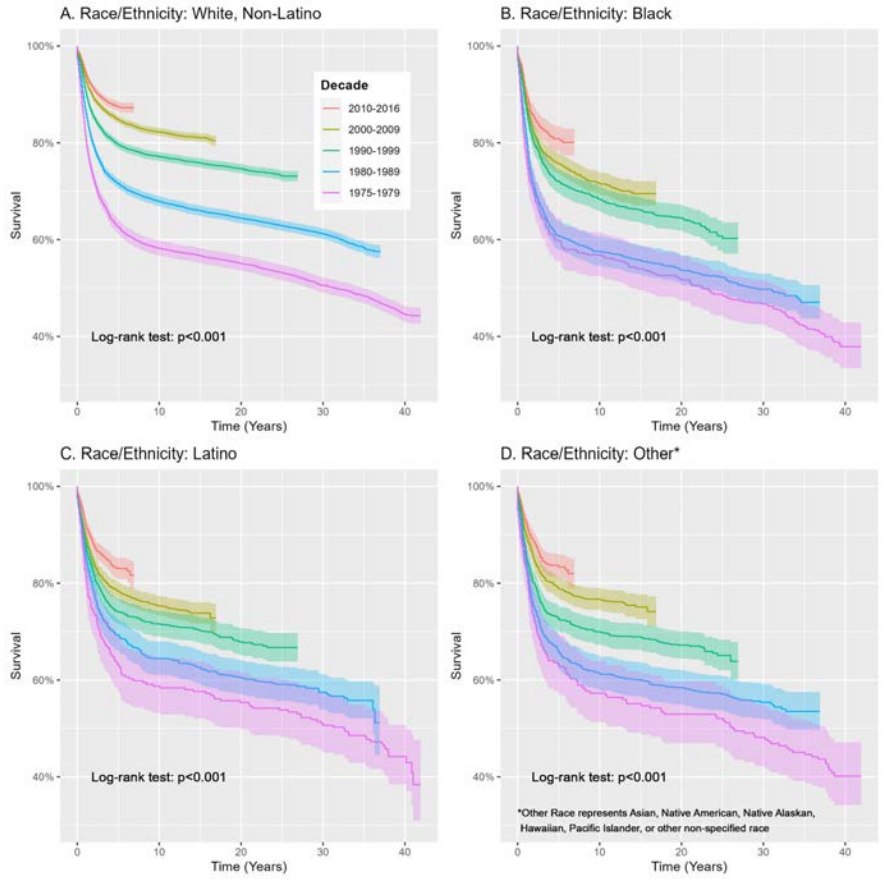
Abstract: Purpose:
Prior studies have demonstrated racial and ethnic disparities in pediatric care and outcomes. The purpose of this study was to examine how racial and ethnic outcome disparities among pediatric oncology patients have changed over time, examining survival by race and ethnicity within the Surveillance, Epidemiology, and End Results (SEER) registry.

Methods:
Using SEER, a population-based registry tracking cancer incidence and survival in the US, pediatric patients < 20 years old were included from 1975 – 2016 (n=50,222). Demographic characteristics, cancer diagnosis, and survival data were extracted for each patient. Patients were divided by race and ethnicity into 4 groups: 1) White/non-Latino, 2) Black, 3) Latino, and 4) Other Race (including:Asian, Native American, Native Alaskan, Hawaiian, Pacific Islander, or other non-specified races). Unadjusted Kaplan-Meier curves describing survival by decade were created for each group. Cox proportional hazards models, controlling for age, sex, and cancer diagnosis (60 diagnoses based on the International Classification of Childhood Cancer), were used to evaluate the association of race, ethnicity, and decade with mortality. An interaction between race/ethnicity and decade was evaluated to better understand how disparities in mortality were changing over time.

Results:
Unadjusted mortality among all cancers improved significantly by decade, with 5-year mortality decreasing from the 1970s to the 2010s (log rank test: $p< 0.001$) for all race and ethnicity groups (Figure 1). However, improvements in mortality were not equal across groups with 5-year overall survival (OS) improving from 62.7% in the 1970s to 87.5% in the 2010s for White patients but only improving from 59.9% to 80.8% for Black patients. In adjusted analysis accounting for cancer diagnosis, the interaction between Race/Ethnicity and decade demonstrated that the Hazard Ratio (HR) for mortality worsened by 10% each decade for Black [HR (95% Confidence Interval): 1.1 (1.05-1.15) and Latino [1.11 (1.07-1.17)] patients compared to White, non-Latino patients.

Conclusion:
These data demonstrate the dramatic improvement in survival for all pediatric oncology patients since 1975; however, survival in Black and Latino patients is consistently lower than in their White, non-Latino peers. More disturbing, this data suggests that survival disparities between these racial and ethnic groups are worsening over time.

Abbreviations: Overall survival (OS)
Hazard Ratio (HR)
Surveillance, Epidemiology, and End Results (SEER)


A. Race/Ethnicity: White, Non-Latino
B. Race/Ethnicity: Black
C. Race/Ethnicity: Latino
D. Race/Ethnicity: Other*
Decade
2010-2016
2000-2009
1990-1999
1980-1989
1975-1979
Survival
Time (Years)
Log-rank test: p<0.001
*Other Race represents Asian, Native American, Native Alaskan, Hawaiian, Pacific Islander, or other non-specified race

Thursday, May 16, 2024

Plenary Session I
8:00 AM – 9:15 AM

APSA 1

ENHANCED RECOVERY AFTER SURGERY FOR PEDIATRIC ABDOMINAL TUMOR RESECTIONS SHORTENS HOSPITALIZATION AND DECREASES OPIOID USE: A PROSPECTIVE MULTI-INSTITUTIONAL STUDY

Sara Mansfield, MD[1], Meera Kotagal, MD, MPH[2], Stephen J. Hartman, MD[2], Andrew J. Murphy[3], Andrew M. Davidoff, MD[3], Brady Hogan[4], Marc Mecoli, MD[2], Nicholas Cost, MD[5], Kyle Rove[6]

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Abstract: Background: Enhanced recovery after surgery (ERAS) protocols are multi-disciplinary approaches to standardize perioperative care. Limiting opioid use is a key component and is associated with improved outcomes. This is the first prospective, multi-institutional study to evaluate ERAS in pediatric patients undergoing resection of abdominal tumors. Here we report the initial results of the Pediatric Oncology Recovery after Tumor Surgery (PORTS) study.

Methods: After IRB approval, all patients >1 month old undergoing resection of abdominal tumors at one of three children's hospitals between 2020–2022 were offered enrollment. ERAS counseling was performed, and informed consent obtained. A standardized ERAS protocol (Table) was utilized at all institutions. We compared the prospective cohort to a propensity-matched historical cohort (2014–2020) from each institution utilizing 16 variables. Demographic and oncology details, length of stay (LOS), intra- and post-operative opioid use (milligram morphine equivalents), and data pertinent to remaining protocol elements were recorded. Categorical variables were compared using McNemar's and Stuart-Maxwell testing as appropriate. Continuous data was compared using logistic regression.

Results: A total of 96 patients in the prospective cohort, and 96 in the historic cohort were enrolled. There were no differences in age, sex, race, or preoperative chemotherapy between groups. The types of surgery (i.e., organ/type of tumor resected) were the same between groups. ERAS patients had a shorter median LOS (4.0 days, IQR 3.0-6.0) compared to historic controls (5.0 days, 4.0–7.0, p=0.041). Intraoperative opioid use decreased in ERAS cohort (0.15 mg/kg, 0.00–0.22) compared to historic (0.61, 0.36–0.92, p< 0.001). Use of regional anesthesia was similar between groups (82.3% ERAS vs 72.9% historic, p=1.00). Postoperative opioids decreased from 0.23 mg/kg/day (IQR 0.12–0.52) to 0.08 mg/kg/day (IQR 0.03–0.16) with the introduction of ERAS (p=0.034). ERAS patients experienced more median opioid-free days 25% vs 0% (p < 0.001).

Conclusion: ERAS protocols are feasible in pediatric patients undergoing abdominal tumor resections. Use of an ERAS protocol significantly reduced opioid consumption and LOS. Our multicenter collaborative is collecting patient-reported outcome measures, complications, fluid management, and other important oncology metrics that we plan to analyze and present in the future.

Abbreviations: Enhanced Recovery after Surgery (ERAS)
Length of Stay (LOS)
Post-operative day (POD)

APSA 2

A DECADE IN REVIEW: CHARACTERISTICS AND OUTCOMES OF FETOSCOPIC ENDOLUMINAL TRACHEAL OCCLUSION FOR CONGENITAL DIAPHRAGMATIC HERNIA AT A LARGE FETAL CENTER

Sarah E. Peiffer, MD, MPH[1], Y. Deniz Sevilmis, BSA[2], Oluyinka O. Olutoye, MD, MPH[1], Michael Gyimah, MD[1], Timothy Lee[3], Sundeep G. Keswani, MD[4], Alice King, MD[3]

[1]Baylor College of Medicine, Houston, TX, USA, [2]Texas Children's Hospital & Baylor College of Medicine, Houston, TX, USA, [3]Texas Children's Hospital, Houston, TX, USA, [4]Baylor College of Medicine and Texas Children's Hospital , Bellaire, TX, USA

Abstract: Purpose: Congenital diaphragmatic hernia (CDH) is highly morbid, however, fetoscopic endoluminal tracheal occlusion (FETO) has demonstrated a survival benefit with decreased pulmonary hypertension amongst high-risk CDH patients. We seek to describe the characteristics and outcomes of patients who underwent FETO over the past 10 years.

Methods: Single-center retrospective cohort review of all CDH patients who underwent FETO at a large fetal center from 2012-2022 (n=42). Demographics, clinical characteristics and perinatal outcomes were collected and descriptive analysis was performed.

Results: Our cohort was predominantly male (59%), 49% Caucasian, and 43% were out-of-state referrals. The median distance travelled was 267 miles (IQR 34-1067). The median gestational age (GA) at diagnosis was 23 weeks (IQR 20-25) with an observed-to-expected total fetal lung volume (oeTFLV) of 21%(IQR 18-26) and most lesions were left-sided (78%). The median GA at FETO insertion was 28.7 weeks (IQR 27.5-29.7) with a duration of 40 days (IQR 31-49) and a median response of +6% oeTFLV (IQR -1-25). There was 1 case of intrauterine fetal demise and 1 failed FETO placement due to subglottic stenosis. Most (90%) were inborn at 36 weeks GA (IQR 34-37) weighing 2580grams (IQR 2120-3040). The 1-Minute and 5-Minute Apgar scores were 2(IQR 1-4) and 6(IQR 4-7), respectively. All were intubated at birth except for 1 patient who was made comfort care prior to delivery. Two patients died on day-of-life one and one died on day-of-life two. The 38 surviving patients underwent CDH repair at 3 days of age (IQR 2-5), and 16 (42%) were performed on ECMO. 17(44%) were type C and 22(56%) were type D. The median length of stay was 69 days (IQR 46-146). Among the 28(68%) surviving to discharge, 15(54%) remained on oxygen, 6(25%) had a tracheostomy and 12(42%) had a gastrostomy. Our overall mortality was 36% at a median of 18 days (IQR 1-148) with a 20% 30-day mortality. No patients with an oeTFLV < 14% survived.

Conclusion: FETO remains a feasible treatment modality for high-risk CDH patients, however our data suggests that FETO might not be sufficient to rescue babies with less than 14% of their expected lung volume.

Abbreviations: CDH = Congenital Diaphragmatic Hernia
FETO = Fetoscopic Endoluminal Tracheal Occlusion
IQR = Interquartile Range
GA = Gestational Age
oeTFLV = observed-to-expected Total Fetal Lung Volume
ECMO = Extracorporeal Membrane Oxygenation

APSA 3

ASSESSMENT OF FUNCTIONAL MUSCLE REGENERATION OF TRANSPLANTED TISSUE ENGINEERED OESOPHAGUS IN A MINI-PIG MODEL

Natalie Durkin[1], Marco Pellegrini[1], Conor McCann[1], Kornilia Nikaki[2], Osvaldo Borrelli[1], Mariana Scuglia[1], Roberto Lutman[1], Giulia Patera[1], Daniele Di Biagio[1], Lucinda Tullie[3], Koji Yamada[1], Simon Eaton[4], **Paolo De Coppi, MD, PhD**[5]

[1]University College London, London, England, United Kingdom, [2]Great Ormond Street Hospital for Children, London, England, United Kingdom, [3]The Francis Crick Institute, London, England, United Kingdom, [4]Great Ormond Street Institute of Child Health, London, England, United Kingdom, [5]Specialist Neonatal and Paediatric Surgery, UCL and Great Ormond Street Hospital for Children, London, England, United Kingdom

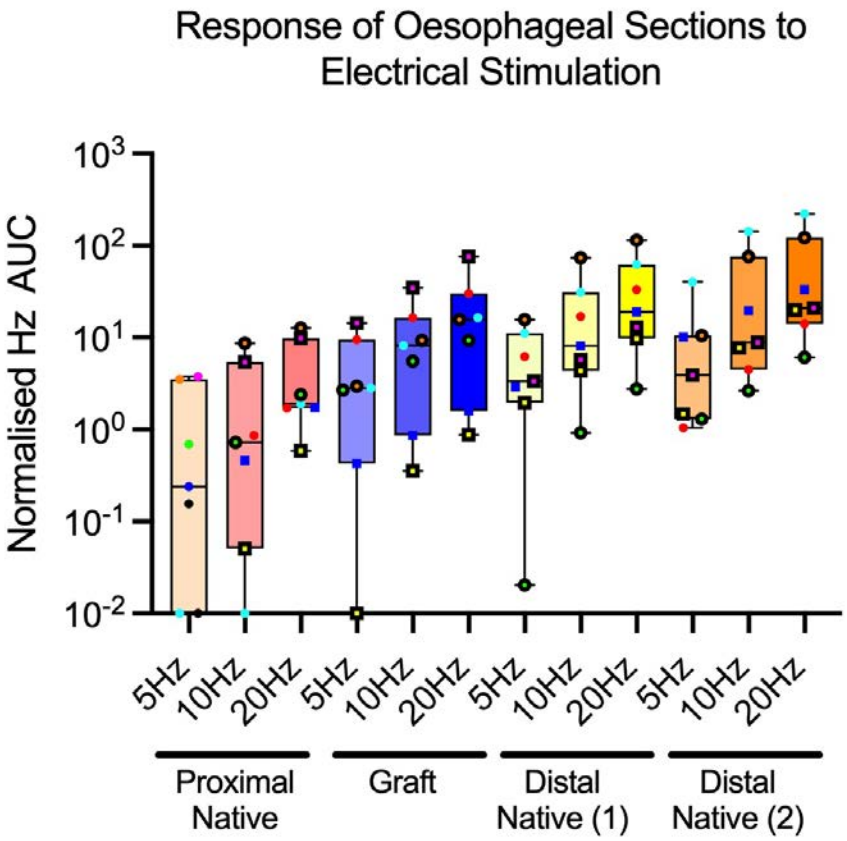
Abstract: Purpose
To assess the function of autologous, tissue engineered grafts for esophageal replacement in mini-pigs as a pre-clinical model of long-gap esophageal atresia (LGEA).

Methods
Autologous myogenic cells derived from rectus abdominis biopsies in mini-pigs (n=8) were delivered to decellularized porcine esophageal scaffolds via microinjection (n=16). Following bioreactor culture, grafts were transplanted orthotopically into 2.5cm esophageal defects via thoracotomy (at ~10kg) with vascularizing pleural wraps and intra-luminal application of biodegradable stents, endoscopically replaced at 3 months. Oral feeding commenced on post-operative day (POD) one without gastrostomy. The presence of muscle in grafts was assessed at 3.5 (n=2) and 6 (n=5) months post-operatively by (i) endoscopic and fluoroscopic guided oesophageal high resolution impedance manometry (HRIM) under general anaesthesia and (ii) ex-vivo isotonic force measurement for confirmation of smooth muscle contraction. Native proximal and distal esophagus was used as control tissue. One-way ANOVA used for statistical analysis. All procedures were ethically approved (PPL:P43EF9FB6, August 2022-2023).

Results
Orthotopic transplantation was successfully undertaken in n=8 pigs with a 100% 30-day survival. Early endpoints were reached at POD 44, 99 and 106 in n=3 after recurrent stent migration and stricture, with 63% (5/8) reaching the 6-month planned endpoint. Growth was similar to non-operated age-matched controls. No endoscopic intervention was required after 4 months with no stents found at the 6-month endpoint. Secondary oesophageal body peristalsis (HRIM) was successfully induced across the graft region by air and saline bolus (20-60ml) in n=5. Ex vivo isotonic force measurement also confirmed graft muscle contraction in 5/7. Appropriate dose-dependent responses were observed by increasing electrical (5/10/20Hz) or chemical (Carbachol 1/10μM) stimulation (Figure 1), comparable to that of proximal and distal native tissue (p=ns). The presence of muscle in the graft at 3.5 and 6 months post-operatively was confirmed by histological analysis.

Conclusions
Autologous cell-seeded tissue engineered grafts successfully work as oesophageal conduits, facilitating oral feeding and normal growth to 6 months. Crucially, grafts show evidence of functioning muscle as early as 3.5 months in vivo. These results indicate our method has superior early integration and functionality, paving the way for future clinical trial in humans.

Abbreviations: LGEA - Long Gap Esophageal Atresia
HRIM - High Resolution Impedance Manometry
POD - Post Operative Day


Response of Oesophageal Sections to Electrical Stimulation
Normalised Hz AUC
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
5HZ
10HZ
20HZ
Proximal Native
Graft
Distal Native (1)
Distal Native (2)

APSA 4

MULTI-INSTITUTIONAL PROSPECTIVE STUDY DEMONSTRATES FREQUENT UTILIZATION OF GIPS TREPHINATION WITH HIGH HEALING RATES AMONG PEDIATRIC PATIENTS WITH PILONIDAL DISEASE

Stephen J. Hartman, MD[1], Amelia E. Gavulic, BS[2], Amelia Collings, MD[3], Nelson Rosen, MD[1], Rebeccah L. Brown, MD[1], K. Elizabeth Speck, MD, MS[4], Cynthia D. Downard, MD, MMSc[5], Matthew P. Landman, MD[6], Patrick A. Dillon[7], Julia E. Grabowski, MD[8], Grace Mak, MD[9], Charles M. Leys, MD, MSCI[10], Jason D. Fraser, MD[11], Dave R. Lal, MD[12], Beth A. Rymeski, DO[1]

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Abstract: Purpose

Pilonidal disease is an increasingly common condition afflicting the pediatric population and can result in significant morbidity. However, there remains wide variation in management, including newer techniques, such as Gips trephination. Given this, we sought to prospectively characterize and compare the 12-month outcomes of medical and surgical treatment strategies across a large multi-institutional cohort of pediatric and adolescent patients with symptomatic pilonidal disease, including evaluating safety and outcomes of the Gips procedure.

Methods

An IRB-approved, multi-center prospective, observational cohort study was conducted. From 8/2019-11/2021 patients 12-21 years who presented with symptomatic pilonidal disease at 10 children's hospitals were included. Primary surgical or medical management was determined by the patient/family and surgeon. Patients were then followed for clinical course, symptoms, and recurrence. Survey data was collected at 1, 6, and 12 months after enrollment. A 1-year chart review was conducted at the conclusion of the study.

Results

There were 249 patients included, with no differences in age, gender, race, and ethnicity in those treated medically or surgically. Most patients (153, 61%) had surgical management, with more than 85% undergoing a Gips procedure. The Gips procedure yielded a low rate of complication (11%) with the most common being drainage. The rate of conversion from medical to surgical management was 24% across the study period. Most patients (81%) reported healing at 12 months. Among patients presenting with their first episode, those who underwent surgery reported a significantly higher rate of healing at 12 months compared to those that had medical management alone (87% vs 68%, $p< 0.05$). Patients treated at centers with more than 30 patients reported higher 12-month healing rates (85% vs 72%, $p< 0.05$).

Conclusion

In this large, prospective observational multi-center study of pediatric patients with pilonidal disease, most reported symptomatic improvement at the study conclusion. Surgical management was found to yield a significantly higher rate of healing in patients who presented with their first episode of disease. The Gips procedure was most frequently used and conveyed a high rate of healing with low morbidity. Patients treated at higher volume centers reported higher rates of healing at 12 months.

APSA 5

ASSOCIATION BETWEEN PALLIATIVE CARE AND HIGH-INTENSITY END-OF-LIFE CARE IN PEDIATRIC ECMO PATIENTS

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Abstract: Purpose: High-intensity end-of-life (HI-EOL) care (e.g., invasive procedures within 48 hours of death) is becoming more common in medically complex, critically ill children. Among populations at high risk for mortality such as patients on pediatric extra-corporeal membrane oxygenation (ECMO), pediatric palliative care (PPC) consultation is considered the standard of care and can facilitate important goals of care conversations. This study aims to evaluate if PPC consultations are associated with a de-escalation of HI-EOL care for pediatric ECMO patients.

Methods: A retrospective cohort study was performed using the Pediatric Health Information System (PHIS) database from October 1st, 2018 to December 31st, 2022. Patients < 18 years of age who underwent ECMO and died during inpatient hospitalization (n=2,337) were identified. Indication for ECMO, type of ECMO, presence of a PPC consultation, do not resuscitate (DNR) code status, and performance of an invasive procedure within 48 hours of death were determined using diagnostic and procedural codes. Hierarchical multivariable logistic regression models were used for analysis with p-values of < 0.05 considered significant.

Results: Of the 2,337 ECMO patients who died, 807 (34.0%) had a PPC consultation and 334 (14.1%) underwent an invasive procedure within 48 hours of death. Following adjustment for clinicodemographic factors, pediatric ECMO patients with a PPC consultation had a reduced odds of HI-EOL care [adjusted odds ratio (aOR): 0.44; 95% Confidence Interval (CI): 0.30-0.66] compared to those without PPC consultation. The presence of a DNR order (aOR: 0.53; 95%CI: 0.35-0.81) and being on veno-venous (aOR: 0.37; 95%CI: 0.20-0.68) or central ECMO (aOR: 0.33; 95%CI: 0.21-0.51) compared to veno-arterial ECMO were also independently associated with decreased odds of HI-EOL care.

Conclusion: Less than half of pediatric ECMO patients have PPC consultation during their terminal admission, presenting an opportunity for improved alignment with the standard of care. PPC consultations are independently associated with a decreased likelihood of HI-EOL care for this vulnerable population. Further research is needed to identify and mitigate barriers to PPC consultations for children undergoing ECMO.

Abbreviations: HI-EOL: High-intensity end-of-life
ECMO: Extra-corporeal membrane oxygenation
PPC: Pediatric palliative care
PHIS: Pediatric Health Information System
DNR: Do not resuscitate
aOR: Adjusted odds ratio
CI: Confidence interval

APSA 6

A NSQIP–PEDIATRIC ANALYSIS OF PATIENTS UNDERGOING LAPAROSCOPIC APPENDECTOMY DEMONSTRATES INCREASING RATES OF SAME-DAY DISCHARGE OVER TIME WITH DECREASED READMISSION RATES

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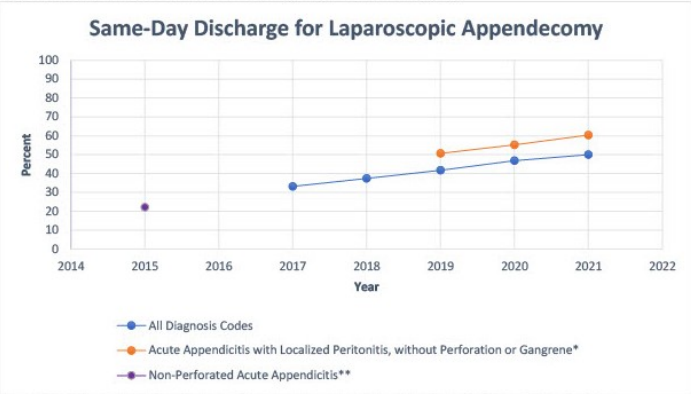
Abstract: Purpose:
Same-day discharge for laparoscopic appendectomy has been determined to be safe for select pediatric patients. However, national practice patterns have not been well analyzed over time, with prior studies finding the rate of same-day discharge to be 22% in the early 2010s. The aim of this paper is to evaluate current national practice patterns and 30-day readmission rates of same-day discharge for laparoscopic appendectomy.
Methods:
The American College of Surgeons National Surgical Quality Improvement Program Pediatric registry was utilized to identify patients from 2017-2021 who underwent laparoscopic appendectomy. Yearly frequency of same-day discharge was determined. Then outcomes of patients discharged within 24 hours postoperatively were compared to those discharged between 24-72 hours postoperatively. A sub-group analysis was performed for acute appendicitis with localized peritonitis, without perforation or gangrene (ICD10 = K35.30). Independent T-tests, $\chi 2$ and Fisher's exact tests were utilized for analysis of the data with a significant p value defined as less than 0.05.
Results:
A total of 73,598 pediatric patients were identified. The same-day discharge rate was 42.6%, with the frequency of same-day discharge increasing from 33.2% in 2017 to 50% in 2021 (Figure 1). For all patients no significant difference in unplanned 30-day reoperation (0.29% vs 0.41, p=0.606), and a significant decrease in 30-day unplanned readmission (1.37% vs 2.43%, p=0.003) was found for same-day discharge versus discharge 24-72 hours postoperatively. Sub-group analysis of nonperforated, nongangrenous acute appendicitis with localized peritonitis identified 7,336 patients. Overall, this cohort had higher same-day discharge rate (55.6%) and decreased rates of unplanned 30-day readmission (0.8% vs 1.8%, p< 0.001) and reoperation (0.1% vs 0.4%, p=0.026) for same-day discharge versus discharge in 24-72 hours postoperatively.
Conclusion:
Same-day discharge for laparoscopic appendectomy in the pediatric population continues to increase in frequency, only recently reaching greater than 50%. Given same-day discharge patients for all laparoscopic appendectomies had no significant increase in rates of adverse outcomes, and for acute, nonperforated, nongangrenous cases had decreased rates of 30-day unplanned readmission and reoperation, likely a greater percentage of patients can be considered for same day discharge.

Abbreviations: International Classification of Diseases, Tenth Revision, Clinical Modification - ICD 10

Figure 1: Trend of Percent Same-Day Discharge Compared to 24-72 Hour Discharge for Laparoscopic Appendectomy in Pediatric Patients Utilizing NSQIP-Pediatric Registry



* ICD-10: K35.30 with no reported cases in 2017, and two reported cases in 2018; data in graph only includes 2019-2021 data
**NSQIP-Pediatric analysis performed on 2012 to 2015 data comparing same-day discharge to 1-2 day discharge postoperatively for non-perforated acute appendicitis by: Cairo SB, Raval MV, Browne M, Meyers H, Rothstein DH. Association of Same-Day Discharge With Hospital Readmission After Appendectomy in Pediatric Patients. JAMA Surg 2017;152(12):1106-12

APSA 7

STATE LAWS PROTECTING CHILD ACCESS TO FIREARMS ARE ASSOCIATED WITH DECREASED FIREARM MORTALITY

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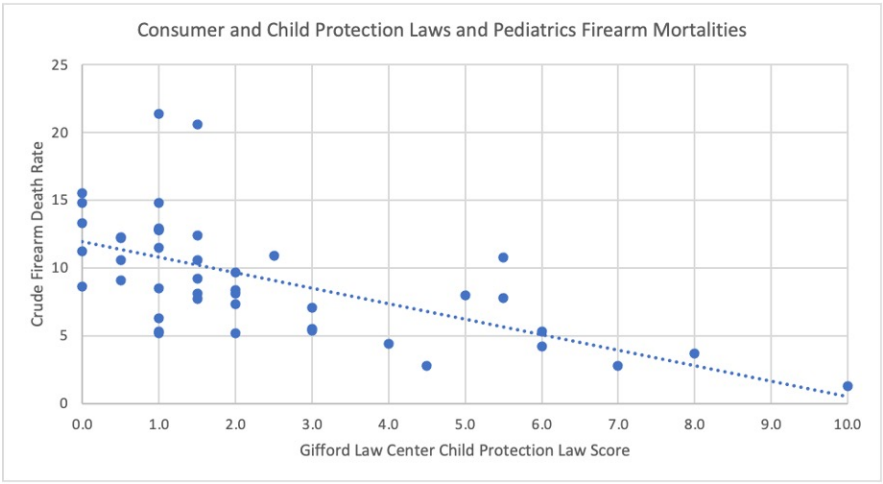
Abstract: Purpose: Firearms are the leading cause of death in the United States in children. Despite this public health crisis, little information exists on federal laws protecting citizens, particularly children, from firearm deaths. Laws for protection vary by state, with a known negative correlation between the strength of the laws and overall firearm mortalities. Limited research has been done correlating specific targeted laws and prevention of firearm deaths for their intended purpose. This study aimed to evaluate correlations of child protection laws with pediatric firearm deaths.

Methods: CDC WONDER was queried for firearm related deaths by state and intent in the year 2021 for ages 0-21. Crude death rates per 100,000 persons were correlated with scores collected on Gifford's Law Center Gun Violence and prevention report card for 2021. This center assigns points for strength of firearm laws by category. Laws relating to consumer and child safety were used for analysis, including minimum age restrictions, laws regarding safety locks or technology for owner-only access, child access protection laws, and laws requiring design safety standards. The total possible score reported is 10. Linear regressions were performed using IBM SPSS 27.0.1.0.

Results: The median score for child protection laws amongst states was 1.5. Strength of child protection laws inversely correlated with firearm mortality, with a fitted regression model of crude death rate = 5.430 - 0.332*(child protection law score), $R^2=0.389$ $p< 0.001$. Similarly, pediatric homicide and suicide rates negatively correlated with child protection law scores ($R^2=0.220$, $p=0.005$ and $R^2=0.276$, $p=0.001$, respectively), protecting from firearm mortality for both intents. Unintentional deaths were not correlated due to censoring and unreliable rates for low absolute numbers.

Conclusion: Laws for gun violence prevention are critical to address the public health crisis of pediatric firearm deaths. While state laws are limited by enforcement across state lines, laws surrounding child protection laws strongly correlate with decreased pediatric mortalities, protecting from both homicides and suicides. Further research on the specific laws that best protect children is necessary to focus political advocacy efforts and prevent future pediatric firearm deaths.

Abbreviations:


Consumer and Child Protection Laws and Pediatrics Firearm Mortalities
Crude Firearm Death Rate
25
20
15
10
5
0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Gifford Law Center Child Protection Law Score

APSA 8

MORTALITY FOLLOWING COMPLICATIONS AFTER SURGERY FOR CHILDREN IN AFRICA: A FOURTEEN-DAY MULTI-CENTER PROSPECTIVE OBSERVATIONAL COHORT STUDY (ASOS-PAEDS)

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Abstract: Background

Safe and affordable anesthesia and surgery is a public health imperative. There are few data describing care provision and outcomes for children undergoing anesthesia and surgery in Africa.

Purpose

This study aimed to evaluate care provision, surgical outcomes, and resources for children undergoing surgery in Africa.

Methods

An international 14-day prospective, observational cohort study of children (< 18 years) undergoing surgery in African countries. We aimed to recruit as many hospitals as possible across all levels of care providing surgical treatment for children. Each hospital recruited all eligible children for a 14-day period between January 2022 and December 2022. The primary outcome was in-hospital postoperative complications within 30 days of surgery. The secondary outcome was in-hospital mortality within 30 days after surgery. We also collected hospital-level data describing equipment, facilities, and procedures considered necessary for safe surgical care of children.

Results

We recruited 8625 children from 249 hospitals in 31 African countries. The mean age was 6.1 (4.9) years, and 5675/8600 children (66%) were male. Most children were healthy (American Society of Anesthesiologists Class I, 6110/8579 children [71%]). 5325/8604 (62%) of children underwent elective surgery. Postoperative complications occurred in 1532/8515 (18.0%) of children. There were 199/8596 deaths (2.3%) following surgery. Deaths following postoperative complications occurred in 166 of 1530 complications (10.8%). Operating rooms were reported as safe for anesthesia and surgery for neonates, infants, and children < 6 years in 121/223 (54.3%), 147/223 (65.9%), and 188/223 (84.3%) of hospitals. 48/221 (22%) of hospitals did not have reliable electricity, and 42/221 (19%) did not have a reliable oxygen supply.

Conclusion

Outcomes following anesthesia and surgery for children in Africa are poor. Complication and mortality rates are fourfold and 11-fold higher than in high-income countries. To improve surgical outcomes for children in Africa, we need health system strengthening, provision of environments that are safe for the conduct of anesthesia and surgery, and strategies to address the high rate of ‘failure to rescue’.

Abbreviations:

APSA 9

LATE-ONSET AERODIGESTIVE MORBIDITIES AFTER TRACHEOESOPHAGEAL FISTULA REPAIR

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Abstract: Background: Short-term digestive complications such as gastroesophageal reflux disease (GERD) and anastomotic stricture are well-described in patients with esophageal atresia with or without tracheoesophageal fistula (EA/TEF). Given the challenges in tracking long-term outcomes for patients with congenital anomalies, it is likely that late-onset aerodigestive morbidities are underreported. We used a unique database to describe the incidence of late-onset aerodigestive complications in this population.

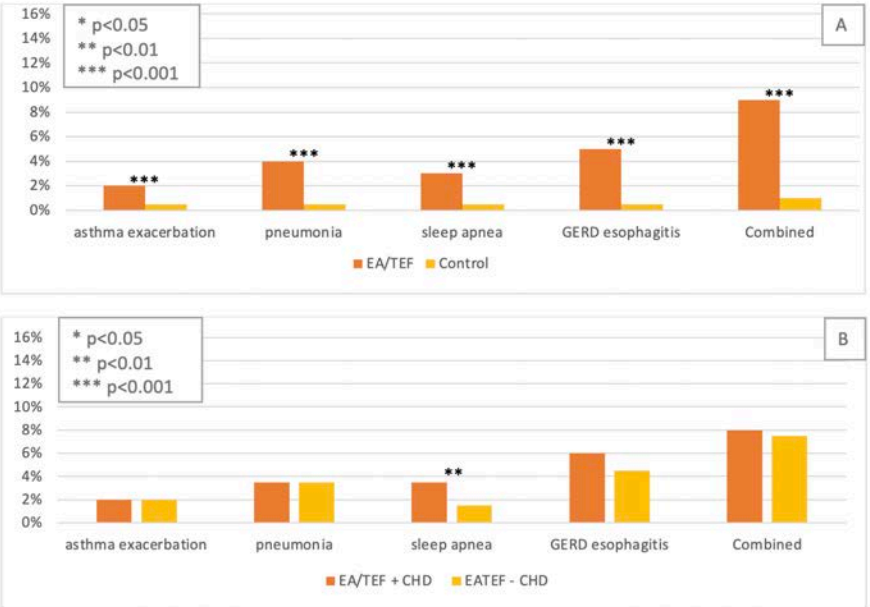
Materials/Methods: TriNetX is an EHR database from 86 healthcare organizations across the United States with over 100 million patients. We used ICD9 and ICD10 codes to search for EA/TEF diagnoses from 2003-2018. Outcomes occurring five or more years after the first database encounter were compared to a propensity-matched (age, race, ethnicity, and gender) control group. Subgroup analysis was run for EA/TEF with congenital heart disease. Outcomes included a new diagnosis of an asthma exacerbation, pneumonia, sleep apnea, GERD esophagitis, esophageal metaplasia (Barrett's), and esophageal cancer.

Results: There were 3,034 patients with EA/TEF and 2,747 after propensity matching. Patient ages ranged from 5 to 30 years (median 14). Compared to matched controls, EA/TEF patients had an increased relative risk of 5x for asthma exacerbations, 9x for pneumonia, 7x for sleep apnea, and 15x for GERD esophagitis ($p < 0.001$) (Fig 1A). Congenital heart disease was an independent risk factor for sleep apnea only (Fig 1, B). The incidence of esophageal metaplasia and esophageal cancer was too low for statistical analysis.

Conclusion: Survivors of EA/TEF experienced higher rates of late-onset aerodigestive morbidities occurring at least 5 years of age compared to a matched cohort. These findings underscore the importance of long-term multidisciplinary follow-up and may inform counseling of parents of infants with EA/TEF regarding long-term outcomes.

Abbreviations: (EA/TEF) Esophageal Atresia with Tracheoesophageal Fistula

Figure 1: Late Onset Outcomes (new diagnosis at least five years after first database encounter)



A) EA/TEF vs no congenital anomaly; B) EA/TEF with CHD vs EATEF alone

Scientific Session I - Advocacy
10:45 AM – 12:00 PM

APSA 29

UNDERSTANDING CONTEXTUAL FACTORS INFLUENCING FIREARM DEATHS OCCURRING AMONG CHILDREN

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Abstract: Purpose: Unintentional pediatric firearm deaths are preventable, with firearm access the most significant risk factor. Understanding the contextual details surrounding unintentional firearm mortality can inform prevention.
Methods: A retrospective review (2004-2020) of the National Fatality Review Case Reporting System identified children/teens (age=0-18) who sustained fatal firearm injuries determined to be of unintentional intent (n=1478). Descriptive analyses of demographics, situational context, and firearm factors were completed, with bivariate comparisons examining differences across developmental context (younger:0-10; older:11-18). Results: Among this 37-state sample of unintentional pediatric firearm deaths, mean age was 12.1 years (SD=5.2), 83.0% were male, 38.7% non-Hispanic White, 38.5% African American, and 9.6% had child protective services involvement. In this sample, most unintentional firearm deaths occurred in urban settings (46.3%), with 22.6% within rural and 20.3% within suburban settings. Handguns accounted for 73.5% of the deaths with common situational factors surrounding unintentional deaths including “playing with a firearm” (75.8%) and “showing a firearm to others” (18.0%). Most firearm deaths occurred at either the decedent’s home (45.7%) or at a friend/relative’s home (38.1%). Overall, 38.1% of deaths occurs in a friend/relative’s home with older children 2.46 times more likely to have the death occur at a friend/relative’s home (44.0%-vs.-24.2%). Compared to young children, older children/teen unintentional firearm deaths were more likely to involve situational factors such as “showing a gun to others” (23.1%-vs.-6.1%; OR=4.61), “target shooting” (5.5%-vs.-2.7%; OR=2.09), and “playing Russian roulette” (13.3%-vs.-0.0%). Compared to older children/teens, young children’s unintentional firearm deaths were more likely to involve a loaded/unlocked firearm (28.2%-vs.-61.8%; OR=0.38) and involve situational factors such as “playing with a weapon” (70.3%-vs.-88.7%; OR=0.30) and being a “bystander” in a firearm event (2.8%-vs.-5.7%; OR=0.48). Additionally, in 30.3% young child deaths, the supervising person was asleep/impaired. Conclusions: Within this sample of unintentional firearm deaths, the majority were related to unsecured handguns and occurred within household or family/relative properties, with contextual differences likely related to developmental differences between younger and older children. Findings highlight the importance of locked storage in homes with children across all age groups as well as supervised access and training specifically for teens engaging in firearm use.

Abbreviations: OR - odds ratio
vs - versus
SD - standard deviation

APSA 30

EXAMINING PRELIMINARY UPTAKE OF UNIVERSAL SCREENING FOR FIREARM INJURY RISK AMONG PEDIATRIC TRAUMA PATIENTS

Emma Cornell, MPH[1], Christian McEvoy, MD, MPH[2], Bailey Roberts, MD[3], Colleen P. Nofi, DO, MBA, MSc[4], Laura Harrison, MPH[5], Sandeep Kapoor, MD, MS-HPPL[6], Chethan Sathya, MD MSc[7]

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Abstract: Purpose: Hospitals systems provide unique opportunities for delivery of firearm injury and mortality prevention (FIMP) strategies. Our health system implemented a universal FIMP screening program in the emergency department (ED) to normalize conversations around firearm access and violence risk for patients, families, and providers. Initial preliminary data revealed that high acuity trauma patients, including those with violent injuries, were not screened in the ED due to injury severity. Thus, we expanded FIMP to the inpatient surgical service as part of the tertiary exam to increase provision of screening and intervention for higher risk trauma patients.

Methods: In March 2023, FIMP was expanded to the inpatient surgical service and administered to all trauma patients ≥ 12 years admitted to the pediatric surgical service. Screening was administered via an electronic tool in REDCap and integrated with the tertiary trauma survey completed by surgical residents. The tool consisted of a question about firearm access within or outside the household, and the 4-question SaFETy score, a validated tool to predict future firearm violence risk. The pediatric surgical fellow instructed all new to complete asynchronous education on FIMP as a public health issue and given guidance on tool utilization and documentation.

Results: Among 63 pediatric trauma patients admitted to the surgical service from March-September 2023, 19.0% (n=12) received FIMP screening in the ED prior to inpatient admission. The number of admitted trauma patients receiving FIMP screen as part of the tertiary trauma survey increased to 50.8% (n=32), leading to increased identification of high-risk patients, and subsequent provision of resources. Reasons for noncompletion included non-English speaking patients, those who were intubated or altered, and user error operating REDCap.

Conclusions: FIMP screening is a promising tool to identify and subsequently provide patients and families with resources and support to increase safety and reduce risk associated with firearm access and violence risk. Integration of FIMP screening into the tertiary trauma survey by surgical residents is a more sustainable way to increase FIMP screening. Factors associated with increased screening were championship by surgical attendings and fellows, who provided daily reminders for residents during morning rounds to increase utilization.

Abbreviations: ED-emergency department
FIMP-firearm injury and mortality prevention

APSA 31

PROFILE OF MASS SHOOTINGS FROM 2009-2021 AND THEIR IMPACT ON CHILDREN

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Abstract: Purpose:
Since 2020, firearm related deaths have been the leading cause of death among children in the US. Deaths by firearms increased by 34.6% compared to the year prior. While mass shootings do not account for most of these deaths, they profoundly affect the social well-being of entire communities and subsequent policy formation. The purpose of our study was to characterize and quantify the toll of mass shootings involving children.
Methods:
We analyzed the Everytown for Gun Safety mass shooting database from 2009-2021. Mass shootings were defined as four or more victims killed. We described the frequency and characteristics of mass shootings involving children ages 18 years or younger. We quantified the victims shot, victims killed, perpetrator intent, and location of the shootings.
Results:
From 2009-2021 there were 267 mass shootings as defined by four or more victims killed. Children were involved in 50% of the mass shootings. Of the 2476 individuals shot, children accounted for 16% of those injured or killed. In shootings involving children, there was a pediatric fatality 98% of the time (131 events, 328 pediatric deaths). Domestic violence accounted for 73% of mass shooting events with a pediatric case fatality of nearly 93%. Five states did not report a mass shooting during this period, while 9 states did not have a child fatality. Texas, Florida, and Connecticut represent the greatest number of fatalities, while Texas, California, and Florida represent the highest number of incidents. Perpetrators were likely to be male (94%) and over age 21 (89%). Of the 25 deadliest mass shootings that occurred during the study period, children were killed or injured in 36% of incidents.
Conclusion:
Children were involved in half of all fatal mass shootings. When mass shootings involve children, children suffer a disproportionately high case fatality rate. Sadly, most mass shootings involving children are likely to be at home due to domestic violence. Efforts focused on reducing domestic violence may have a significant impact on reducing mass shootings involving children.

Abbreviations:

APSA 32

YOUTH FIREARM HUNTING LAWS IN THE UNITED STATES: AN OPPORTUNITY FOR STANDARDIZATION OF SAFETY TRAINING AND SUPERVISION REQUIREMENTS

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Abstract: PURPOSE: Firearm injury is the leading cause of death for American children, and actionable primary prevention measures that lower firearm injury risk have been challenging to develop due to the polarizing nature of this issue. The objective of this study was to describe variability of youth hunting laws across US states for individuals less than 18 years of age, and to identify opportunities for evidence-based recommendations on youth hunter education and supervision requirements.

METHODS: We determined individual state requirements for youth hunter education/training and youth hunter supervision requirements from individual state government agency websites. Descriptive statistics were used to describe differences in legal requirements for youth hunter education training and adult supervision requirements for youth hunters less than 16 years of age across all 50 US states. Five states were excluded from the adult supervision analysis due to lack of an explicit age of required supervision.

RESULTS: Eleven states (22%) have a mandatory requirement for youth hunter education, 38 states (76%) do not require youth hunter education if hunting occurs with adult supervision, and one state has no youth hunter education requirement. The mean age at which youth can hunt without supervision in the US is 15.3 ± 2.2 years. Thirty-eight states allow youth to hunt without supervision when they are older than 12 years, 6 states allow youth to hunt without supervision between the ages of 10 and 12 years. Notably, Alaska, Arizona, and Texas (6%) allow youth ≤ 10 years of age to hunt without adult supervision. Forty-two states (84%) have state sponsored programs for youth hunters.

CONCLUSION: There is significant variation in the laws governing firearm hunting by children and adolescents across U.S. states. There is an opportunity for surgical organizations to collaborate with state agencies and conservation organizations to recommend minimum standards for youth hunter safety training and adult supervision requirements for adolescents and youth learning to hunt using lessons learned from developing evidence-based guidelines for graduated driver licensing and child pedestrian safety.

Abbreviations:

APSA 33

LESS IS MORE: OPTIMIZING SURGICAL TRAYS REDUCE COST AND ENVIRONMENTAL IMPACT

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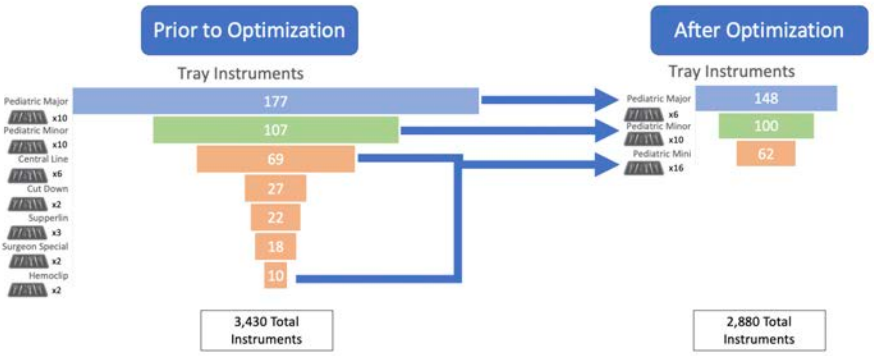
Abstract: Purpose: Surgical trays are commonly curated to the needs of surgeons and, over time, accumulate items that are rarely used. The result is an inefficient potpourri that is costly and wasteful including sterilization burdens that are environmentally unfriendly. The objective of this study was to 1) update pediatric surgical tray options and optimize instruments within each tray and 2) quantify the impact on costs and greenhouse gas (GHG) emissions of these changes.

Methods: An in-depth audit of pediatric surgical trays was performed with surgeons, nurses, and surgical technologists. Trays were designed based on use and stakeholder preferences. Costs were calculated using $0.66 per instrument for sterile processing based on industry standards and inflation adjustment. Environmental impact was calculated using 77g of CO2 equivalents per instrument.

Results: The types of trays decreased from 7 to 3 unique trays (Figure). The total number of trays available decreased from 35 to 32 trays. This resulted in a decrease from 3,430 to 2,880 instruments. Based on annual surgical volume and tray usage data, sterilization costs decreased by $40,524 annually. The environmental impact decreased by 4.73 metric tons of CO2. This is equivalent to driving 12,118 miles in a gasoline car. Anecdotally, surgeons and operating room (OR) staff noted no issues with optimization. OR staff noted ease in set up efficiency and less confusion regarding surgeons' intraoperative needs.

Conclusion: Critical appraisal of surgical instrument trays results in decreased costs, improved sterile processing burden, and reduced environmental impact. Pediatric surgical groups should periodically assess instrument trays to promote environmentally responsible surgery while balancing efficiency and staff satisfaction.

Abbreviations: greenhouse gas=GHG
Operating room=OR



APSA 34

FROM TRASH TO TREASURE: LAUNCHING A MEDICAL DEVICE REPROCESSING PROGRAM

Alison Lehane, MD[1], Katelyn Storton, BA, CMRP[2], Mallory N. Perez, MD[3], Charesa J. Smith, MD, MS[3], Gwyneth A. Sullivan, MD, MS[4], Mehul V. Raval[5]

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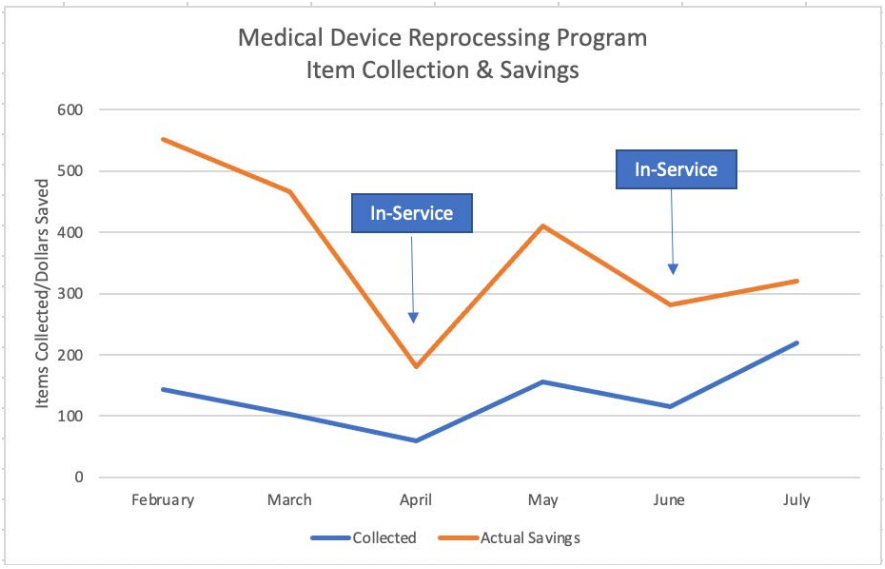
Abstract: Purpose: Over the past two decades, single-use devices have dramatically increased in healthcare. Medical device reprocessing programs decrease waste from single-use devices and promote a circular economy. Implementation of medical device reprocessing programs has not been thoroughly evaluated. The purpose of this study was to report early implementation results as well as program benefits and challenges at a free-standing children's hospital.

Methods: A medical device reprocessing program was launched in February 2023 at a free-standing children's hospital for collection of two single-use devices; tourniquets and compression sleeves. In May 2023, this program was expanded to 15 devices. Data included monthly assessment of items collected for reprocessing and cost analysis. In-service learning sessions were held periodically to educate operating room (OR) staff on reprocessing. Environmental impact was calculated using industry standard life cycle analysis CO2 equivalents for each product's creation.

Results: In the first month, 144 tourniquets and compression sleeves were collected. Reprocessing declined to a nadir of 60 items over the subsequent two months. The program was then expanded to include additional single-use items (e.g., arthroscopic shavers, tissue sealers, ultrasonic scalpels, trocars/cannulas). This resulted in an increase in the total number of items collected to 473 over the three months of expansion. Two in-service learning sessions occurred and resulted in increased collection of items for reprocessing (Figure). Based on the most recent monthly assessment, the program collected 7% of eligible items. The program has generated total savings of $2,218 since inception year-to-date. Projected cost savings were $99,638 year-to-date if all items were collected to their unique target goal amounts (typically 75% collection) with purchasing of reprocessed items. The program has reduced environmental impact by 113 metric tons of CO2, which is equivalent to driving 289,681 miles in a gasoline-powered vehicle.

Conclusion: While medical device reprocessing programs are a key aspect of OR sustainability efforts, implementation of these programs can be challenging. Frequent in-service sessions facilitate stakeholder engagement and are essential to program success. Additional interventions, such as data feedback to OR staff regarding cost savings and environmental impact, may increase compliance with medical device reprocessing programs.

Abbreviations: OR-Operating room


Medical Device Reprocessing Program
Item Collection & Savings
Items Collected/Dollars Saved
600
500
400
300
200
100
0
In-Service
In-Service
February
March
April
May
June
July
Collected
Actual Savings

APSA 35

THERE IS NO PLANET B: OPERATING ROOM SUSTAINABILITY PILOT PROJECT IN PAEDIATRIC SURGERY

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Abstract: Background: Operating rooms account for 70% of hospital waste, which presents an opportunity for green surgical practices. Many instruments and disposable items remain unused, leading to unnecessary waste, termed “overage.

Purpose: We aimed to optimize the Instrument Trays and Disposable Packs to reflect the procedural needs. We determined a waste reduction strategy to quantify, catalogue and reduce overage and CO2 emissions.

Methods: We conducted a waste audit of appendectomies and open inguinal hernias repairs (IHR) from July to August 2023 at a single institution. Laparoscopic procedures require a laparoscopic and general instrument tray, while open procedures utilize a single tray. The unused disposable items were categorized and weighed. Reusable instruments were captured with photographic analysis of the postprocedure tray and verified with a postoperative checklist sheet. Environmental burden was calculated by material type.

Results: Data from 32 appendectomies (68% single-port) and 18 IHRs was included. For single-port appendectomies, 19% of laparoscopic instruments were utilized, compared to 49% with three-port appendectomy ($P < 0.00001$). Usage of instruments from the general tray was comparable: 42% and 54% for the single-port and three-port appendectomy respectively. The open IHRs utilize 52% of the instruments from the General Set.
Annually, 340 IHR and 350 appendectomies are performed at our institution. In total, 28511 individual instruments are unnecessarily washed per year. There is tremendous eutrophication potential as reprocessing uses energy, water, detergents, corrosive chemicals to treat the wastewater and cleaning the water to make it potable
Both appendectomy techniques utilized 56% of the disposable laparoscopy pack. Open IHR used 71% of the general minor pack.
Figure 1 demonstrates the theoretical CO2 reduction with implementing a conservative reduction in disposables. Eliminating the overage for both procedures will annually reduce 494 kgCO2e from plastic and 754 kgCO2e from cotton material. This is approximately the greenhouse gas emissions released driving from Phoenix to Chicago and back.

Conclusions: Our study illustrates an opportunity for green surgical practices and waste audit methodology to evaluate item utilization. Streamlined effort to regularly evaluate obsolete products to maintain a judicious supply and instrument selection can be financially beneficial and significantly reduce CO2 emissions.

Abbreviations: IHR : inguinal hernia repair

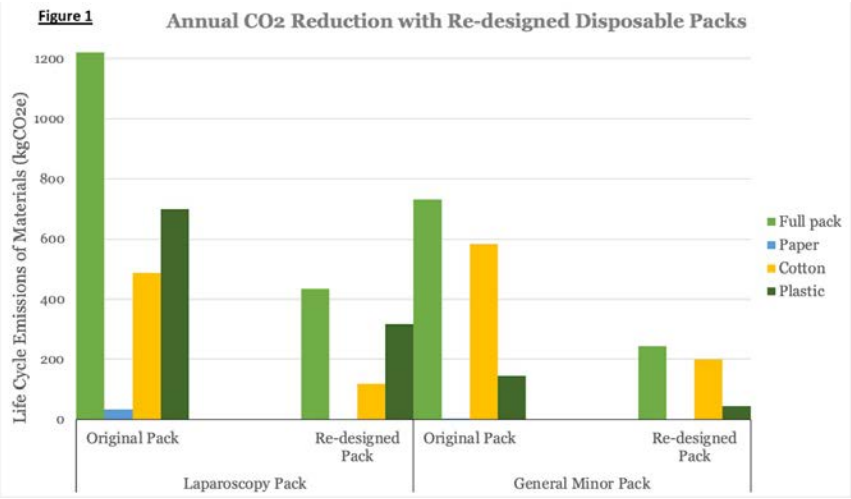


Figure 1
Annual CO2 Reduction with Re-designed Disposable Packs
Life Cycle Emissions of Materials (kgCO2e)
1200
1000
800
600
400
200
0
Full pack
Paper
Cotton
Plastic
Original Pack
Re-designed Pack
Laparoscopy Pack
Original Pack
Re-designed Pack
General Minor Pack

APSA 36

LET'S TALK ABOUT IT: FIREARM INJURY PREVENTION TRAINING FOR MEDICAL STUDENTS

Claire Juhas, Rithika Reddy Proddutoor, Kelly Harrell, Lauran Barry, Katie Wiggins-Dohlvik, MD

University of Texas Health San Antonio, San Antonio, TX, USA

Abstract: ● Purpose

Decrease firearm injuries by evaluating medical student knowledge/familiarity with primary injury prevention strategies focused on patient counseling, providing education and resources to medical students, and evaluating the efficacy of education on medical student perceptions, comfort, and willingness to engage in primary firearm injury prevention counseling.

● Methods

In 2023, we implemented an hour-long training session regarding firearm injury prevention as part of third year medical students' surgery rotation. Pre and post education surveys composed of Likert scale questions, open response questions, and agree/disagree statements were conducted. Data was analyzed using paired t-tests.

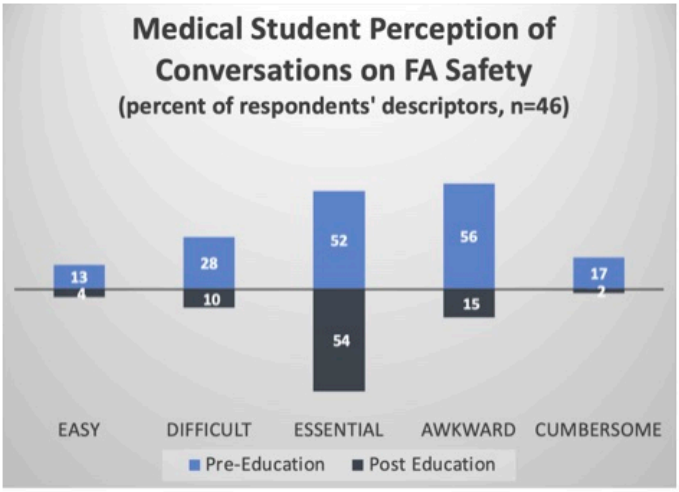
● Results

Before our session, only 4% of medical students report having received training on counseling patients regarding firearm safety. Despite this, the majority identify firearm safety as an important health care issue (67%), feel that it is the responsibility of all members of the healthcare team to counsel patients on firearm safety (71%), and report that with more training they would be more likely to speak with patients and families about firearm safety (82%). After training, knowledge regarding legal aspects of firearm safety increased significantly among medical students ($p < 0.001$). Reported comfort engaging in conversations about firearm safety also increased significantly from 12% reporting they were comfortable or very comfortable before training to 85% after ($p < 0.001$). After education, most trainees either agreed or strongly agreed with the following statements: "After today's session, I will be more comfortable in having conversations with patients/families regarding firearm injury" (78%), "I am now more likely to discuss firearm safety with patients/families" (71%), "Today's training was useful" (87%), and "I will change my practice based on today's training" (65%).

● Conclusion

Despite the public health impact of firearm injury, very little training regarding primary injury prevention in this arena is integrated into current medical education. Our data show that medical students' knowledge and comfort regarding firearm injury prevention can be augmented and greatly increased using a straightforward training session. This project highlights an easy-to-implement and low-cost method that may be useful in mitigating firearm injury.

Abbreviations:


Medical Student Perception of Conversations on FA Safety
(percent of respondents' descriptors, n=46)
13
4
28
10
52
54
56
15
17
2
EASY
DIFFICULT
ESSENTIAL
AWKWARD
CUMBERSOME
Pre-Education
Post Education

Scientific Session II - Basic Science

10:45 AM – 12:00 PM

APSA 55

GPR68 ACTIVATION REDUCES POST-OPERATIVE ABDOMINAL ADHESIONS IN A MURINE PILOT STUDY

Matthew Byrne, MD[1], Miranda Chacon, MD[2], Sarah E. Wayson, PhD[1], Korry T. Wirth, MD[1], Amy Lawrence, MD[3], David Darcy, MD[4], Derek Wakeman, MD[5], Walter Pegoli, MD[6], R. Matthew Kottmann, MD[1], Alayna Loiselle, PhD[1], Nicole A. Wilson, PhD, MD[7]

[1]University of Rochester Medical Center, Rochester, NY, USA, [2]University of Rochester Medical Center | Golisano Children's Hospital, Rochester, NY, USA, [3]Children's Hospital of Orange County, Orange, CA 92868, CA, USA, [4]Golisano Children's Hospital, University of Rochester Medical Center, Rochester, NY, USA, [5]University of Rochester, Rochester, NY, USA, [6]University of Rochester Department of Surgery, Rochester, NY, USA, [7]University of Rochester | Golisano Children's Hospital, Rochester, NY, USA

Abstract: Purpose: Adhesive disease following abdominal surgery is common and is associated with complications including bowel obstruction, infertility, and chronic pain. Adhesions are formed by myofibroblast driven collagenic matrix formation. Our purpose was to investigate a small molecule, Ogerin, that blunts TGF-β-induced myofibroblast differentiation by activating a G-protein coupled receptor (GPR68). We hypothesized that Gpr68 activation, through intra-peritoneal (IP) Ogerin injection, would decrease abdominal adhesion formation in a murine model.

Methods: A pilot, randomized, blinded trial was performed using an established murine model of right lower quadrant (RLQ) adhesions following IACUC approval. Blinded investigators performed surgery on C57BL/6J mice, randomized to Ogerin (n=10) or control (n=10) groups. IP injections were performed preoperatively (Day 0) and daily through postoperative Day (POD) 5. Animals were sacrificed on POD 10. Standardized gross photographs were taken to document adhesive burden, and assessed by four blinded pediatric surgeons using an established clinical adhesion score. Paraffin histology and hematoxylin and eosin immunohistochemistry characterized adhesive tissue between the abdominal wall and cecum. Maximum adhesion length and thickness was measured. Clinical adhesion scores were compared using the Mann-Whitney U-test, adhesion measurements between groups were compared using unpaired t-tests, and $p< 0.05$ indicated statistical significance.

Results: Ogerin-treated mice had less overall adhesive burden compared to the control group (Figure A&B), with median clinical adhesion scores of 1.3 vs. 2.3 (Figure E), (p=0.03). Ogerin-treated mice also had less adhesive tissue between the abdominal wall and cecum compared to the control group (Figure C&D), with mean maximum adhesion length of 968uM vs. 5409 uM (Figure F), (p=0.02) and mean maximum adhesion thickness of 194uM vs. 581uM (Figure G), (p=0.09).

Conclusion: We conclude that Ogerin treatment significantly reduced gross and histologic abdominal adhesion formation after surgery. These results suggest that Ogerin reduces the formation of postoperative abdominal adhesions, by preventing myofibroblast differentiation through blunting of TGF-β. Ogerin (or other GPR68 activators) may have potential as therapy for the prevention of postoperative abdominal adhesions in surgical patients.

Abbreviations: TGF-β - Transforming growth factor-β; GPR68 - G-protein coupled receptor 68; IP - intraperitoneal; IACUC - Institutional Animal Care & Use Committee; POD - postoperative day

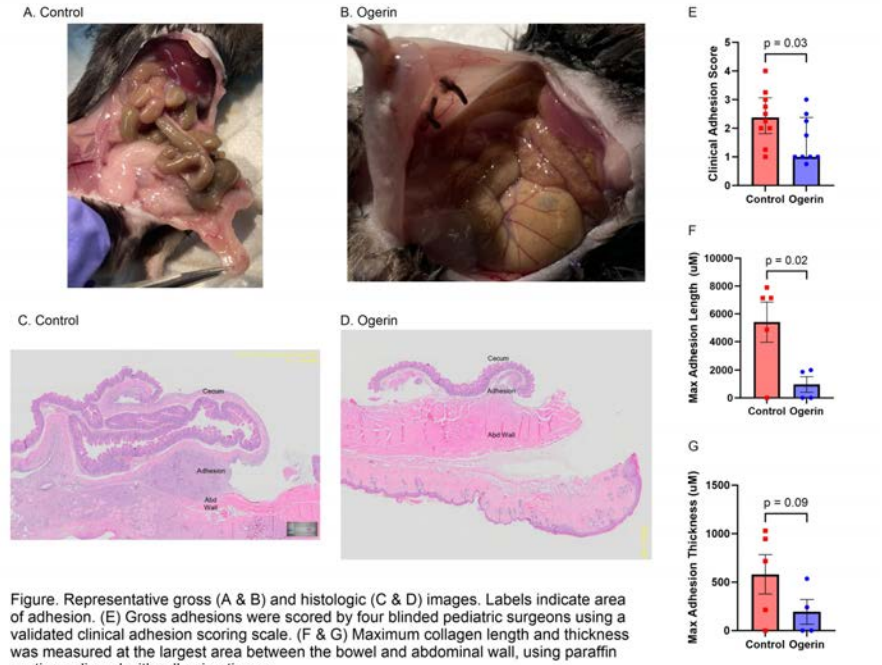


Figure. Representative gross (A & B) and histologic (C & D) images. Labels indicate area of adhesion. (E) Gross adhesions were scored by four blinded pediatric surgeons using a validated clinical adhesion scoring scale. (F & G) Maximum collagen length and thickness was measured at the largest area between the bowel and abdominal wall, using paraffin sections aligned with adhesion tissue.

APSA 56

ARGON INHALATION: A NOVEL TREATMENT FOR EXPERIMENTAL NECROTIZING ENTEROCOLITIS

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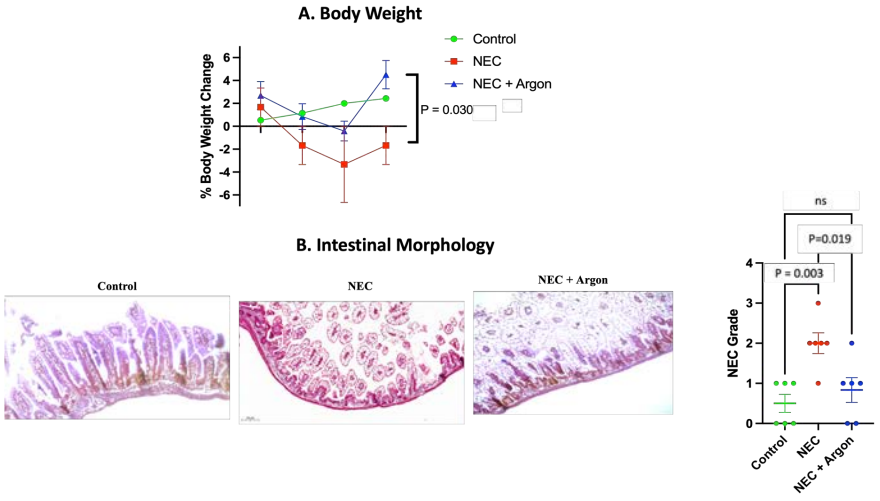
Abstract: Purpose Necrotizing enterocolitis (NEC) remains one of the most severe gastrointestinal emergencies affecting premature neonates. Patients with severe NEC are frequently mechanically ventilated, creating an opportunity for the investigation of inhalational therapy. Argon is an emerging interest in the field of noble gas therapy due to its organo-protective properties. Herein, we investigated argon inhalation as a novel treatment strategy in experimental NEC.

Methods NEC was induced in C57BL/6 pup mice on postnatal days (P) 5-9 using hypoxia, gavage feeding of a hyperosmolar formula and oral lipopolysaccharide (4mg/kg). The study groups included NEC alone (n=6), NEC with argon inhalation (n=6) and breastfed controls (n=6). 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. Body weight changes were recorded. On P9, pup mice were sacrificed, and distal ileum was harvested. Morphology of the ileum was assessed using H&E staining. Histological slides were graded by 3 investigators blinded to treatment allocation based on the NEC histopathological scoring system. Gene expression of intestinal mucosal inflammation markers IL-6 and TNFa (RT-qPCR) were also measured.

Results Argon inhalation allowed pup mice to gain weight in the last day of the NEC induction period compared to NEC alone (Fig. A). Induction of NEC resulted in separation of submucosa and lamina propria, partial loss of villi, and villus sloughing. However, following the administration of argon, there was recovery of the NEC-induced villi damage and reduced separation of the submucosa and lamina propria was significantly reduced (Fig. B). Compared to control, gene expression of IL-6 and TNF□ were increased during NEC ($P < 0.05$) and reduced by argon inhalation ($P < 0.05$).

Conclusions Argon promotes weight gain and reverses NEC-induced intestinal damage by improving intestinal morphology and reducing mucosal inflammation. The delivery of argon during NEC is a novel and practical therapeutic intervention as it can be easily introduced in the respiratory circuit of ventilated preterm neonates with NEC. This research is the first step towards a paradigm shift in the treatment of neonates with necrotizing enterocolitis.

Abbreviations: Necrotizing enterocolitis (NEC)


A. Body Weight
Control
NEC
NEC + Argon
% Body Weight Change
6
4
2
0
-2
-4
-6
P = 0.030
B. Intestinal Morphology
Control
NEC
NEC + Argon
ns
P=0.019
P = 0.003
NEC Grade
4
3
2
1
0
Control
NEC
NEC + Argon

APSA 57

COLONIZING MOUSE INTESTINE WITH A MULTI-STRAIN PROBIOTIC PROMOTES GASTROINTESTINAL MOTILITY AND DECREASES INFLAMMATION IN NEC

Daphne Klerk, BS[1], Daniel J. Scheese, MD, MBS[2], Hannah Moore[3], Cody Tragesser, MD[1], Zachariah Raouf, MD[1], **Johannes Duess, MD, PhD**[3], Sierra Williams-McLeod, BS[1], Koichi Tsuboi, MD, PhD[2], Mahmoud El Baassiri, MD[4], Hee-Seong Jang, PhD[2], Maame Sampah, MD, PhD[5], William B. Fulton[3], Menghan Wang[6], Thomas Prindle[3], Sanxia Wang[3], Chhinder Sodhi, PhD[1], David Hackam, MD, PhD[1]

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Abstract: Purpose: Administration of probiotics to premature infants can decrease the incidence of necrotizing enterocolitis (NEC) through mechanisms that are largely unknown. We have previously shown that impaired intestinal motility is a factor in the pathogenesis of NEC. We hypothesize that colonization of the premature intestine with a multi-strain probiotic can prevent NEC in mice by promoting gastrointestinal motility.

Methods: Newborn C57BL/6 mice were fed a multi-strain probiotic from postnatal day 3 to 11, consisting of Bifidobacterium infantis, Bifidobacterium lactis and Streptococcus thermophilus. Colonization was tested by 16s qRT-PCR using strain-specific primers on bacterial DNA isolated from stool. From postnatal day 7, mice were exposed to an experimental model of NEC by formula feeding with NEC bacteria and 0.5% DSS and intermittent hypoxia (5% O2, 10min exposure, twice daily) for 4 days. To evaluate gastrointestinal motility, mice were fed FITC-dextran (70Kda, 10mg/ml, 50ul/mouse), 30-min prior to sacrifice. The small intestine was divided into 1cm sections and FITC fluorescence was measured for each section. The small intestinal transit time was derived from the position of the geometric (Geom) center of FITC-dextran. Proinflammatory mediators were evaluated by measuring a gene expression profile through total RNA isolation from ileum and colon followed by qRT-PCR.

Results: Probiotic colonization was confirmed in probiotic-fed mice and not in control mice. The induction of NEC was associated with markedly reduced intestinal motility that was significantly improved in probiotic colonized mice (Geom Center, Probiotics/NEC 4.4 vs. non-probiotics/NEC 2.9, *p< 0.05). Probiotic administration significantly improved clinical features of NEC development (pneumatosis, discoloration of the bowel, and mortality rate (Probiotics/NEC 2 vs. non-probiotics/NEC 5, *p< 0.05). In addition, pro-inflammatory mediators TLR4, TNF and IL1B were reduced in probiotic fed mice compared to non-probiotic fed mice (TLR4, Probiotics/NEC 62.9 vs. non-probiotics/NEC 41.1, *p< 0.01).

Conclusion: Previous studies show that gastrointestinal dysmotility develops in NEC before the onset of systemic disease. Our findings suggest that probiotic administration may prevent NEC in part by restoring gastrointestinal motility and decreasing inflammatory response. Investigations into the exact mechanism are currently being conducted.

Abbreviations: NEC = Necrotizing Enterocolitis, geometric = Geom, qRT-PCR = Quantitative real-time reverse-transcription polymerase chain reaction.

APSA 58

TRANSAMNIOTIC DELIVERY OF COAGULATION FACTOR VIII MRNA: A POTENTIAL NOVEL STRATEGY FOR THE PERINATAL MANAGEMENT OF HEMOPHILIA A

Kamila Moskowitzova, MD[1], Emily Scire[1], Tanya T. Dang[2], Beatriz Bechara[1], Yash Shroff[1], Eva Zacharakis[1], Isabela Fitzgerald[1], Aaliyah Couto[1], David Zurakowski, MS,PhD[3], Dario O. Fauza, MD, PhD[4]

[1]Boston Children's Hospital, Harvard Medical School, Boston, MA, USA, [2]Boston Children's Hospital, Boston, MA, USA, [3]Boston Children's Hospital, Department of Anesthesia, Critical Care, and Pain Medicine Research, Boston, MA, USA, [4]Boston Children's Hospital, Department of Surgery, Boston, MA, USA

Abstract: Purpose: Hemophilia A is a prenatally diagnosable X-linked monogenetic disease that results in insufficient levels of circulating pro-coagulant factor VIII (FVIII). Infants with hemophilia A are at risk for life-threatening hemorrhage in the perinatal period including severe intracranial bleeding, especially during birth. Current management of hemophilia A involves costly multiple administrations of the very short lived FVIII protein. Messenger RNA therapies have emerged experimentally as novel strategies for the postnatal treatment of this disease. More recently, it has been shown that exogenous mRNA delivered into the amniotic fluid can reach the fetal circulation via the placenta. We sought to determine whether FVIII mRNA so delivered could be translated by the fetus leading to the presence of FVIII in the fetal circulation.

Methods: Thirteen time-dated pregnant Sprague Dawley dams underwent laparotomy followed by volume-matched intra-amniotic injections in all their fetuses (n=166) of either a custom-made human FVIII (hFVIII) mRNA encapsulated by a semi-synthetic composite lipopolyplex (mRNA group; n=115), or of the same lipopolyplex without mRNA (Control group; n=51) on gestational day 17 (E17; term=E21-22). Fetal liver and serum samples were procured daily thereafter until term and screened for the presence of the exogenous mRNA-encoded hFVIII protein by ELISA. Statistical analysis was by nonparametric Wilcoxon rank sum test ($p< 0.05$).

Results: There was no maternal mortality or premature labor. Overall survival was 90% (149/166). Controlled by the mRNA-free injections, fetal serum levels of hFVIII showed statistically significant higher overall levels in the mRNA group ($p=0.002$), peaking at E20 (24.4+/-2.4ng/mL in the mRNA group vs. 10.5+/-1.9ng/mL for Control, $p< 0.001$; Figure). In the fetal liver there was variability in statistically significant differences between the groups, with the Control group showing higher levels at select time points suggesting possible interspecies homology manifesting at that anatomical site (Figure).

Conclusions: Encapsulated exogenous mRNA encoding for pro-coagulation factor VIII appears to be incorporated and translated by the fetus following simple intra-amniotic injection in a rat model. Topographic mapping of mRNA incorporation/translation remains to be determined in a model with minimal/no human homology. Transamniotic mRNA delivery could become a novel strategy for the perinatal management of hemophilia A.

Abbreviations: mRNA - messenger nucleic acid
ELISA - enzyme-linked immunosorbent assay

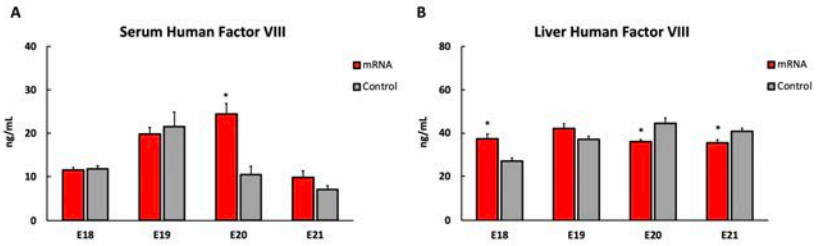


Figure. Human Factor VIII levels in fetal rats from E18 to E21 from the mRNA and Control groups in **(A)** serum and **(B)** liver. Data presented as mean ± SEM, * $p<0.05$ for mRNA vs. Control. E = gestational day (term = E21).

APSA 59

TRAUMATIC BRAIN INJURY INDUCES GASTROINTESTINAL INFLAMMATION AND DYSMOTILITY DUE TO ALTERATIONS IN EEC, ENTERIC NERVOUS SYSTEM AND CCR2 DEPENDENT PATHWAYS

Mahmoud El Baassiri, MD[1], Daniel J. Scheese, MD, MBS[2], Johannes Duess, MD, PhD[3], Zachariah Raouf, MD[4], William B. Fulton[3], Chhinder Sodhi, PhD[4], David Hackam, MD, PhD[4], Isam Nasr, MD[5]

[1]Division of Pediatric Surgery, The Johns Hopkins Medical Institutions, Baltimore, MD, USA, Baltimore, MD, USA, [2]Division of Pediatric Surgery, Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA, Baltimore, MD, USA, [3]Johns Hopkins University School of Medicine, Baltimore, MD, USA, [4]Johns Hopkins University School of Medicine, Department of Pediatric Surgery, Baltimore, MD, USA, [5]The Johns Hopkins Hospital, Baltimore, MD, USA

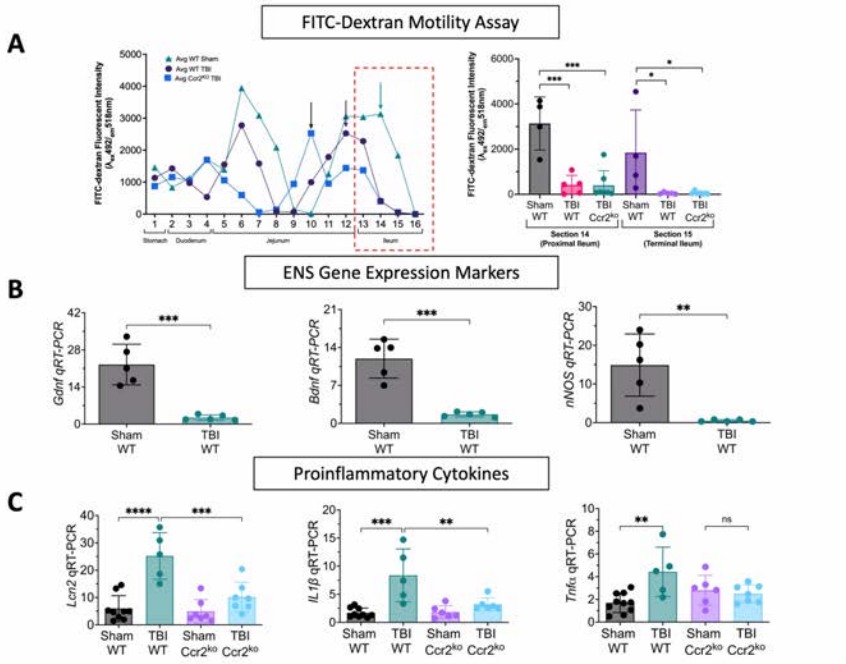
Abstract: Background: Traumatic brain injury (TBI) leads to acute gastrointestinal (GI) dysfunction and mucosal damage, resulting in feeding intolerance. Ccr2+ monocytes are crucial immune cells that regulate the gut's inflammatory response and enteric nervous system (ENS) via the brain-gut axis. Using CCR2KO mice, we investigated the intricate interplay between these cells to better elucidate the role of systemic inflammation after TBI.

Methods: A murine-controlled cortical impact model was utilized, and results were analyzed on post-injury days (PID) 1 and 3. The experimental groups included (1) Sham C57Bl/6 wild type (WT), (2) TBI WT, (3) Sham CCR2KO and (4) TBI CCR2KO. Mice were euthanized on PID 1 and 3 to harvest the ileum and study intestinal dysfunction and ENS activity, as well as monocyte infiltration using a combination of quantitative real-time PCR (qRT-PCR), immunohistochemistry, FITC- dextran motility assays, and flow cytometry. The Institutional Animal Care and Use Committee (IACUC) approved all our animal protocols. Student's t-test and one-way ANOVA were used for statistical analysis, with significance achieved when $p< 0.05$.

Results: TBI resulted in severe dysfunction and dysmotility of the small intestine in WT mice as established by impaired passage of FITC-dextran throughout the GI tract (3137+/-588.4, n=4 vs 411.8+/-190.9, n=5, $p< 0.001$) and significant upregulation of inflammatory cytokines Lcn2 ($p < 0.0001$), TNFα ($p < 0.01$), IL1β ($p < 0.001$), the innate immunity receptor toll-like receptor 4 (Tlr4) ($p < 0.01$), as well as iNOS as measured by staining ($p < 0.05$). This was accompanied by downregulation of ENS related genes including Gfap ($p < 0.001$), Gdnf ($p < 0.001$), Bdnf ($p < 0.001$) and nNos ($p < 0.01$). Notably, CCR2KO mice subjected to TBI showed substantial improvements in the intestinal inflammatory profile: TBI CCR2KO groups demonstrated reduced expression of inflammatory mediators including iNOS, Lcn2, IL1β, and Tlr4 ($p < 0.05$)

Conclusion: Our study reveals a critical role for both Ccr2+ monocytes and the ENS in modulating intestinal homeostasis after TBI. Increased infiltration of Ccr2+ monocytes aggravates intestinal inflammation while disruption in the ENS contributes to ileal dysmotility. Therefore, targeting Ccr2+ monocyte-dependent responses and ENS function provides therapeutic options to alleviate the deleterious sequelae of TBI in the gut and ultimately improve cognitive outcomes.

Abbreviations: CCR2: C-C chemokine receptor type 2
FITC: Fluorescein Isothiocyanate
LCN2: Lipocalin 2
TNFα: Tumor Necrosis Factor-alpha
IL1β: Interleukin-1 beta
GFAP: Glial Fibrillary Acidic Protein
BDNF: Brain-Derived Neurotrophic Factor
GDNF: Glial Cell Line-Derived Neurotrophic Factor
nNOS: Neuronal Nitric Oxide Synthase
iNOS: Inducible Nitric Oxide Synthase



(A) TBI leads to intestinal dysmotility as established by the impaired passage of FITC-dextran throughout the gastrointestinal tract, particularly the ileum, on post-injury day (PID) 3 **(B)** TBI causes a significant downregulation in ENS gene expression markers (*Gdnf*, *Bdnf*, *nNos*) on PID3 **(C)** TBI in Ccr2^{KO} mice exhibits gastroprotection, demonstrated by a decrease in expression of proinflammatory cytokines (*Lcn2*, *IL1β*, *TNFα*) on PID3.
Each dot on the graph represents a different mouse. Error bars indicate the mean ± SEM.
*p<0.05, **p<0.01, ***p<0.001, ****p<0.0001
TBI= traumatic brain injury, WT= wild-type

APSA 60

TRANSCRIPTOMIC ANALYSIS OF INFLAMED RAT FETAL GASTROSCHISIS INTESTINE REVEALS ALTERED HOMEOSTASIS THAT CAN BE REVERSED BY STEM CELL EXTRACELLULAR VESICLE ADMINISTRATION

Lina Antounians, MSc[1], **Elke Zani-Ruttenstock, MD**[2], Lindsey Li[3], Rebeca Figueira[4], Fabian Doktor, MD[1], Kasra Khalaj[1], Augusto Zani, MD, PhD, FACS, FAAP[5]

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Abstract: PURPOSE:
The pathophysiology of bowel inflammation in fetuses with gastroschisis (GS) remains poorly understood. Currently, there is no antenatal therapy that can reverse bowel inflammation in these babies. We and others have reported that extracellular vesicles derived from amniotic fluid stem cells (AFSC-EVs) have regenerative effects on various models of neonatal bowel inflammation. Herein, we aimed to analyze architectural and transcriptomic changes and AFSC-EV effects on GS bowel.

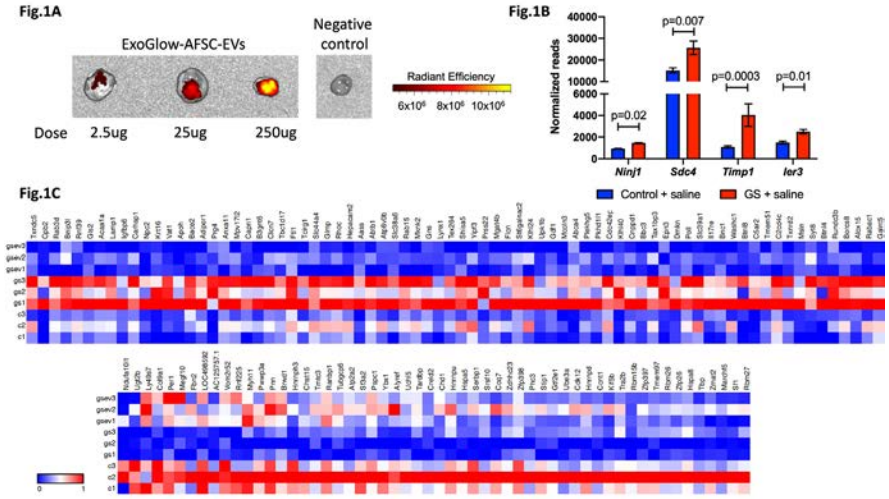
METHODS:
AFSC-EVs: isolation from rat AFSC conditioned medium was performed by ultracentrifugation. Vesicles were characterized for size, morphology, and canonical protein markers.
In vivo studies: Following approval (AUP#64117), on embryonic (E) day 18.5 rat fetuses underwent surgical creation of GS defect and received intra-amniotic injection of AFSC-EVs (GS+AFSC-EV group) or saline (GS+saline group). Fetuses that did not receive surgery served as control. On E21.5, fetuses were collected, bowel harvested to assess wall thickness (hematoxylin/eosin), and RNA isolated for sequencing.
Tracking studies: AFSC-EVs were labeled with ExoGlow-Vivo (doses: 2.5ug, 25ug, 250ug) and injected at E18.5 in GS and control fetuses. The bowel was imaged using IVIS® at E21.5.
RNA-sequencing studies: Three biological replicates/group were subjected to library preparation (Ribo-ZeroPlus rRNA Depletion Kit) and sequencing (Illumina-NovaSeq2). Groups were compared using DESeq2/gprofiler.

RESULTS:
Tracking studies confirmed that intra-amniotically injected AFSC-EVs reached the fetal bowel, as best shown with 250ug dose (Fig.1A). Bowel wall thickness was greater in GS+saline fetuses compared to controls ($p< 0.0001$), and was restored to normal in GS+AFSC-EV fetuses ($p< 0.0001$ vs. saline-treated; p=n.s. vs. controls). Compared to control, GS+saline bowel had upregulation of 241 genes (log2foldchange>0.5, p-adjusted< 0.05), including pro-inflammatory (Ninj1, Sdc4), stress-inducible (Ier3), and tissue remodeling (Timp1) genes (Fig.1B). Together, the 241 genes were enriched in biological processes related to immune responses (p=4.6E-06), extracellular matrix organization (p=0.003), metabolism (p=0.002), and apoptosis (p=0.02). The bowel of GS+AFSC-EV treated fetuses had 56 up- and 76 down-regulated compared to saline-treated GS fetuses (Fig.1C).

CONCLUSIONS:
We demonstrated that architectural changes to the fetal bowel in gastroschisis are associated with pro-inflammatory and immune responses on a transcriptional level. Moreover, in vivo administered AFSC-EVs reach the fetal bowel and restore cellular homeostasis.

Abbreviations: extracellular vesicles derived from amniotic fluid stem cells (AFSC-EVs)
gastroschisis (GS)
embrionic (E)
Ninjurin (Ninj1)
Syndecan-4 (Sdc4)
Metalloproteinase inhibitor 1 (Timp1)

Immediate Early Response 3 (Ier3)



APSA 61

EXPLORING THE THERAPEUTIC POTENTIAL OF IL-17A INHIBITORS IN NECROTIZING ENTEROCOLITIS

Krishna Manohar, MD[1], Jasmine Lee[1], Sharon Joseph, MD, MS[2], Jianyun Liu[1], John Brokaw[1], William Shelley[3], Troy Markel, MD[3]

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Abstract: Necrotizing enterocolitis (NEC) is a severe inflammatory condition affecting primarily premature infants, characterized by intestinal ischemia and the need for surgical intervention. Dysregulation of T-helper 17 (Th17) cells, a cell line implicated in autoimmunity and inflammation, has been proposed as a contributor to NEC pathogenesis. IL-17A, the primary cytokine released by Th17 cells, is implicated as a key effector cytokine in NEC, triggering subsequent inflammatory signaling cascades leading to intestinal, lung, and brain inflammation. IL-17A inhibitors, such as Secukinumab, are already utilized in children and adolescents for other Th17 prevalent conditions. We hypothesized that in vivo neutralization of IL-17A would attenuate NEC in a murine experimental model.

NEC was induced in five-day-old mouse pups using gavage formula feeds and intermittent hypoxia and hypothermia. Four groups were studied (n=6-7): breastfed controls, NEC, NEC + low-dose IL-17A inhibitor(1mg/kg/day), and NEC + high-dose IL-17A inhibitor (3 mg/kg/day). IL-17A inhibitor was administered daily to pups via intraperitoneal injection. Pups were assessed daily for clinical sickness scores and euthanized on postnatal day 9. Intestinal segments were explanted to assess macroscopic intestinal score. Groups were compared using Kruskal-Wallis tests.

Animals with NEC exhibited significantly worse weight gain compared to breastfed controls ($p=0.0178$). However, there were no significant improvements in weight gain with IL-17A inhibitor treatment. The NEC group had significantly worse clinical sickness scores than the breastfed control group ($p< 0.0001$), which were significantly improved with high-dose IL-17A inhibitor ($p=0.0158$). Additionally, the NEC group had significantly worse macroscopic intestinal injury scores compared to breastfed controls ($p=0.0001$), which were significantly improved with low-dose IL-17A inhibitor ($p=0.0109$).
As IL-17A inhibitors are already prevalent and well studied biologic therapies in other pediatric diseases, IL-17A inhibition shows promise as a potential adjunct therapy for NEC. Further research is needed to optimize the dosage of the inhibitor as well as to investigate the potentially therapeutic downstream effects of IL-17A inhibition on the brain and lung, which are also affected organs in NEC.

Abbreviations: IL-17A: Interleukin-17A, NEC: necrotizing enterocolitis, Th-17:T-helper 17

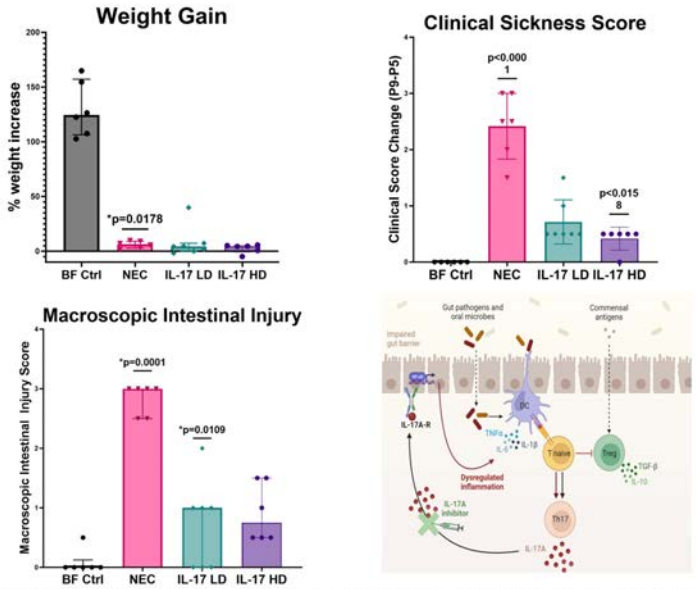

Figure 1: IL-17A Inhibitor Therapy improves outcomes in murine NEC. There are no significant improvements in weight gain with IL-17A inhibitor treatment. Mice with NEC had significantly worse clinical sickness scores than breastfed controls (p<0.0001), which was significantly improved with high-dose IL-17A inhibitor (p=0.0158). Additionally, mice with NEC had significantly worse macroscopic intestinal injury scores compared to breastfed controls (p=0.0001), which were significantly improved with low-dose IL-17A inhibitor (p=0.0109). The graphic describes how IL-17A inhibitor thoeretically neutralizes IL-17A cytokine *in-vivo* resulting in blocking the dysregulated inflammatory cascade in NEC caused by increased Th17 cells releasing more IL-17A in a pathogenic inflammatory cycle.

APSA 62

ADENOSINE SUPPLEMENTATION PROTECTS THE INTESTINAL EPITHELIUM AND REDUCES SEVERITY OF NECROTIZING ENTEROCOLITIS

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Abstract: Purpose: Necrotizing enterocolitis (NEC) is the leading cause of death from gastrointestinal disease in premature infants. We have previously shown that activation of the gram-negative bacterial receptor, toll-like receptor 4 (TLR4), on the intestinal epithelium is required for NEC development, due to the effect of TLR4 on inducing mucosal inflammation. The resulting mucosal inflammation causes epithelial cell death which releases large stores of extracellular inflammatory ATP which are enzymatically dephosphorylated to anti-inflammatory adenosine. We hypothesized that the supplementation of oral adenosine to the intestinal epithelium will protect against the TLR4-induced mucosal inflammation and epithelial cell death seen in NEC.

Methods: IEC6 enterocytes were co-cultured with Lipopolysaccharide (LPS) (50ug) and 5′-N-ethylcarboxamide adenosine (NECA) (1ug) and NF-κB translocation was performed. NEC was then induced in newborn C57Bl/6 mice through four days of formula gavage, intermittent hypoxia, and oral inoculation with stool from an infant with severe NEC. NECA (0.2ug/mL) was administered via oral gavage to the treatment group with each feed. Tissue was obtained to determine NEC severity and intestinal inflammation by histology and qRT-PCR. Lastly, an endotoxemia model was performed on P12 C57Bl/6 mice with intraperitoneal LPS (5mg/mL, 6hrs) and orally fed NECA (1ug/pup) to the treatment group. Serum was collected after six hours to determine mucosal barrier integrity through a FITC-dextran permeability assay.

Results: NECA treatment significantly reduced LPS-induced translocation of the downstream transcription factor NF-κB from the cytoplasm to the nucleus in IEC6 enterocytes (LPS+NECA=950 vs. LPS=1044, $p< 0.0001$). Mice treated with NECA demonstrated a significant decrease in the expression of TLR4 (NEC+NECA=11.93 vs. NEC=19.24, $p=0.0018$) and pro-inflammatory cytokines, TNF-a (NEC+NECA=1.786 vs. NEC=3.977, $p=0.0039$) and IL-6 (NEC+NECA=1.081 vs. NEC=2.260, $p=0.0064$). The NECA-treated mice also demonstrated a significant increase in mucosal barrier integrity, demonstrated by a significant decrease in serum FITC-dextran fluorescence (LPS+NECA=14.83 vs. LPS=33.97, $p=0.0027$).

Conclusion: Direct adenosine supplementation to the intestinal mucosa through oral administration restrains TLR4 signaling during bacterial colonization to reduce NEC severity, suggesting a novel therapeutic target for this devastating disease.

Abbreviations: NEC - Necrotizing Enterocolitis
TLR4 - Toll-like Receptor 4
ATP - Adenosine Triphosphate
NECA - 5'-N-ethylcarboxamide adenosine
FITC-dextran - Fluorescein Isothiocyanate-Dextran

APSA 63

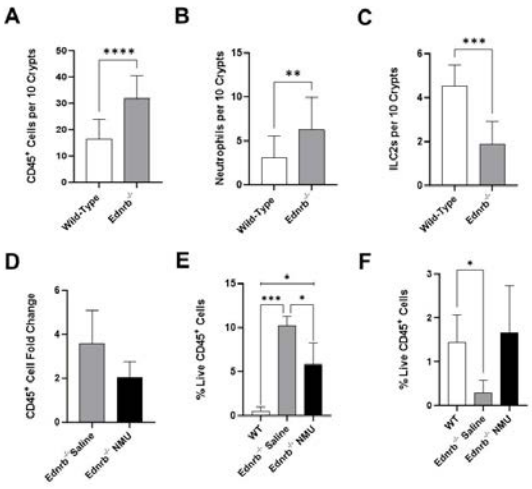
THE ENTERIC NEUROTRANSMITTER NEUROMEDIN-U REDUCES INFLAMMATION IN HIRSCHSPRUNG-ASSOCIATED ENTEROCOLITIS THROUGH ACTIVATION OF GROUP 2 INNATE LYMPHOID CELLS

Leah C. Ott, MD, Takahiro Ohkura, MD, PhD, Rhian Stavely, PhD, Kensuke Oishi, PhD, Christopher Han, BS, Abigail Leavitt, BS, Ryo Hotta, MD, PhD, Allan M. Goldstein, MD

Massachusetts General Hospital, Boston, MA, USA

Abstract: Purpose: Hirschsprung-associated enterocolitis (HAEC) is the most serious complication of Hirschsprung disease (HSCR). Impaired mucosal immunity is likely a contributing factor. Group 2 innate lymphoid cells (ILC2s) regulate mucosal immunity and are activated by enteric neurons via the neurotransmitter neuromedin U (NMU). It is unknown whether colonic ILC2s are reduced in HSCR or if activated ILC2s can attenuate HAEC.
Methods: ILC2s (CD3- KLRG1+), leukocytes (CD45+), and neutrophils (S100a+) were quantified in the colons of P14 wild-type and Ednrb knockout (Ednrb-/-) mice (n = 2 per group) by immunofluorescence. Counts were performed per 20x high power field and normalized to the number of crypts. P14-16 Ednrb-/- mice were treated with one dose of recombinant NMU (1 µg/g body weight) or saline vehicle (n = 3-5 per group) then sacrificed 72 hours post-injection. Colons were digested to single cell suspensions, stained with fluorescent antibodies, and immune cell populations analyzed by flow cytometry.
Results: P14 Ednrb-/- mice demonstrated prominent leukocyte (Fig 1A, p=0.003) and neutrophil (Fig 1B, p = 0.008) infiltration in the colon consistent with HAEC, but had significantly fewer ILC2s than wild-type mice (Fig 1C, p < 0.0001). NMU injection resulted in a significant reduction in leukocyte (Fig 1D, fold change from wild-type) and neutrophil (Fig 1E) infiltration, consistent with markedly decreased inflammation, and promoted ILC2 expansion (Fig 1F) compared to saline injection.
Conclusions: Ednrb-/- mice have fewer colonic ILC2s, likely due to impaired or absent enteric neuronal signaling. NMU decreases colonic inflammation in these mice, suggesting that restoration of neuroimmune signaling through ILC2s may be a promising treatment strategy for HAEC.

Abbreviations: ILC2- group 2 innate lymphoid cell
NMU- neuromedin-u
HAEC- Hirschsprung associated enterocolitis
HSCR- Hirschsprung disease



Scientific Session III - Common Pediatric Surgery Issues #1
10:45 AM – 12:00 PM

APSA 37

MINIMALLY INVASIVE PILONIDAL EXCISION FOR THE TREATMENT OF PILONIDAL DISEASE - A MULTI-CENTER PROSPECTIVE TRIAL

James K. Moon, MD[1], Arturo Aranda, MD[2], Eunice Huang, MD, MS[3], Tim Jancelewicz MD MA MS[4], Maria ValenciaBradd[5], Samir Pandya[5], Barrie S. Rich MD[6], Sohail R. Shah MD MSHA[7], Bethany J. Slater MD MBA[8], Christopher Turner[9], Aaron M. Lipskar, MD[10], Charlotte Kvasnovsky[8]

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Abstract: Introduction
Pilonidal disease is a common condition with multiple surgical options for treatment, depending on severity of disease as well as surgeon and patient preference. Recently, minimally invasive pilonidal excision (MIPE) has gained traction as a less invasive procedure in adults. We aimed to assess uptake of MIPE and surgical outcomes across children's hospital. We hypothesized that uptake would be high, with favorable outcomes and acceptable recurrence rates.

Methods
Nine children's hospitals with surgeons participating in the Pediatric Surgery Research Collaborative, enrolled patients in a prospective observational study from 1/2019-6/2022. Surgeons, patients, and their families were free to proceed with the operative intervention they preferred. Patients were followed longitudinally to assess outcomes, including disease recurrence.

Results
151 children from 6 children's hospitals had data available for review. Median age was 16 years (IQR 15-17, Table 1). Patients had a median of 1 occurrence of pilonidal disease prior to enrollment (range 0-4, IQR 1-2). 39 patients (26%) had a prior incision and drainage procedure, while 18 patients (12%) had prior MIPE and 10 patients (7%) had undergone other operative intervention.

Most patients, 134 (89%) underwent MIPE while 13 patients had a modification including concomitant incision and drainage or other debridement. 4 patients (2.6%) underwent complex excision of pilonidal disease. At follow up, 97% of respondents stated that they would recommend their procedure to a friend.

Of sites with follow-up data for two or more years, 5/49 patients (10.2%) underwent a second procedure for their pilonidal disease. Recurrence rate was 0 within 6 months, 4.1% within 1 year, and 10.2% within 2 years, with follow-up ongoing.

Conclusions
Among participating centers and surgeons, the MIPE was the preferred procedure for pilonidal disease both as an initial procedure and for recurrence. Consistent with prior reports in adults, 10.2% of patients needed an additional procedure during the first 2 years following MIPE. Most patients would recommend MIPE.

Abbreviations: minimally invasive pilonidal excision (MIPE)

APSA 38

KICKING THE CAN DOWN THE ROAD: OVERNIGHT DECISION-MAKING FOR EQUIVOCAL APPENDICITIS OFTEN INVOLVES UNNECESSARY HOSPITAL ADMISSIONS

Steven T. Papastefan, MD[1], Sara Ungerleider, BA[2], Michela Carter, MD[3], J. Benjamin Pitt, MD[4], Kathryn L. McElhinney, MD[5], Seth D. Goldstein, MD, MPhil[4]

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Abstract: Purpose: After-hours surgical consultations for appendicitis are common in children's hospitals. When clinical presentation or imaging are equivocal, options include hospital observation with serial examinations, discharge from the emergency department (ED) with return precautions, and surgery, recognizing a higher possibility of negative appendectomy. The purpose of this study is to characterize the benefits and harms of equivocal appendicitis hospital observation admissions, given they are primarily after-hours phenomena.

Methods: This is a single-institution retrospective review of patients < 18 years evaluated for suspected appendicitis between 6PM and 6AM from 7/2021-7/2023. Appendicitis was defined as equivocal based on MRI or CT findings and/or discordant imaging with clinical presentation as evaluated by overnight staff. Patients were grouped based on initial ED disposition, and clinical characteristics at presentation and progression to appendectomy evaluated. Statistical analysis was performed using Student's T-test and Chi-squared or Fisher's exact test for subgroup analysis.

Results: In total, 517 patients with suspected appendicitis were evaluated, with 84 (16.2%) equivocal cases. Of these, 38 (45.2%) were discharged home from the ED and 46 (54.8%) admitted for observation. Appendectomy was performed in 10 (21.7%) admitted patients with 3 negative appendectomies. One (2.7%) patient initially discharged from the ED underwent appendectomy, which was negative on final pathology. Rate of equivocal imaging findings were similar between admitted and discharged patients (71.1% vs. 80.4%, P=.315), with the remainder diagnosed equivocal based on imaging/presentation discordance. Alvarado score was significantly higher for admitted versus discharged patients overall (Table), and for patients with pathologic confirmation of appendicitis versus admitted patients without appendicitis (5.9 ± 1.7 vs. 4.2 ± 1.8, P=.031).

Conclusion: Children offered overnight observation for equivocal appendicitis presentations are most often discharged the following day and have unexpectedly high negative appendectomy rates. Children with similar presentations initially discharged home rarely require subsequent surgical intervention. Clinical features distinguishing true cases of appendicitis are identifiable at the time of emergency department evaluation by validated scoring systems, and the added value of hospital admission for serial examinations is questionable. We conclude that for equivocal cases presenting overnight, more often the disposition should be dichotomized as operating room versus home.

Abbreviations: ED: Emergency department
MRI: Magnetic resonance imaging
CT: Computed tomography

APSA 39

INTEGRATION OF CARE FOR PEDIATRIC PATIENTS WITH GASTROSTOMY TUBES

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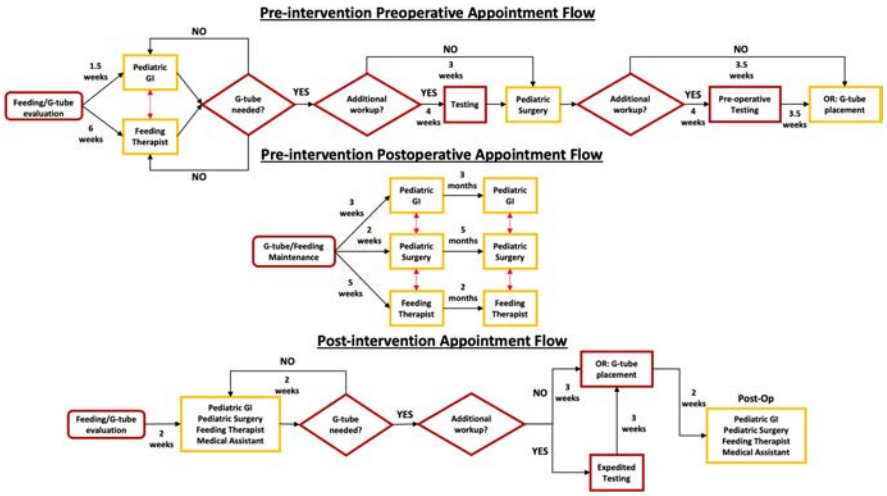
Abstract: Purpose: Design a multidisciplinary, integrated outpatient visit model for pediatric patients with gastrostomy tube needs.

Methods: A new care model was implemented and followed over a 1-year period (5/2019-4/2020) at our institution. The model consolidated multiple subspecialties into one colocalized space and one multidisciplinary program, where provider teams performed pre-visit huddles to coordinate care. During outpatient visits, patients were simultaneously seen by the pediatric surgeon, pediatric gastroenterologist, and feeding therapist. The model additionally incorporated patient education and telehealth services. Twenty-one patients were included in the study. Physical appointments, missed visits, emergency department (ED) visits, and billable encounters and procedures were compared to the year prior to the intervention (5/2018-4/2019). A paired samples t-test was used to compare means between groups. A statistically significant difference was defined as $p < 0.05$.

Results: Following the intervention, physical visits were reduced by 57% (pre-intervention vs. post-intervention mean 6.05 and 2.19, respectively. $p < 0.001$) by the joint visit model compared to the year prior. Missed appointments were reduced by 86% (pre-intervention vs. post-intervention mean 2.19 and 0.10, respectively. $p < 0.001$) and ED visits related to gastrostomy tube care were reduced by 87% (pre-intervention vs. post-intervention mean 0.76 and 0.10, respectively. $p = 0.045$). Oral autonomy and gastrostomy tube removal were achieved in 25% of the cohort post intervention, which was an increase of 50% from the year prior. There was no statistically significant difference in billable encounters or billable procedures.

Conclusions: We conclude that this intervention serves as a successful model to integrate care, streamline care delivery, and reduce avoidable visits while maintaining billable encounters. This method could be applied to other complex pediatric medical conditions and further expanded to coordinate care among providers in various practice settings. Patient populations with limited resources and access to transportation may particularly benefit from the reduction in physical visits.

Abbreviations: Emergency Department (ED)



APSA 40

FACILITATING THE USE OF SAME-DAY DISCHARGE AFTER APPENDECTOMY IN CHILDREN: IMPLEMENTATION OF AN EVIDENCE-BASED POST-OPERATIVE PATHWAY

Emmanuel L. Abebrese, MD[1], Radek Buss, MD[2], Kyle Van Arendonk, MD PhD[3], Kathleen Leak[4], David Gourlay, MD[5]

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Abstract: Purpose

Same-day discharge (SDD) after laparoscopic appendectomy provides high-value appendicitis care to children, minimizing length of stay (LOS) and costs, without increasing readmissions or emergency department (ED) visits. We describe implementation of an evidence-based post-operative SDD pathway for children with uncomplicated appendicitis (UA) at a large free-standing children's hospital, during and adjusting for concurrent changes related to the COVID-19 pandemic.

Methods

Using Lean Six Sigma methodology, we found that operative timing, lower socioeconomic status, and travel distance were barriers underlying prior variability in SDD utilization among children with UA at our institution (March 2020). A multidisciplinary team including surgeons, advance practice providers, nurses, and hospital leadership then designed, implemented (April 2021), and re-evaluated (April 2022) a new post-operative SDD pathway. This pathway optimized pre-operative expectations, enabled discharge directly from the recovery room when clinically appropriate, and addressed families' socioeconomic and travel barriers. A retrospective review compared SDD utilization pre- (January 2018-April 2021) and post-implementation (April 2021-March 2023). Multivariable regression models analyzed the impact of pathway implementation on SDD utilization, adjusting for other factors.

Results

Among 1235 children with UA, 56.3% underwent appendectomy before and 43.7% after SDD pathway implementation. Age, sex, and race were similar between groups ($p>0.05$). Utilization of SDD increased to 82.8% post-implementation compared to 51.8% pre-implementation ($p< 0.001$) (Table 1). Total hospital charges decreased by nearly $700 per patient ($p< 0.001$), and post-operative LOS decreased by 5.6 hours ($p< 0.0001$) post-implementation. Readmissions, ED visits, and outside hospital visits within 30 days were similar between groups ($p>0.05$). Increased utilization of SDD post-implementation was seen among patients undergoing surgery before noon (95.3% vs. 78.4%, $p< 0.001$) and after (65.1% vs. 32.1%, $p< 0.001$). Implementation increased the likelihood of SDD utilization by 69% (adjusted odds ratio 1.69, 95% CI 1.15-2.49, $p=0.008$), adjusting for the COVID-19 pandemic, age, sex, race, and operative time of day.

Conclusion

Multidisciplinary design and implementation of an evidence-based post-operative pathway successfully increased utilization of Same Day Discharge among children with Uncomplicated Appendicitis without increasing post-operative returns to the hospital. These improvements were accomplished during and despite the COVID-19 pandemic and were beyond what would be attributable to the pandemic alone.

Abbreviations: IQR = interquartile range, LOS = length of stay, ED = emergency department, OSH = outside hospital, UA = Uncomplicated Appendicitis, SDD= Same Day Discharge

APSA 41

A RETROSPECTIVE ANALYSIS OF PERIOPERATIVE NAUSEA AND EMESIS BASED ON PRE-OPERATIVE NPO TIME IN PEDIATRIC PATIENTS WITH APPENDICITIS

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Abstract: Purpose:

Preoperative fasting reduces the risk of perioperative complications relating to anesthesia, particularly aspiration with induction. Some advocate adjusting standard nothing by mouth (NPO) times for solids in the setting of gastrointestinal factors that might affect gastric transit time, like appendicitis. Patients admitted with appendicitis with plans for next day surgery are often kept NPO from the time of admission, rather than no solid food after midnight prior to appendectomy. We sought to analyze if there is a difference in post-operative outcomes between these groups.

Methods:

For patients admitted in preparation for surgery the next day without active nausea or concerns for bowel obstruction, we began allowing orders for solid food up until midnight, and NPO for solids after midnight. Patients undergoing nonelective appendectomy at our institution between May 2014 and December 2019 were included (n=617). The primary variable analyzed was time of NPO order, specifically comparing patients who were initially allowed to eat and then made NPO at midnight (Group 1, n=91) vs patients who were made NPO on admission (Group 2, n=526). Our primary outcome was pre- and post-operative nausea and emesis, including emesis with induction of anesthesia. Analysis using independent T-test, Fisher’s exact, and Chi-square tests were performed with SPSS (Version 29.0, Armonk, NY). Two-sided p-value < 0.05 was considered significant.

Results:

There were no significant differences in demographic characteristics and either preoperative nausea or emesis between groups. There was only one recorded instance of emesis with induction in a patient NPO from admission (Group 2), and no aspiration events. There were decreased rates of postoperative nausea (4.4% vs 12.0%, p=0.032) and emesis (3.3% vs 9.7%, p=0.046) in Group 1 when compared to Group 2. Group 1 also had significantly shorter overall NPO times (750 mins vs 882 mins, p=0.026).

Conclusions:

In pediatric patients with appendicitis admitted for next day surgery, those initially allowed to eat and then made NPO at midnight rather than NPO from admission have decreased total NPO time and decreased postoperative nausea and emesis.

Abbreviations:

APSA 42

PAUSE THE REPEAT: EVALUATING THE EFFICACY OF REPEAT IMAGING IN TRANSFERRED PEDIATRIC PATIENTS WITH SUSPECTED APPENDICITIS

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Abstract: Current imaging practices in pediatric patients transferred with suspected appendicitis to tertiary children's hospitals may result in repeated ultrasound (US) or computed tomography (CT) imaging, or requires an image overread. This results in more time in the emergency department and higher healthcare costs. This study aims to evaluate whether repeat imaging improves outcomes by comparing pre- and post-transfer imaging to surgical pathology to determine the accuracy of imaging performed at referring centers.

Methods

This is a retrospective observational study using electronic medical record data from a single tertiary children's hospital. Inclusion criteria were age < 18 years, transfer from a referring hospital with abdominal imaging, and a suspected diagnosis of appendicitis as the reason for referral. Exclusion criteria included transfers for alternate diagnoses and no imaging prior to transfer. Statistical analysis included descriptive statistics and sensitivity calculations. Fisher's Exact Test was used to determine statistical significance between each diagnostic modality.

Results

519 patients transferred to a tertiary care center with previous imaging were analyzed. Prior to transfer, 34 (26%) of patients had US and 348(67%) had CT. Prior to transfer 26 (0.05%) patients had ultrasound followed by CT . After transfer, 122 (23.5%) of patients had US and 8 (0.02%) had repeat CT, while 331 (62%) of patients received a second read of a prior CT. Of 347 patients transferred with a CT, 94% had surgery and 93% of those were found to have appendicitis on pathology. Outside CT scan was found to have 99.6% sensitivity, while overread was found to have 97.9% sensitivity.

Of 135 patients transferred with US, 84% had surgery and 90% of the operative patients had appendicitis on pathology. Outside ultrasound was found to have 93% sensitivity. Post-transfer repeat US was found to have 98.9% sensitivity. There was no statistical significance between the sensitivities of US or CT.

Conclusions:

Pre-transfer US and CT imaging had comparable sensitivity in the diagnosis of acute appendicitis to post-transfer imaging for pediatric patients referred for suspected appendicitis. Repeat imaging or overread by in-house radiologists. Additional repeat imaging or reinterpretation following transfer may be unnecessary in the diagnosis of acute appendicitis.

Abbreviations:

APSA 43

REDUCING BLOOD DRAWS IN PEDIATRIC PATIENTS WITH SOLID ORGAN INJURY THROUGH PROTOCOLIZED TRANSCUTANEOUS HEMOGLOBIN MONITORING

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Abstract: Background: Management of pediatric solid organ injuries has significantly evolved in the last two decades decreasing the need for serial hemoglobin measurement, repeat imaging, and operative intervention. Most children can be safely cared for with a short hospitalization for hemoglobin monitoring followed by activity restriction after discharge. Transcutaneous hemoglobin monitoring (TCHM) has been shown to be safe and effective in these patients. When used in a protocolized fashion, TCHM may virtually eliminate the need for serial blood draws in most pediatric solid organ injury patients.

Methods: A 6-year, single-center, retrospective chart review was conducted of pediatric solid organ injury patients aged 30 days to < 18 years admitted to a quaternary children's hospital following the implementation of a highly protocolized TCHM system. Laboratory hemoglobin measurements were obtained at admission, and additional blood draws were determined by injury grading (Table 1). Adverse events were tracked and included: blood product(s) administration, percutaneous embolization procedures, operative intervention, and invasive line placement for hemodynamic monitoring.

Results: A total of 96 patients met inclusion criteria. Pre- and post-protocol groups had no statistically significant variations in basic demographics. Blood draws were greatly reduced following TCHM protocol implementation during the study period (3.0 [IQR 2.0-6.0] vs 2.0 [IQR 1.0-4.0], $p < 0.02$). There was no significant difference seen in blood product administration ($p= 0.14$), operative intervention ($p= 0.29$), line placement for hemodynamic monitoring ($p= 1$), or length of stay ($p= 0.28$). The rate of ICU transfer, percutaneous embolization procedures, and operative intervention was too low for statistical evaluation.

Conclusion: This study suggests that institutional implementation of a TCHM system in pediatric solid organ injury patients is safe and effective. When utilized within a well-defined protocol, TCHM greatly reduced the need for blood draws following admission; this likely resulted in reducing both stress for patients and families and the period of post-injury anemia. Further studies may be useful to evaluate the role of TCHM in shortening or eliminating hospital admissions for low-grade solid organ injuries in children.

Abbreviations: Transcutaneous hemoglobin monitoring (TCHM)

APSA 44

ASSOCIATION OF PROPHYLACTIC ANTIBIOTIC USE WITH OUTCOMES IN INFANTS UNDERGOING PYLOROMYOTOMY

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Abstract: Purpose: The purpose of this study was to compare rates of surgical site infection and hospital readmission in children undergoing pyloromyotomy who did and did not receive antimicrobial prophylaxis.

Methods: Children undergoing pyloromyotomy were identified from the 2021 ACS NSQIP-Pediatric general participant use file (PUF). Outcomes including surgical site infection (incisional and organ space) and hospital readmission within 30 postoperative days were obtained from the general use file while prophylaxis utilization data was obtained from the NSQIP-Pediatric Surgical Antibiotic Prophylaxis (SAP) PUF for the same year. Outcomes were compared between patients after propensity matching on age at time of surgery, history of prematurity, ASA class, preoperative length of stay, and method of pyloromyotomy (laparoscopic vs open).

Results: 2120 patients were included from 150 hospitals. The median age at repair was 35 days (IQR: 27-46 days) and 84.4% were male. Overall, 48.5% received antimicrobial prophylaxis and the most common agents included cefazolin (95.7%) and cefoxitin (3.6%). The overall rate of SSI was 1.4% (incisional: 1.2%; organ space: 0.2%) and 2.3% were readmitted to the hospital. In the pre-matched cohort, patients receiving prophylaxis were less likely to have a history of prematurity, had overall lower ASA scores, and were more likely to undergo open surgery (Figure). Following matching, no differences were found in these or other patient characteristics (Figure). No differences were found between groups in SSI or hospital readmission in either the unmatched or matched cohorts (Figure).

Conclusion: Use of antimicrobial prophylaxis was not associated with clinically relevant improvement in outcomes in children undergoing pyloromyotomy.

Abbreviations: PUF - ACS NSQIP-Pediatric general participant use file
SAP - NSQIP-Pediatric Surgical Antibiotic Prophylaxis
ASA - American Society of Anesthesiologists
SSI - Surgical site infection
LOS - length of stay

Summary of the frequencies of patient characteristics and outcomes in the unmatched and matched cohorts.

	Unmatched Cohort			Matched Cohort		
	Antibiotics (-) (N = 1091)	Antibiotics (+) (N = 1029)	P value	Antibiotics (-) (N = 907)	Antibiotics (+) (N = 907)	P value
Patient Characteristics						
Age* at Operation, median (IQR)	**36 (28-47)**	**34 (27-44)**	**0.017**	35 (27-46)	35 (27-46)	0.965
Prematurity, N (%)	**105 (9.6)**	**66 (6.4)**	**0.008**	60 (6.6)	61 (6.7)	0.925
ASA[a] Class, N (%)			**0.046**			0.901
1	**189 (17.3)**	**225 (21.9)**		186 (20.5)	189 (20.8)	
2	**658 (60.3)**	**604 (58.7)**		550 (60.6)	533 (58.8)	
3	**229 (21.0)**	**193 (18.8)**		164 (18.1)	179 (19.7)	
4	**11 (1.0)**	**5 (0.5)**		5 (0.6)	4 (0.4)	
Open Surgery, N (%)	**112 (10.3)**	**216 (21.0)**	**<0.001**	112 (12.4)	119 (13.1)	0.663
Preoperative LOS**, N (%)			0.690			0.902
0	294 (26.9)	269 (26.1)		245 (27.1)	240 (26.5)	
1	674 (61.8)	653 (63.5)		569 (62.7)	570 (62.8)	
2+	123 (11.3)	107 (10.4)		92 (10.1)	97 (10.7)	
Outcomes						
SSI[b], N (%)	16 (1.5)	14 (1.4)	0.856	15 (1.7)	13 (1.4)	0.849
Readmission, N (%)	22 (2.0)	26 (2.5)	0.467	17 (1.9)	22 (2.4)	0.518

*Age in days
**Length of stay in days
[a]American Society of Anesthesiologists (ASA) physical classification system is a grading system that determines the health of a person before a surgical procedure
[b]Surgical site infection includes superficial, deep and organ space infections.

APSA 45

FACTORS ASSOCIATED WITH DELAY TO CARE IN PEDIATRIC AND ADOLESCENT ADNEXAL TORSION: A MULTI-INSTITUTIONAL REVIEW

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Abstract: Purpose: The diagnosis of adnexal torsion is challenging due to the variable clinical presentation and often inconclusive imaging results. We hypothesize that delays in diagnosis of torsion are common, which may lead to prolonged ischemia and subsequent tissue loss. We aimed to identify factors associated with diagnostic delays in pediatric patients with adnexal torsion.

Methods: A multi-institutional retrospective review was performed in females aged 5-18 years who underwent an operation for confirmed adnexal torsion between 2013-2022. Delay to care was defined as a) Emergency Room (ER) discharge within 7 days prior to operation or b) hospital admission without initial plan for operative intervention.

Results: 606 patients with adnexal torsion were identified from 8 institutions. Patient demographics are summarized in Table 1. Most patients were treated in an urban (99.7%), free-standing children's hospital (99.0%). Diagnosis was delayed in 30.5% of patients. On univariable analysis, distance from hospital ($p=0.004$), insurance status ($p=0.014$) and area deprivation index (ADI) ($p< 0.001$) were associated with delays. ADI remained associated on multivariable analysis ($p < 0.001$); for every unit increase in ADI, the odds of delay increased by 2% (OR 1.022, 95% CI 1.015-1.030). No significant association was found with age, obesity, menarchal status, comorbidities, transfer from outside ER, and presenting symptoms. Those with delay were less likely to have imaging at initial ER visit ($p=0.008$) and patients with delay who had a pelvic ultrasound were less likely to have peripheralization of follicles ($p=0.003$), diminished flow ($p=0.003$), or twisted pedicle ($p< 0.001$) on initial imaging. Overall rates of oophorectomy and salpingectomy were 7.9% and 11.0%; those with delay were more likely to undergo oophorectomy (11.4% vs 6.2%, $p=0.028$), but not salpingectomy.

Conclusion: Delay in diagnosis of adnexal torsion is common and associated with ADI. Rates of oophorectomy were higher in patients with a delay in diagnosis. Increased awareness and understanding of this disparity in care with regards to adnexal torsion is critical to reduce diagnostic errors, decrease time to definitive treatment and improve rates of adnexal salvage.

Abbreviations: ADI: Area Deprivation Index; ER: Emergency Room

Friday, May 17, 2024

Plenary Session II
8:15 AM – 9:30 AM

APSA 10
EXTRACELLULAR CIRP EXACERBATES NECROTIZING ENTEROCOLITIS

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Abstract: Purpose: Necrotizing enterocolitis (NEC) is a devastating disease of preterm infants characterized by bowel ischemia and necrosis, resulting in high morbidity and mortality. Extracellular cold-inducible RNA-binding protein (eCIRP) is a recently discovered alarmin that propagates inflammation, causes tissue injury, and directly correlates with clinical sepsis severity and mortality. Milk fat globule-EGF factor-VIII (MFG-E8) enhances the clearance of apoptotic cells to maintain homeostasis. This study aimed to uncover the role of eCIRP in worsening NEC pathogenesis and elucidate the therapeutic potential of MFG-E8-derived oligopeptide (MOP3), designed to scavenge eCIRP and attenuate NEC severity.

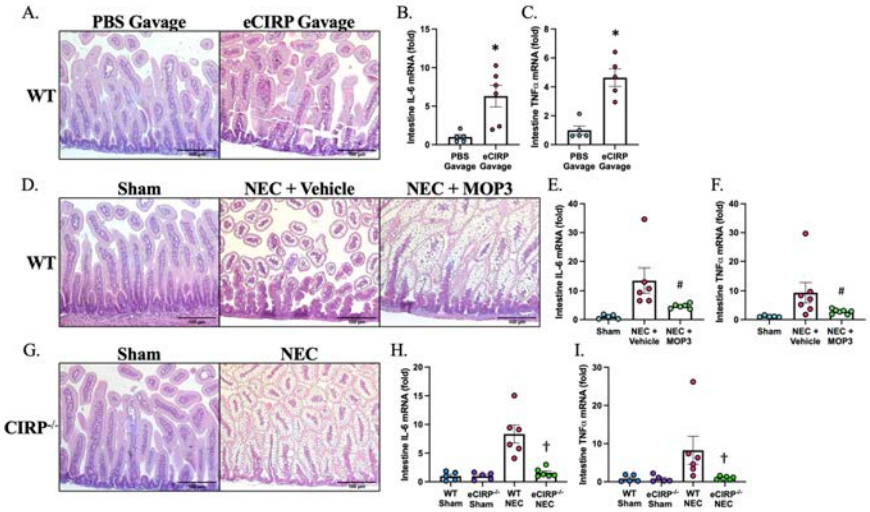
Methods: Wild-type (WT) 5-7-day-old mouse pups were administered recombinant murine (rm)-CIRP (eCIRP; 5 mg/kg) or PBS by orogastric gavage twice/day. After 4 days, blood and intestines were analyzed for inflammatory parameters. NEC was induced in WT and CIRP-/- 5-7-day-old pups utilizing a combination of hypercaloric formula gavage (Similac:Esbilac 2:1) 5 times/day (supplemented with LPS twice, 4 µg/g/day), and hypoxia (95% N2, 5% O2) for 10 minutes twice/day. WT pups were treated intraperitoneally with MOP3 (20 µg/g) or vehicle daily. After 4 days, blood and intestines were analyzed for inflammatory parameters. Differences in overall mortality were assessed in a 5-day survival study.

Results: eCIRP gavage induced histopathologic intestinal injury and inflammation compared to PBS (Figure 1, A-C). WT pups treated with MOP3 were significantly protected against NEC-induced intestinal injury and inflammation compared to vehicle (Figure 1D-F). Quantification of histopathologic injury revealed a 41.5% reduction in NEC injury severity score in MOP3-NEC pups compared to vehicle-NEC ($p< 0.001$). Systemic inflammation assessed by sera eCIRP was significantly decreased with MOP3 treatment by 64.1% compared to vehicle ($p=0.01$). 5-day survival was significantly greater in MOP3-NEC pups compared to vehicle-NEC (87.5% vs. 47.1%, respectively, $p=0.02$). eCIRP-/- pups were also significantly protected against NEC-induced intestinal injury and inflammation compared to WT (Figure 1D, G-I). There were no mortalities at 5-days in CIRP-/- pups subjected to NEC.

Conclusion: eCIRP is a critical contributor to NEC-induced intestinal injury and mortality. Targeting eCIRP, as evidenced through MOP3 treatment and eCIRP knockdown, uncovers a new factor in NEC pathogenesis and offers an exciting novel therapeutic strategy to ameliorate NEC.

Abbreviations: NEC, Necrotizing enterocolitis;
eCIRP, Extracellular cold-inducible RNA binding protein;
MFG-E8, Milk fat globule-EGF factor VIII;
MOP3, MFG-E8-derived oligopeptide, MOP3.

Figure 1



**p<0.05 vs. PBS Gavage; #p<0.05 vs. NEC + Vehicle; †p<0.05 vs. WT NEC.*

APSA 11

REDUCTION OF PEDIATRIC GASTROSTOMY TUBE HEALTHCARE UTILIZATION AND SOCIOECONOMIC DISPARITIES: LONGITUDINAL BENEFITS OF QUALITY IMPROVEMENT

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Abstract: Purpose: Previously, children from lower socioeconomic backgrounds had increased emergency department (ED) utilization after gastrostomy (G) tube placement at our children's hospital. We formulated a quality improvement initiative aimed to reduce postoperative G-tube dislodgements and ED visits. We aimed to determine if this intervention diminished disparities in healthcare outcomes for children with varying socioeconomic status.

Methods: We formed an interdisciplinary quality improvement team (1/2018) and implemented a G-tube care bundle (6/2018-9/2019). Interventions included care standardization in the preoperative, intra-operative, and postoperative periods, as well as caregiver preparedness.
All G-tube patients present in our institution's NSQIP-Pediatric database were included. Outcomes were tracked prospectively, while demographic information, comorbidities, and national area deprivation index (ADI; high ADI = ≥80, low ADI = < 80) were obtained retrospectively. Univariate comparisons before and after interventions were made using Mann-Whitney U test for continuous data and Chi-square for proportions. Mean (standard deviation), instead of median (interquartile range) reported for non-parametric test results if median=0.

Results: A total of 396 patients were included (188 patients pre-intervention, 208 post-intervention). Median ADI was similar between groups [71.0 (IQR 35.0) vs 76.0 (IQR 34.0), p=0.583] and median follow up was longer in the pre-intervention group [5.6 (IQR 6.3) years vs 2.5 (IQR 2.3) years, p< 0.001]. Compared to the pre-intervention cohort, post-intervention there were fewer: a) postoperative ED visits per patient [1.3 (SD 2.3) vs 0.7 (SD 1.5), p=0.002]; b) patients with 2 or more postoperative ED visits [53 (28.2%) vs 40 (19.2%), p=0.036]; c) patients with an outpatient dislodgement within 90 days of G-tube placement [40 (21.3%) vs 21 (10.1%), p=0.002]; and d) G-tube-related radiographic studies per patient [0.8 (SD 1.3) vs 0.5 (SD 1.0), p=0.013]. Pre-intervention children from high ADI neighborhoods had significantly greater healthcare utilization compared to those from lower ADI neighborhoods (Table). Post-intervention, previously statistically significant disparities were no longer present; outpatient G-tube dislodgements within 90 days were particularly mitigated (Table).

Conclusion: A longstanding quality improvement initiative has led to sustained reductions in overall G-tube related health care utilization. Care standardization and improvement may mitigate outcome disparities related to socioeconomic status.

Abbreviations: emergency department (ED)
gastrostomy tube (G-tube)
National Surgery Quality Improvement Program-Pediatric (NSQIP-Pediatric)
national area deprivation index (ADI)
interquartile range (IQR)

standard deviation (SD)

APSA 12

SCREENING ULTRASOUND FOR DEEP VEIN THROMBOSIS DETECTION IN HIGH-RISK PEDIATRIC TRAUMA: A REPORT FROM THE MIDWEST PEDIATRIC SURGERY CONSORTIUM (MWPSC) NO CLOT STUDY

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Abstract: PURPOSE
Venous thromboembolism (VTE) is a rare but significant complication among high-risk pediatric trauma patients. The NO CLOT study's primary aim was to evaluate the safety of chemical prophylaxis against VTE in high-risk pediatric trauma patients with a secondary aim of evaluating use of screening venous duplex ultrasound (sUS) to identify deep vein thrombosis (DVT) before symptoms develop. We hypothesized that sUS would detect asymptomatic DVT at a high rate in high-risk patients.

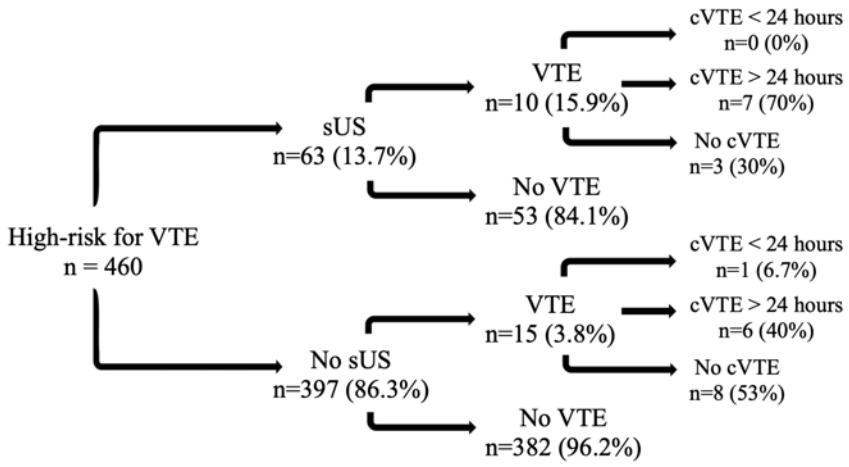
METHODS
We performed a prospective multi-institutional study at eight level one pediatric trauma centers from October 2019 to October 2022. Use of chemical VTE prophylaxis in high-risk pediatric trauma patients was tracked. The protocol recommended all high-risk patients undergo sUS on day 7 of admission, regardless of receipt of chemical prophylaxis. Univariate and multivariate analyses were performed.

RESULTS
Of 460 high-risk trauma patients included, 63/355 (17.7%) remained admitted on day 7 and underwent sUS. Ten of 63 (15.9%) had a DVT identified on sUS (median of 6 [IQR 5,8] days after trauma). In 397 (86.3%) patients without sUS, 15 (3.8%) developed symptomatic DVT (median of 4 [IQR 3,8] days after trauma); the most common symptoms were extremity swelling and fever. Asymptomatic patients with a positive sUS were a median age of 14.4 [IQR 11.2,15.8] years with median ISS of 36 [IQR 18,44], which was statistically similar to those with symptomatic DVT. For the sUS cohort, 9/10 (90%) DVTs were associated with an indwelling central venous line (CVL) with chemical prophylaxis never used in 3/10 (30%) or initiated more than 24 hours post-trauma in 7/10 (70%). Eight of 10 (80%) of sUS-identified

DVTs were treated with therapeutic anticoagulation and 2/8 (25%) developed bleeding complications.

CONCLUSIONS
Symptomatic DVTs are uncommon in high-risk pediatric trauma patients. Utilization of sUS increases DVT detection, 90% of which were associated with a CVL. Further investigation is needed to determine the clinical consequences of asymptomatic detection of DVT and utility of sUS. Quality improvement in DVT prevention may center on decision-making around timing of chemical prophylaxis and CVL utilization in high-risk pediatric trauma patients.

Abbreviations: Venous thromboembolism (VTE); screening venous duplex ultrasound (sUS); deep vein thrombosis (DVT); central venous line (CVL)



VTE identification and prophylaxis status by utilization of screening ultrasound (sUS) stratified by when chemical VTE prophylaxis (cVTE) was started.

APSA 13

PERSONAL CHARACTERISTICS ARE ASSOCIATED WITH IMPOSTER PHENOMENON AMONGST PEDIATRIC SURGEONS

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Abstract: Purpose: Imposter phenomenon, or imposterism, has been defined as feelings of inadequacy, self-doubt, and a fear of being exposed as a fraud, despite having achieved success in their chosen field. Our purpose was to understand the factors associated with imposterism in the field of pediatric surgery. We hypothesized that imposterism is common, but not associated with objective measures of achievement (e.g., case volumes, board certification).
Methods: After IRB approval, an anonymous, voluntary survey, including the validated Clance Imposter Phenomenon Scale, was distributed to pediatric surgeons via email list from the American Pediatric Surgical Association. Chi-square test was used to compare differences between groups with logistic regression and Pearson's correlation used to further understand associations.
Results: Imposterism was common among all respondents (29.7% response rate, n=335), with 59.8% of pediatric surgeons reporting at least moderate symptoms of imposterism (Table). Imposter score was not associated with the number of cases performed during pediatric surgery fellowship (p=0.837), geographic location of the fellowship (p=0.905), nor with the number of fellows at the program (p=0.663). However, some personal characteristics were associated with high imposterism, including: relationship status of single (p=0.009) and not having children ($p < 0.001$). High imposterism was also associated with requiring more than one attempt to pass the Pediatric Surgery Qualifying Exam (p=0.048) and Certifying Exam (p=0.021).
Conclusions: Imposter phenomenon is prevalent among pediatric surgeons. Personal characteristics, not training variables, were associated with higher levels of imposterism. Pediatric surgeons whose relationship status was single (i.e., not married or partnered) and those without children are particularly affected. High imposterism was also associated with the likelihood of requiring multiple attempts at passing board exams. These findings emphasize the importance of detecting imposterism before board certification and highlight an opportunity for early career coaching and systemic interventions to mitigate imposterism among particularly vulnerable pediatric surgeons.

Abbreviations:

APSA 14

SENSORY RECOVERY FOLLOWING INTERCOSTAL NERVE CRYOABLATION FOR THE NUSS PROCEDURE

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Abstract: BACKGROUND: Intercostal nerve cryoablation (INCR) is an effective means of postoperative pain control for the Nuss procedure but little is known about patterns of sensory recovery following its use.

METHODS: A single institution prospective study of 121 patients undergoing Nuss bar placement for pectus excavatum was conducted to assess sensory recovery following INCR. All patients received INCR from T3-T8. Patients were followed every 3 months for the first year then every 6 months thereafter. Average follow up was 2.4 years (0.8 – 4.4 years) The primary outcome was time to return of normal chest wall sensation. Secondary outcomes included alterations in sensation, permanent numbness and chronic neuropathic pain.

RESULTS: Following INCR, average time to normal chest wall sensation was 6.7 months (range 1-12 months). By 3 months postoperatively, 16/121 (13%) had normal sensation, by 6 months 73/121 (60%), by 9 months 102/121 (84%) and by 12 months 119/121 (98%) had normal sensation. 2/121 (2%) had a small area of persistent/permanent numbness in the lower central sternum at 4 years and 3 years postoperatively. The most common altered sensation was hypersensitivity which occurred in 25/121 (21%). Hypersensitivity began on average at 3.0 months postoperatively (range 1 week – 6 months) and lasted an average of 2.2 months (range 2 weeks- 9 months). Of patients with hypersensitivity, 5/25 (20%) described it as painful and all of these were successfully treated with gabapentin and/or capsaicin cream; all others resolved spontaneously. 7/121 (6%) described tingling or pins and needles; 2/121 (1.6%) described burning sensations. One patient in each of these groups required (successful) treatment with gabapentin; the others resolved spontaneously. There were no cases of chronic neuropathic pain.

CONCLUSIONS: Sensory recovery following INCR is a slow, gradual process that ultimately leads to normal sensation in virtually all patients by one year. Hypersensitivity occurs at a higher rate than expected but is rarely described as painful and always resolves. Gabapentin and capsaicin cream can be effective in treating altered sensory symptoms. Permanent numbness can occur but is very rare and limited in scope. Importantly, there were no cases of chronic neuropathic pain.

Abbreviations: INCR: intercostal nerve cryoablation

APSA 15

THE EFFECT OF RACE ON EVALUATION AND TREATMENT OF ADNEXAL MASSES IN PEDIATRIC PATIENTS

Taylore King, MD[1], Kamaria Dansby, B.S.[2], Molly Lavaud[3], Zhulin He[4], Valerie Dutreuil, MPH[5], Nancy Sokkary, MD[6], Allison F. Linden, MD, MPH[6]

[1]Emory University, ATLANTA, GA, USA, [2]Emory University School of Medicine, DECATUR, GA, USA, [3]Emory University School of Medicine, Decatur, GA, USA, [4]Emory University, Atlanta, GA, USA, [5]Pediatric Biostatistics Core, Department of Pediatrics, Emory University, Atlanta, GA, USA, [6]Emory University/Children's Healthcare of Atlanta, Atlanta, GA, USA

Abstract: Purpose: Race, ethnicity, gender and social determinants of health have been found to impact access to pediatric surgical care and outcomes. Their effect on evaluation and treatment of pediatric ovarian masses has not been investigated.

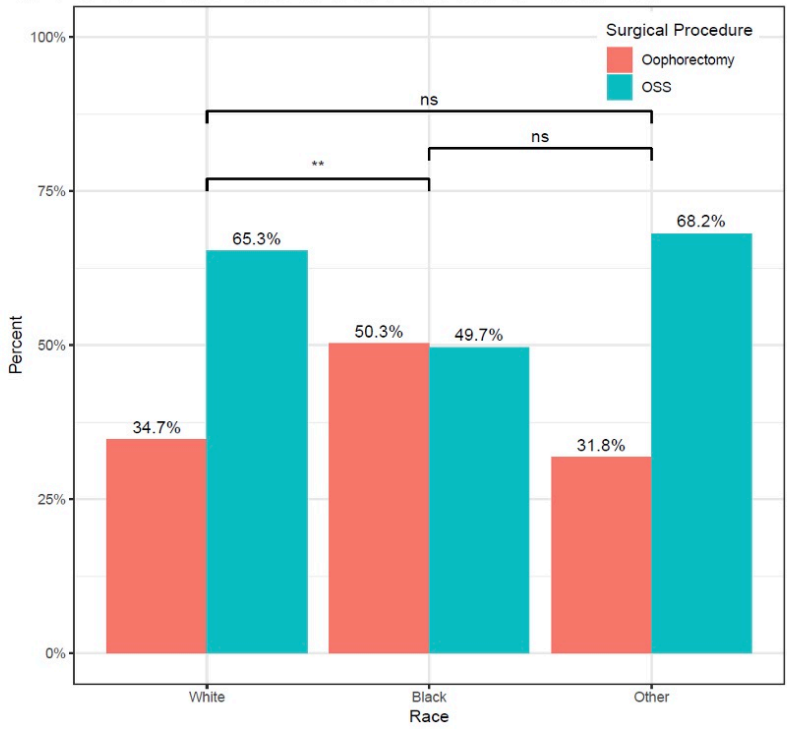
Methods: A retrospective review of individuals 18 years of age or under with sex assigned as female at birth and with an adnexal mass presenting to a large tertiary children's hospital between 2009 and 2021 was performed. Sociodemographics, including race, as well as components of the preoperative assessment, type of surgery, and final pathology were collected. Fisher's exact test was used to compare clinical findings among three race groups (white, black and other patients). A post-hoc analysis was conducted for pairwise comparisons, where p-values were adjusted using the Holm method. IRB approval was obtained.

Results: The study period included 409 cases with adnexal masses. 196 (48%) of patients identified as White race, 159 (41%) identified as Black race, and the remaining 44 (11%) were labelled as other. There was a significant difference by race of patients receiving ovarian-sparing surgery vs. oophorectomy with Black patients undergoing a higher proportion of oophorectomies compared to White patients (50.3% vs. 34.7%, adj. p=0.009). This occurred despite no difference in abnormal preoperative tumor markers between race (p=0.452) and no difference in benign vs. malignant pathology (0.882). There was a significant difference in those undergoing a CT scan preoperatively (p=0.034) with Black patients undergoing more CT scans.

Conclusions: Despite similar rates of benign ovarian adnexal mass pathology, Black patients underwent more oophorectomies compared to White patients. Black patients were also subject to more radiation exposure during workup. Further investigation in to systemic and individual bias needs to be performed to achieve equity in workup and treatment of pediatric adnexal masses.

Abbreviations:

Figure 1. Ovarian Sparing Surgery vs. Oophorectomy Rate by Race



OSS = ovarian sparing surgery

**= adjusted p-value <0.01; ns = not significant (i.e., adjusted p-value >=0.05).

APSA 16

CURRENT STATE OF SPLENECTOMY IN HEMODYNAMICALLY UNSTABLE PEDIATRIC BLUNT SPLENIC INJURY

R Scott Eldredge, MD[1], David M. Notrica, MD[1], Todd Nickoles, MBA, BSN, RN, CPN, TCRN[2], Brielle Ochoa, MD[2], Jae-O Bae, MD[1], Ramin Jamshidi, MD[2], Jamie Harris, MD[2], Katie W. Russell, MD[3], Mark S. Molitor, MD[1], Dorothy Rowe, MD[2], Erin Garvey, MD[2], Patrick E. McGovern, MD[4], Kathleen van Leeuwen, MD[1], Daniel J. Ostlie, MD[1], Justin Lee, MD[5], Benjamin Padilla, MD[6]

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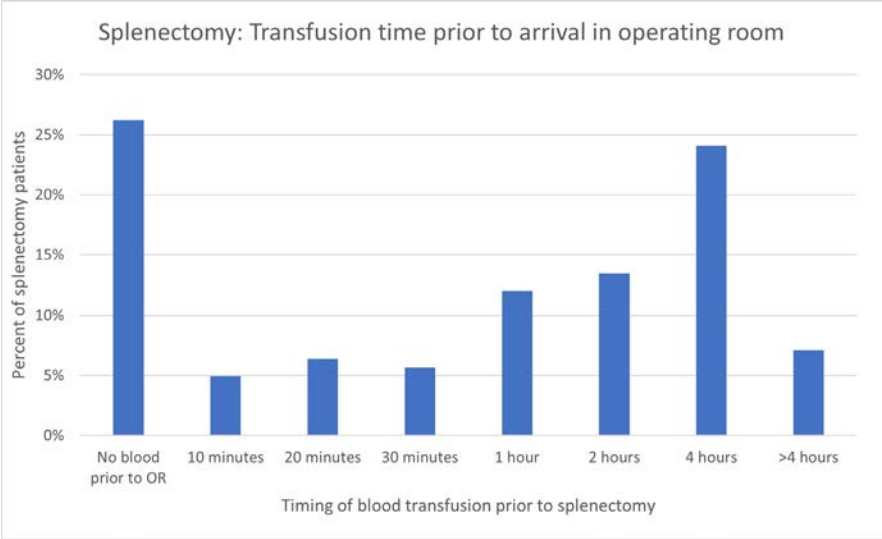
Abstract: Purpose: Current APSA guidelines recommend blood transfusion in hemodynamically unstable patients with BSI prior to operative exploration. Literature suggests hemodynamic response to transfusion can lead to splenic preservation in most cases. However, the contemporary management practice of patients with BSI presenting with hypotension is unknown. The aim of this study was to evaluate the risk factors of splenectomy in BSI patients initially presenting with hypotension.

Methods: The 2021 Trauma Quality Improvement Project database was queried for trauma patients aged 0 to 18 years with BSI who arrived with a systolic blood pressure < 90mmHg and shock index >1.1. Patients were excluded if they were transferred from another facility or if they had additional intra-abdominal injuries. Demographic, injury characteristic and timing, transfusion, operative, and outcome data were collected. Children and adolescent age ranges were defined as age 0–9 years old and 10–18 years old. Timing of initial blood products and operative procedure were obtained.

Results: A total of 516 patients were identified with BSI and hypotension at presentation; the majority were male (60.1%) with a mean age of 12.3±5.5 years (68.6% adolescent). On arrival, mean shock index was 1.4±0.4, ISS 31.7±15.1, and GCS 10.7±5. 30% of patients underwent laparotomy (27% splenectomy and 3% splenorrhaphy). Among the splenectomy group, 26.2% of patients did not receive blood prior to surgery. Another 11.4 % received blood < 20 min prior to arrival in operating room, Figure 1. Splenectomy rates were higher among adolescent patients compared to children (37.3% vs 5.6%, OR 10.1 95%CI[4.99-20.48], p< 0.0010). Multivariate regression analysis controlling for patient factors and care at a pediatric trauma center identified three associated variables for splenectomy: adolescent age (OR 7.53 95%CI[2.30-24.60], p< 0.001), grade IV/V injury (OR 5.61 95%CI[2.96-10.65], P=0.010), and lack of preoperative blood transfusion (OR 2.40 95%CI[1.00-5.74], p=0.05).

Conclusion: More than 70% of pediatric BSI patients with hemodynamic instability are managed without splenectomy, though adolescent age and grade IV/V BSI indicate a higher risk of nonoperative management failure. Concentrated efforts are needed to increase splenic preservation in these groups. Preoperative transfusion is not universally applied and may present an opportunity for improvement.

Abbreviations: American Pediatric Surgery Association – APSA
Blunt splenic injury – BSI
Confidence Interval – CI
Odds Ratio – OR


Splenectomy: Transfusion time prior to arrival in operating room
30%
25%
20%
15%
10%
5%
0%
Percent of splenectomy patients
No blood prior to OR
10 minutes
20 minutes
30 minutes
1 hour
2 hours
4 hours
>4 hours
Timing of blood transfusion prior to splenectomy

APSA 17

A COMPARATIVE ANALYSIS OF "SURGERY FIRST" VS. "ENDOSCOPY FIRST" FOR PEDIATRIC CHOLEDOCHOLITHIASIS PRESENTING AT THE END OF THE WEEK : A MULTICENTER STUDY

Jessica L. Rauh, MD, MS[1], Garrett Reid[2], Goeto Dantes, MD[3], Matthew T. Santore, MD[4], Marshall Wallace, MD[5], Irving J. Zamora, MD, MPH[6], Kylie Callier[7], Bethany J. Slater, MD, MBA[7], Derek Krinock, MD[8], Sabina Siddiqui, MD[9], Robert Vandewalle, MD/M.B.A.[8], Amanda Witte, MD[10], Katherine T. Flynn-O'Brien, MD[11], Utsav M. Patwardhan, MD[12], Romeo C. Ignacio, Jr., MD[13], J. Leslie Knod, MD[14], Katerina Dukleska, MD[15], Michael H. Livingston, MD, MSc, FRCSC[16], Stefan Scholz, MD[17], Maggie E. Bosley, MD[18], Lucas Neff, MD[19], Hanna Alemayehu, MD[20]

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Abstract: Background

Choledocholithiasis in children is commonly managed with an “endoscopy first” (EF) strategy, which includes endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy (LC) under a separate anesthetic. Because ERCP availability is often limited at the end of the week (EoW), we hypothesized that a “surgery first” (SF) approach with LC, intraoperative cholangiogram (IOC), and possible transcystic laparoscopic common bile exploration (LCBDE) is associated with a decreased length of stay (LOS) and time to definitive intervention (TTDI).

Methods

A multicenter, retrospective cohort study was conducted on pediatric patients from 2018-2023 with suspected choledocholithiasis. Demographics, clinical data, and complications were compared for patients admitted EoW (Friday morning to Sunday morning). SF patients underwent LC+IOC +/- LCBDE, whereas EF patients underwent ERCP followed by LC under a second anesthetic. Work week (WW) presentation was defined as admission between Monday to Thursday. TTDI was defined as time to LC. Patients who underwent interval LC were excluded. Complications were defined as post-procedure pancreatitis, bleeding, perforation, or stent migration. Statistical analysis completed using Microsoft Excel and R software.

Results

Among four pediatric hospitals, there were 252 pediatric patients with 156 (62%) managed with SF (91 WW, 65 EoW) and 96 (38%) managed with EF (53 WW, 43 EoW). LOS was shortest for SF during WW followed by SF for EoW presentation. Both SF groups had shorter mean LOS than EF for both WW and EoW presentation (68.7h, 95.2h, 125.6h, 121.8h; $p< 0.05$ (Figure 1). TTDI was decreased in SF (Figure 1). Every patient in the EF group underwent two anesthetic procedures while approximately 24% of the SF group required postoperative ERCP (23% WW and 25% EoW). Overall, there were fewer complications with SF compared to EF (1.9% versus 15.6%, $p< 0.05$), but there were no differences between WW and EoW.

Conclusion

Children who present with choledocholithiasis at the end of the work week have a longer LOS and TTDI. These findings are amplified when children enter an endoscopy first treatment pathway. A surgery first

approach results in fewer procedures and complications, regardless of the time of presentation.

Abbreviations: “endoscopy first” (EF)
endoscopic retrograde cholangiopancreatography (ERCP)
laparoscopic cholecystectomy (LC)
end of the week (EoW)
“surgery first” (SF)
intraoperative cholangiogram (IOC)
transcystic laparoscopic common bile exploration (LCBDE)
length of stay (LOS)
time to definitive intervention (TTDI)
Work week (WW)

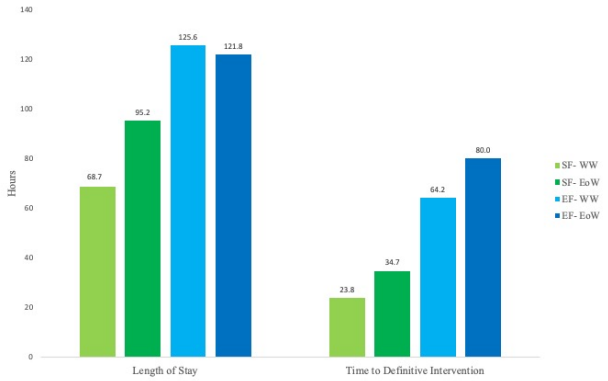

Figure 1. Length of stay and time to definitive intervention in ‘Surgery First’ (SF) (blue) compared to ‘Endoscopy First’ (EF) (green) approach. A surgery first approach is faster irrespective of if the patient presents during the work week (WW) versus the end of week (EoW). On average, the length if stay is shorter with SF approach (SF-WW 68.7h ± 43.9, 95.2h ± 104.1 , 125.6h ± 166.4, 121.8h ± 112.6; p<0.05). TTDI was decreased in SF (SF-WW 23.8h ± 28.6 , SF-EoW 34.7h ± 33.6 , EF-WW 64.2h ± 112.0, EF-EoW 80.0h ± 174.7; p<0.05).

APSA 18

A NOVEL HIGH-FIDELITY IN-VITRO MODEL OF ESOPHAGEAL BUTTON BATTERY INGESTION DEMONSTRATES BENEFITS OF HONEY AND ACETIC ACID

Charlotte Reich[1], Nomin Krespach[1], karina Khakim[1], Andreas Lindner[1], Oliver J. Muensterer, MD, PHD[2], **Danielle S. Wendling-Keim, MD**[3], Charlotte Reich[1]

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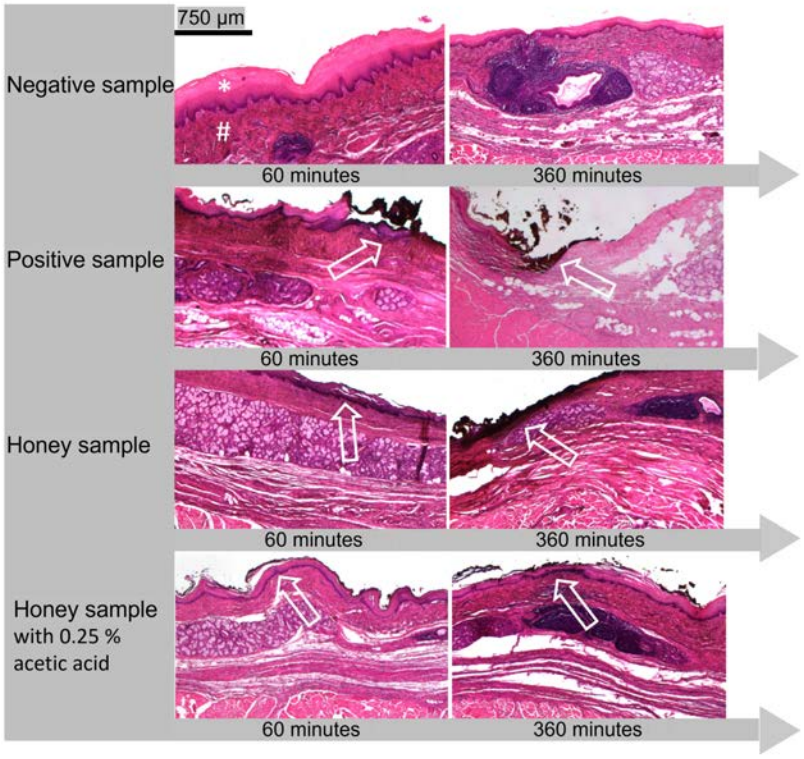
Abstract: Purpose: Retained esophageal button batteries (BB) are associated with high morbidity. The current guidelines recommend administration of honey in children older than 1 year, as well as irrigation of the esophagus with 0.25% acetic acid. However, evidence confirming these guidelines is scarce. Therefore, the aim of our study was to design a high-fidelity in-vitro model of the esophagus to test the efficacy of these recommendations.
Methods: Our novel model included fresh porcine esophagi that were suspended in an environment simulating body temperature, peristalsis, and flow of saliva. Fully charged type CR2032KB 3 Volt button batteries (diameter 20mm) or non-charged dummies of similar shape and size were placed in the esophagi. The honey was given at specific intervals after BB insertion. After BB removal, we briefly washed the lesion with 0.25% acetic acid or buffer solution as a control. Paraffin slides were stained with hematoxylin-eosin (HE) to quantify necrosis.
Results: The application of honey after BB insertion resulted in macroscopically smaller ulcers than in esophagi without the treatment. After 60 minutes, the mean pH was significantly lower in samples exposed to honey (p=0.0006; 95%-CI: 1,70-2.63). After 360 minutes, the protective effect became even more apparent (p=0.0002; 95%-CI:2.41-4.3). HE staining confirmed the macroscopic results with significantly deeper ulcers reaching into the submucosa without honey treatment compared to only mild to no lesions of the mucosa with honey application. The combination of honey treatment before BB removal and irrigation with 0.25% acetic acid after removal was significantly more effective than treatment with honey only, and lead to the prevention of ulcer formation by maintaining the mucosa (Figure 1).
Conclusion: We created an in vitro model to imitate the swallowing process, body temperature, and saliva flow. Our findings support the guidelines' recommendations that combining honey application before endoscopic battery removal with a 0.25% acetic acid flush at the end of the endoscopy protects the mucosa after esophageal BB retention.

Abbreviations: BB button battery


750 µm
Negative sample
*
#
60 minutes
360 minutes
Positive sample
60 minutes
360 minutes
Honey sample
60 minutes
360 minutes
Honey sample with 0.25 % acetic acid
60 minutes
360 minutes

Scientific Session IV - Common Pediatric Surgery Issues #2

10:00 AM – 11:15 AM

APSA 46

ASSESSING CONCORDANCE OF PRE-OPERATIVE PERCUTANEOUS CORE AND INTRA-OPERATIVE WEDGE LIVER BIOPSIES IN BILIARY ATRESIA: ARE BOTH VALUABLE?

Nicholas Schmoke, MD[1], Christopher Nemeh, MD[2], Yeu Sanz Wu, MD[2], Stephen Lagana, MD[2], Helen Remotti, MD[2], Mercedes Martinez, MD[2], Robert A. Cowles, MD[3], Angela Kadenhe-Chiweshe, MD[4], Vincent P. Duron, MD[5], Steven Stylianos, MD[6]

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Abstract: Purpose: The utility of liver biopsy in the workup and diagnosis of biliary atresia (BA) remains controversial, with significant practice variability among institutions. BA prognosis is traditionally based on age at the time of Kasai Portoenterostomy (KP), anatomical variant, surgical expertise, and histological grading. Our study aimed to evaluate the concordance and safety of preoperative percutaneous core needle and intraoperative wedge biopsies in biliary atresia.

Methods: A single-institution retrospective review evaluated all patients with BA who underwent KP between October 2004 and July 2023 (n=116). Institutional review board approval was obtained. Available liver pathology, including preoperative and intraoperative biopsies, was reviewed by an experienced liver pathologist. The degree of fibrosis was staged based on the Batts-Ludwig scoring system. Liver biopsies were determined to be discordant if there was ≥ 1 point difference in fibrosis. Unpaired t-tests were used to compare means between groups.

Results: One hundred sixteen patients were included. Median age at the time of KP was 59 days (IQR 48-71 days). Ninety-one patients had both a preoperative core needle and intraoperative wedge biopsies completed. The median time between biopsies was 6 days (IQR 3-8 days). Discordant results were found between pre-op core needle and intra-op wedge biopsies in 37/91 (41%) patients. No significant difference in the timing between biopsies in concordant and discordant results was observed (6 vs. 5 days, p=0.92). The histologic detail was more significant in the surgical wedge biopsy in 70/91 (77%) patients. No biopsy-related complications were observed in either group. Survival with native liver occurred in 70/116 (60%) patients at one year (or last) follow-up.

Conclusion: Significant discordance exists between contemporaneous preoperative core needle and intraoperative liver biopsies in patients with BA. Wedge biopsies provided more detailed results in 77% of patients compared to core needle biopsies. While pre-op core needle biopsy often adds confirmatory evidence when BA is suspected, the intra-op wedge biopsy provides a level of detail that may allow for better prognostication for clinicians and families. Given the greater histologic detail and low risk, a wedge liver biopsy is recommended at the time of KP.

Abbreviations: BA, biliary atresia; KP, Kasai Portoenterostomy

APSA 47

UTILIZATION OF ENHANCED RECOVERY AFTER SURGERY (ERAS) PROTOCOL IN PEDIATRIC LAPAROSCOPIC SLEEVE GASTRECTOMY

Fari Fall, MD, MA[1], Devon Pace, MD, MPH[2], Julia Brothers, DO[3], Manish Purohit, MD[3], Kesavan Sadacharam, MD[3], Connie Lin, MD[3], Kirk Reichard, MD, MBA[4], Loren Berman, MD, MHS[5], Robert S. Lang, MD[3]

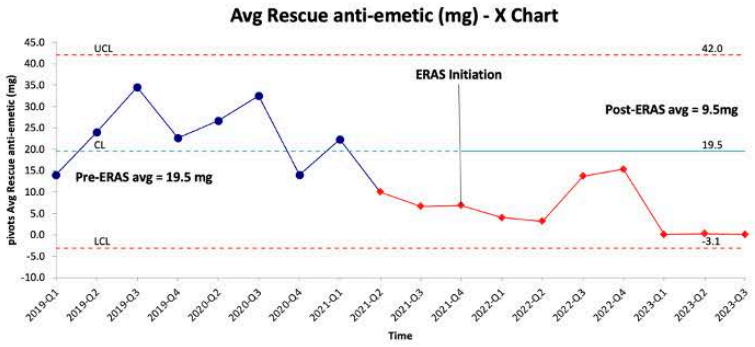
[1]Nemours Children's Health/Thomas Jefferson University Hospital, Philadelphia, PA, USA, [2]Thomas Jefferson University Hospital, Philadelphia, PA, USA, [3]Nemours Children's Health, Wilmington, DE, USA, [4]Nemours Children's Health, Wilmington, DE, USA, [5]Nemours Children's Hospital-Delaware, Wilmington, DE, USA

Abstract: Intro: The obesity epidemic has led to an increased number of adolescents requiring bariatric surgery and enhanced recovery after surgery (ERAS) protocols are becoming increasingly utilized in this patient population. We implemented an ERAS protocol for adolescents undergoing laparoscopic sleeve gastrectomy (LSG) that incorporates a robust perioperative anti-emetic and analgesic regimen to reduce post-operative nausea and hospital length of stay (HLOS).
Methods: Stakeholders across surgery, anesthesia, and peri-operative nursing were convened to design a bariatric-specific ERAS protocol encompassing pre-hospital, pre-, intra-, and post-operative care for all patients undergoing LSG. Key elements included pre-operative fasting with carbohydrate loading the morning of surgery, a comprehensive anti-emetic and analgesic regimen including an intraoperative lidocaine infusion, regional anesthetic utilization, and early goal-directed ambulation. We tracked postoperative pain, opioid and rescue anti-emetic use, time to oral intake, and HLOS in the pre- (1/2019-11/2021) and post-ERAS (12/2021-8/2023) periods. Return to the system within 72 hours of discharge was captured as a balancing measure. Control charts were used to assess the impact of ERAS implementation on outcomes.
Results: Eighty-six patients underwent LSG with a mean age of 16 and a body mass index of 46.5 kg/m2. There were no significant differences in demographics between the pre-ERAS (52 patients) and post-ERAS groups (34 patients). The post-ERAS group used less post-operative opioids (0.168 vs. 0.213 MME/kg), less rescue anti-emetic, (9.5 vs. 19.5 mg) [fig 1A], had earlier time to oral intake (3.6 vs. 7.5 hours) [fig 1B], and had shorter HLOS (37 vs. 52 hours) [fig 1C].
Conclusions: Our novel use of bariatric-specific ERAS protocol with intraoperative lidocaine infusion has proven effective in maximizing multimodal analgesic and anti-emetic properties to accelerate time to goal-directed oral intake and decrease HLOS without increasing rate of returns to the system. This study highlights the feasibility and effectiveness of adapting ERAS protocols to the pediatric bariatric surgery population

Abbreviations: ERAS
LSG
HLOS

Factor	Pre-ERAS	Post-ERAS	p-value
n	52	34	
Female gender n (%)	35 (61)	22 (39)	0.06
Age, mean (SEM)	16.6 (0.21)	16.0 (0.26)	0.051
BMI, mean (SEM)	46.7 (0.61)	46.4 (1.16)	0.4
ASA Class 2 (%)	15 (29%	7 (21%)	0.391
ASA Class 3 (%)	37 (71%	27 (79%)	
Hospital LOS (hours), mean (SEM)	52 (2.5)	37 (2.0)	**< 0.001**
Floor 24-48 Hours Opioid (MME/kg), mean (SEM)	0.055 (0.013)	0.011 (0.013)	**0.006**
Total Post-op Opioid (MME/kg), mean (SEM)	0.213 (0.022)	0.168 (0.018)	**0.04**
Rescue Anti-emetic (mg), mean (SEM)	19.2 (1.8)	9.5 (1.4)	**< 0.001**
Time to PO intake (hours), mean (SEM)	7.0 (0.86)	3.6 (0.50)	**0.002**

A



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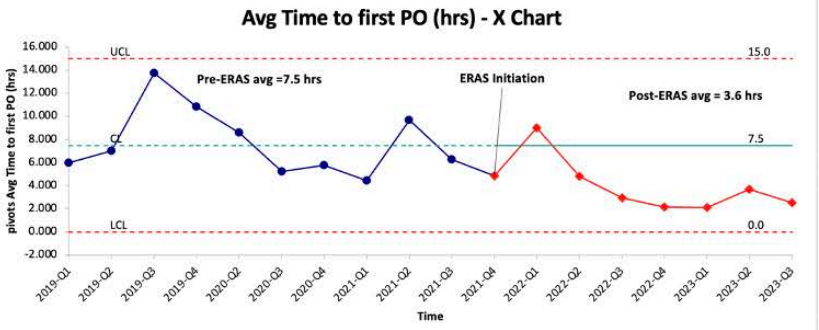

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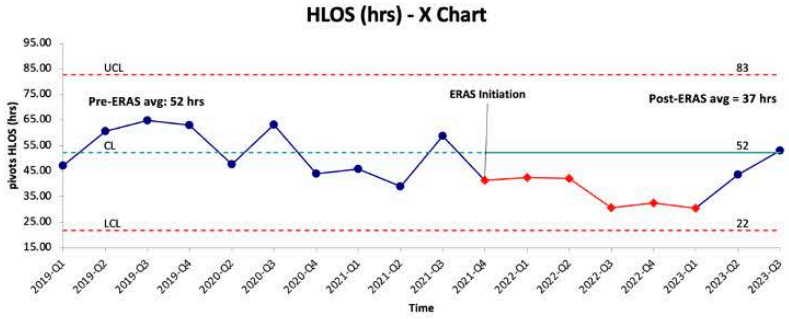

APSA 48

REMOTE ISCHEMIC CONDITIONING DECREASES THE INCIDENCE AND SEVERITY OF NECROTIZING ENTEROCOLITIS - VALIDATION IN A LARGE ANIMAL MODEL

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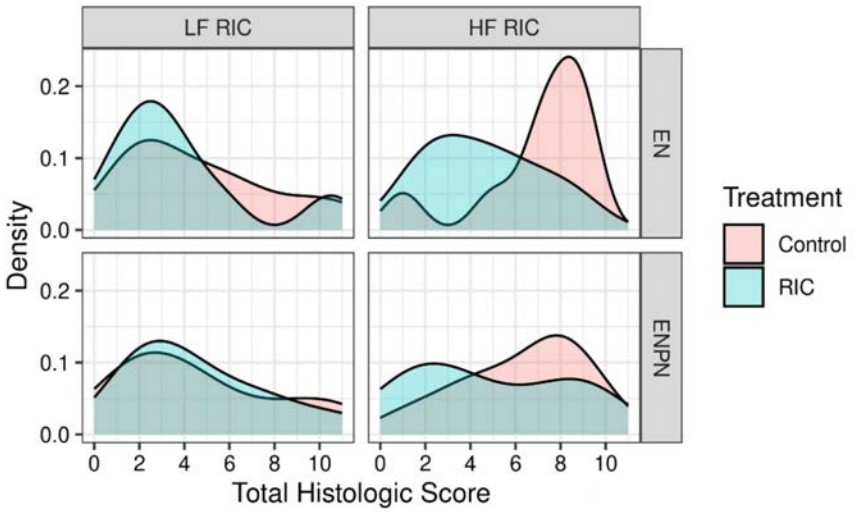
Abstract: Purpose: Necrotizing enterocolitis (NEC) remains a devastating disease that affects 5-7% of preterm neonates and is associated with US treatment costs of $500M-$1B annually. Remote ischemic conditioning (RIC) protects against intestinal ischemia and prolongs survival in rodents. We aimed to determine the efficacy of RIC in a large animal model of NEC and improve upon previous murine RIC protocols.

Methods: Piglets were delivered by c-section between 103-107 days gestation (term = 115 days). Preterm piglets received enteral nutrition only (EN) or total parenteral nutrition for 48 hours with the addition of enteral feeds for the remaining 48 hours of the 96-hour study (ENPN). RIC was induced through intermittent occlusion of hind limb arterial flow (4 cycles of a 4-minute occlusion with subsequent reperfusion). RIC was initiated at 24 hours of life. RIC was repeated every 24 hours in the low frequency (LF) RIC group and every 12 hours in the high frequency (HF) RIC group. Piglets were monitored for signs of NEC, which was confirmed anatomically and histologically postmortem.

Results: Eighty-seven piglets were randomized into control (N=39) and RIC groups (LF-N=26 and HF-N=22). RIC reduced NEC with an odds ratio of 0.38 (95% CI: 0.15, 0.97; p=0.043). A subgroup analysis with littermate controls revealed no difference between controls and LF RIC (OR=0.64; 95% CI: 0.15, 2.823; p=0.56), but a reduction in NEC following HF RIC (OR=0.13; 95% CI: 0.03, 0.64; p=0.012). In piglets who received enteral feeds only (EN), HF RIC appeared to reduce NEC severity with a lower total histologic score compared to those who received enteral and parenteral nutrition (ENPN) (β=-0.62; 95% CI: -1.4, 0.16; p=0.11) (Figure 1).

Conclusions: RIC in the piglet model protects against early stages of NEC. The decrease in NEC within the HF RIC group compared to the LF RIC group may indicate a dose-dependent effect; these findings suggest that the dose of RIC needed for effect in large animals may be more than that applicable in rodents. This may have implications in the translation of RIC into clinical models.

Abbreviations: NEC - necrotizing enterocolitis
RIC - remote ischemic conditioning
EN - enteral nutrition
ENPN - enteral + parenteral nutrition
HF - high frequency
LF - low frequency


LF RIC
HF RIC
EN
ENPN
Density
0.2
0.1
0.0
0
2
4
6
8
10
Total Histologic Score
Treatment
Control
RIC

APSA 49

VASCULAR ACCESS FOR RENAL REPLACEMENT THERAPY IN THE INFANT, A SINGLE CENTER EXPERIENCE

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Abstract: Introduction: Neonatal renal replacement therapy (RRT) is a treatment modality used for severe renal impairment, fluid overload, and metabolic disorders. Historically, its use has been limited in small infants due to circuits with large extra-corporeal volumes that require large double lumen vascular catheters. We sought to review our institution's experience with vascular access and overall survival in infants who receive RRT.

Methods: A retrospective chart review of infants less than 5 kilograms (kg), to focus on the smallest infants, was performed at our free-standing children's hospital from January 2016 to July 2023. Patients undergoing RRT in-line with extracorporeal membrane oxygenation (ECMO) or ventricular-assist devices (VAD) were excluded from analysis. We assessed the number of catheters used per patient, location of catheter placements, size of catheter, duration of treatment, reasons for line removal, and mortality.

Results: A total of 93 neonatal patients were identified who underwent RRT. Thirty-two patients (34.4%) required more than one catheter. The number of catheters ranged from 1 to 9 per patient, with a total of 145 catheters placed for this cohort. The median [IQR] weight at insertion was 3.3kg, [2.7 – 4.0 kg]. Six patients underwent catheter placement at a weight of less than 2kg. The most common location for placement was the right internal jugular vein (n = 114, 78.6%), followed by femoral (n=13, 9%), umbilical (n=13, 9%), right subclavian (n=4, 2.7%), and left internal jugular (n=1, 0.7%) veins. For neonates weighing less than 2kg, 3 of these initial catheter placements were in the umbilical vein, 3 of them were in the right internal jugular vein. Patients required catheters for RRT for a median [IQR] of 16 days, [7 – 39 days]. Forty-five patients died during their hospitalization (48.4%). In those under 2kg, 3 patients died during the study period (50%). Eleven total patients went on to peritoneal dialysis (11.8%).

Conclusion: To our knowledge this is the largest review of catheter use for RRT in infants within an intensive care unit and it reveals the success in treating renal failure in even the smallest infants.

Abbreviations: RRT - Renal Replacement Therapy
ECMO - Extracorporeal membrane oxygenation
VAD - Ventricular-assist devices
IQR - Interquartile range
kg - kilograms

APSA 50

EFFECTIVENESS OF INTRAOPERATIVE NERVE MONITORING IN REDUCING RATES OF RECURRENT LARYNGEAL NERVE INJURY IN AERODIGESTIVE & CARDIOVASCULAR PEDIATRIC SURGERY

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Abstract: Background:
Children undergoing aerodigestive or cardiovascular procedures are at risk for recurrent laryngeal nerve (RLN) injury, leading to vocal fold movement impairment (VFMI) and significant morbidity. Though intraoperative nerve monitoring (IONM) has been shown to decrease RLN injury in adults, there is paucity of data in children. We investigate the effectiveness of IONM at decreasing VFMI in children undergoing at-risk procedures.

Methods:
Retrospective single center cohort study of children who underwent airway, esophageal, or great vessel surgery between 2018-2023. VFMI was evaluated with pre- and post-operative awake flexible nasolaryngoscopy. VFMI rates and associated characteristics were compared between those with and without IONM.

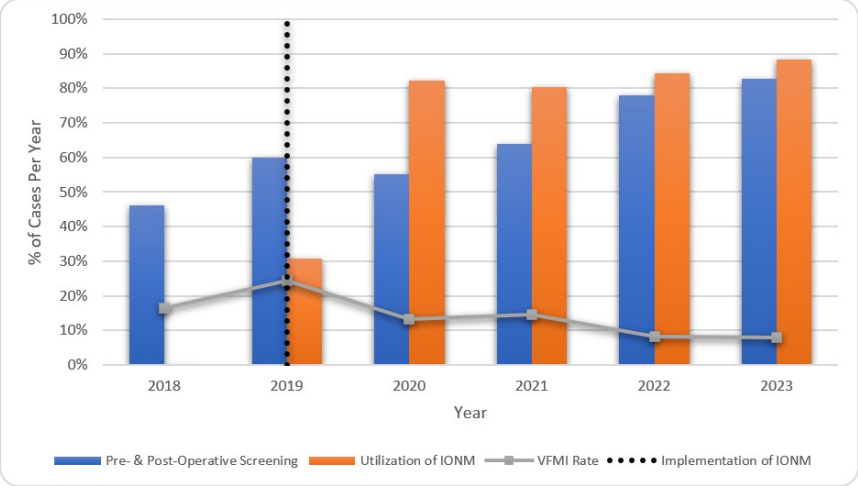
Results:
396 children (60% male) with a median (IQR) age of 15 months (6-59), underwent 437 procedures, the majority being classified as combined airway-esophageal (37.3%, e.g., tracheopexy with esophagoplasty). IONM was employed in 71.6% (n=313) of procedures. IONM was associated with a significant reduction in postoperative VFMI compared to those without IONM (11.5% vs. 19.4%, p=0.032, 40.7% relative risk reduction [RRR], number needed to treat [NNT]: 13). Specifically, for procedures where children had pre-operative VFMI (n=79, 18%), IONM had enhanced protective effects in preventing further injury (VFMI 7.8% with IONM vs. 25% without IONM, p=0.046, 68.6% RRR, NNT: 3). Bilateral postoperative VFMI (1.8% overall, 0.3% with IONM, 5.6% without) was 14.4 more likely (95% CI: 1.6, 126.7; P=0.016) if IONM was not utilized. After an initial increase in VFMI likely reflecting a learning curve and increased screening rates, IONM utilization increased and corresponding rates of VFMI decreased year over year (p=0.046) (Figure 1).

IONM's protective effect did not significantly differ between IONM technique, procedure category or approach. After controlling for age, weight, procedure category/approach, and re-operative status, multivariable logistic regression showed IONM to be significantly associated with reduced risk of VFMI (OR 0.51, 95% CI: 0.29, 0.92; P=0.025).

Conclusion:
Intraoperative nerve monitoring in children is challenging, yet feasible, and very effective at decreasing recurrent laryngeal nerve injury and consequently vocal fold movement impairment. Intraoperative nerve monitoring should be strongly considered in children undergoing cervico-thoracic aerodigestive or cardiothoracic procedures, especially in those with preoperative vocal fold movement impairment.

Abbreviations: recurrent laryngeal nerve (RLN); vocal fold movement impairment (VFMI); intraoperative nerve monitoring (IONM); interquartile range (IQR); relative risk reduction (RRR); number needed to treat (NNT);

Figure 1. Correlation between Nerve Monitor Implementation, Screening Rates, and VFMI Rate



APSA 51

WHAT HAPPENS POST-MALONE? AN INVESTIGATION OF LONG-TERM POSTOPERATIVE MANAGEMENT OF ANTEGRADE CONTINENCE ENEMAS

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Abstract: Background

One of the last options for medically refractory constipation is the antegrade continence enema (ACE). To better inform future patients, we sought to investigate patients'/families' perceptions of ACE usage and the natural history of their use, including whether they were able to wean from use of the appendicostomy/cecostomy tube.

Methods

Patients who underwent creation of an appendicostomy/neoappendicostomy or placement of a cecostomy tube at two institutions between 2012 and 2021 were reviewed. Patients or parents/guardians were then contacted for completion of a survey regarding their general satisfaction with the appendicostomy or cecostomy tube as well as about strategies they used to manage constipation and wean from use of ACEs. Summary statistics for clinical data were tabulated and associations were evaluated with chi-square analysis.

Results

One hundred and sixty-five patients were included, including 92 (55.8%) males. Eighty-one (49.1%) surveys were completed. Most patients (51.5%) presented with constipation, while 38 (23.3%) presented with fecal incontinence and 41 (25.2%) with a combination. More patients had a primary underlying diagnosis of anorectal malformation (39.4%), followed by functional constipation (21.2%), Hirschsprung disease (18.8%), and spinal malformation (17.6%). In this population, the vast majority (98.8%) underwent appendicostomy creation. Patients were actively followed for a median duration of 41.8 months (IQR 10.9-78.5). Thirty-one (18.8%) patients were able to wean off flushes by the time of contact, with switch to laxatives being the most common reason (28.1%), followed by patient preference (18.8%), appendicostomy stenosis/closure (15.6%), switch to ileostomy/colostomy (15.6%), and various other individual situations. There was no difference in patients' ability to stop using flushes based on underlying diagnosis ($p = 0.24$). Eight (9.9%) surveyed participants reported weaning on their own. The majority (84.3%) of survey respondents said they would be "very likely" to recommend antegrade enemas to other children with similar diagnosis and 77% reported being "very satisfied" that the operation was done.

Conclusions

There remains a high degree of satisfaction with antegrade continence enemas for children with chronic constipation and fecal incontinence; some children are able to wean off using antegrade enemas with varied mechanisms including patient/family weaning versus with assistance and laxative trials.

Abbreviations: ACE, antegrade continence enema
IQR, interquartile range

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UTILIZING AN ANTEGRADE CONTINENCE ENEMA PROGRAM TO TRANSITION A PATIENT TO VOLUNTARY BOWEL MOVEMENTS

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Abstract: Purpose:
An antegrade continence enema (ACE) program is effective in achieving social continence for patients with constipation and/or soiling with underlying diagnoses of functional constipation (FC), anorectal malformation (ARM), Hirschsprung disease (HD), or those with spinal disorders. Once cleanliness is achieved using a mechanical program, the goal for many patients is to transition from enema reliance to voluntary bowel movements, usually with oral laxative therapy. The rate and timing of this transition is not well defined.

Methods:
We retrospectively reviewed pediatric patients at a single institution (1/2020-1/2023) with constipation and/or fecal incontinence who underwent ACE surgery and had at least 6 months of follow-up. Our cohort included patients with FC, ARM, HD. Spina bifida patients and ARM patients with poor prognosis for fecal continence were excluded. A patient is considered successfully transitioned to voluntary bowel movements when they no longer require a daily ACE to maintain fecal continence. Additional covariables included age at time of ACE procedure and coincident behavioral diagnoses.

Results:
100 patients (49 FC, 32 ARM, 19 HD) met inclusion criteria with a median follow up of 17 months (range 6-40). 88 (88%) patients became clean of stool using ACE during the study period. By diagnosis: 8/32 (25%) of ARM, 6/49 (12%) of FC, and 2/19 (11%) of HD patients went on to achieve voluntary bowel movements with laxatives. There was no significant difference in the underlying diagnosis, age at time of ACE procedure, or presence of coincident behavioral diagnosis between patients that transitioned vs remained on enemas. Overall, 16 (16%) patients successfully transitioned to voluntary bowel movements at a median time of 15 months (range 7-28 months). Of those clean of stool who remain on enemas, 5 ARM patients specifically chose to remain on mechanical flushes due to their reliability.

Conclusion:
The majority of patients who undergo ACE become clean for stool and most continue to utilize flushes beyond 6 months after surgery. Those that transitioned to voluntary bowel movements did so at a median time of 15 months. This data may be useful for counseling families on when they can expect to transition away from enemas.

Abbreviations: ACE: antegrade continence enema
FC: functional constipation
ARM: anorectal malformation
HD: Hirschsprung disease

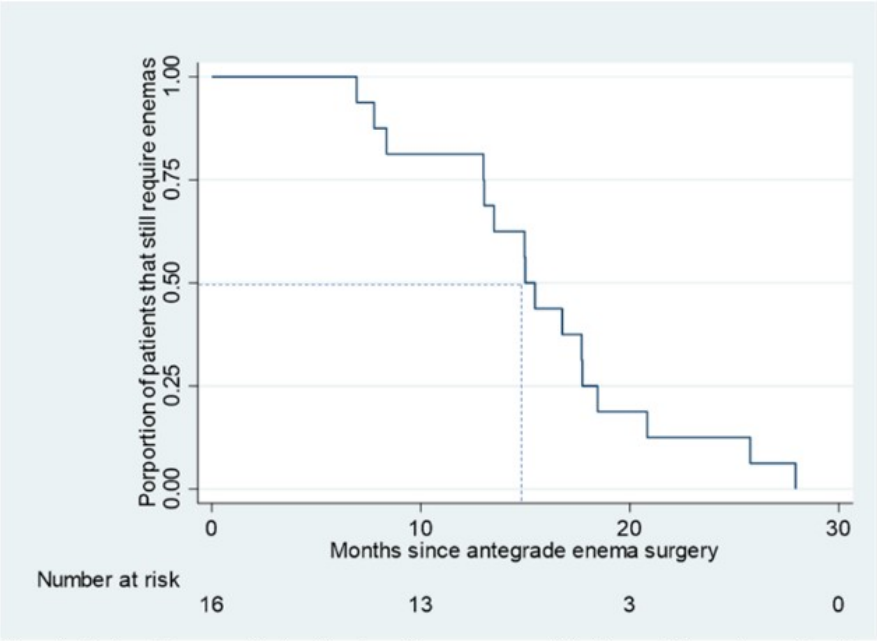

Figure 1: Kaplan-Meier curve for the 16 patients that were successfully able to achieve voluntary bowel movements with laxatives after an antegrade continence enema program. Median time of transition 15 months (range 7-28 months).

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OUTPATIENT OPIOID MONITORING AND RECLAMATION PROGRAM FOLLOWING THE MINIMALLY INVASIVE REAPIR OF PECTUS EXCAVATUM

R Scott Eldredge, MD[1], Brielle Ochoa, MD[2], Emalee M. Orcutt, BSHS[2], Melissa Nguyen[2], Kristin Mihalcin[1], Lisa E. McMahon, MD[1], Jae-O Bae, MD[1], Justin Lee, MD[3], David M. Notrica, MD[1], Benjamin Padilla, MD[4]

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Abstract: Introduction:
Outpatient opioids are commonly prescribed following MIRPE. To decrease diversion of unused opioids, we developed an opioid monitoring and reclamation program, including patient education and monitoring of opioid use and disposal. Clinic-based drug disposal bins and at-home charcoal activated drug disposal pouches were provided. The aim was to evaluate outpatient opioid use and disposal following MIRPE.
Methods:
A retrospective review was conducted at a single center from May to August 2023 among patients < 21 years who underwent MIPRE with intercostal nerve cryoablation. Demographic and clinical data, including outpatient opioid prescriptions were reviewed. Patients/families were encouraged to bring unused opioids to the first postoperative visit for disposal and questionnaires were administered regarding pain control, opioid use, and disposal plan.
Results:
Of 61 eligible patients, 38 (62%) participated in the program: 90% (34/38) were male, and the median age was 15.2 years [IQR:14.3-16.4]. The median length of stay was 1 day [IQR:1-2]. At discharge, 38 patients were prescribed a total of 402, 5 mg oxycodone tablets, with a median of 10 tablets per patient [IQR:10-10]. Prior to follow-up 26% (10/38) required an opioid refill, resulting in 68 additional tablets prescribed. The median time to clinic follow-up was 16.5 days [IQR:10-21]. Patients reported using opioids for a median of 6 days [IQR:3.8-8.0]; 92% (35/38) had unused opioids. The median number of unused tablets per patient was 5 [IQR:3-10], totaling 220 unused tablets (47% [220/470]). Of patients with unused opioids, 66% (23/35) had a plan for disposal: 57% (13/23) at the clinic-based disposal bin, 22% (5/23) via charcoal pouch, and 22% (5/23) were unsure how they would dispose of unused opioids. Twelve patients (34%), who had a total of 65 tablets, planned to keep the unused opioids.
Conclusion:
Despite highly conservative opioid prescribing, 47% of outpatient opioids go unused following MIRPE with intercostal nerve cryoablation. After education on the risks of opioids and providing a convenient means for safe opioid disposal, two thirds of patients/families intended to dispose of unused opioids. Future opioid stewardship after MIRPE should focus on decreasing the number of opioids prescribed and reducing barriers to opioid disposal.

Abbreviations: Minimally invasive repair of pectus excavatum - MIRPE
oral morphine equivalence - OME

APSA 54

EFFECT OF PAIN ON QUALITY OF LIFE IN CHILDREN AND ADOLESCENTS WITH PILONIDAL DISEASE

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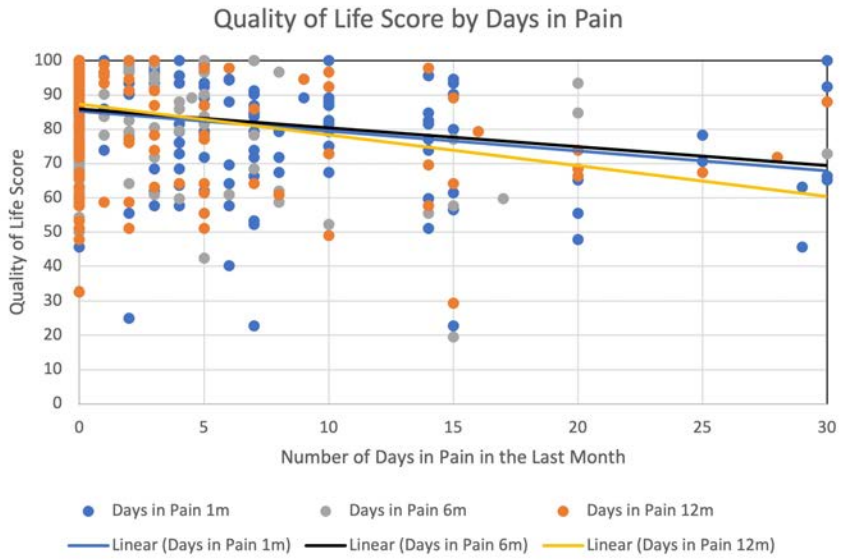
Abstract: Purpose:
Pilonidal disease in adolescents and young adult carries substantial burden to quality of life, with wide variation seen in disease course and disease management. Pain related to pilonidal disease is a pervasive factor that negatively affects these patients. Quantifying the effect of pain on quality of life may lead to more optimal management strategies.

Methods:
An IRB-approved, prospective, multi-center cohort study of children and adolescents ages 12 to 21 with pilonidal disease treated at 10 pediatric hospitals from 2019 to 2021 was conducted. Patients were followed for one year after their initial visit for pilonidal disease and were surveyed for an array of variables related to their pilonidal disease at intake, 1, 6, and 12 months, including quality of life scores using the Pediatric Quality of Life (QoL) survey.

Results:
Responses from participants regarding pain ranged from 173-192 at each survey. At 1 month, patients' reported number of days taking pain medication for their pilonidal disease was negatively correlated with QoL score, $R2 = 0.04$, $p = 0.002$, but the correlation was not significant at 6 or 12 months. Number of days in the last month with pain due to pilonidal disease was negatively correlated with QoL score at 1, 6, and 12 months, $R2 = 0.08$, $p < 0.001$, $R2 = 0.08$, $p < 0.001$, and $R2 = 0.10$, $p < 0.001$, respectively (Figure 1). There was a negative correlation between reported days in the last month with pain related to pilonidal disease at 12 months and the change in QoL score over 1 year, $R2 = 0.15$, $p = 0.0024$.

Conclusion:
Pain related to pilonidal disease significantly affects quality of life in teens and young adults. Pain management should be considered in the long-term treatment for these patients. Further studies are needed to characterize the most effective types of pain management for pilonidal disease.

Abbreviations: QoL - Quality of Life


Quality of Life Score by Days in Pain
Quality of Life Score
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
Number of Days in Pain in the Last Month
Days in Pain 1m
Days in Pain 6m
Days in Pain 12m
Linear (Days in Pain 1m)
Linear (Days in Pain 6m)
Linear (Days in Pain 12m)

Scientific Session V - Fetal

10:00 AM – 11:15 AM

APSA 117

3-PORT FETOSCOPIC MENINGOMYELOCELE REPAIR

Krysta M. Sutyak, DO[1], Ramesha Papanna, MD MPH[2], Stephen Fletcher, DO[1], Eric Bergh, MD[1], Mary T. Austin, MD, MPH[3], KuoJen Tsao, MD[3]

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Abstract: Purpose: In this video, we aim to describe our technique for fetoscopic meningomyelocele repair. Specifically, we aim to highlight the use of 3 trans-uterine ports, complete neural placode dissection with full release of tethered cord, and dural patch repair with cryopreserved umbilical cord.

Methods: Retrospective review of our fetal registry was performed. Data collection was performed on number of cases, conversion rate, gestational age at operation, gestation age at birth, and mortality. Video footage of 2 cases was obtained with patient consent that represent primary and patch skin closure with umbilical cord patch. Cases included meningomyeloceles and myeloschisis open neural tube defects. The video was then compiled and narrated to describe the operative technique.

Results: Fetoscopic meningomyelocele is performed via team approach with pediatric general surgery, maternal fetal medicine, and pediatric neurosurgery. To date our fetal center has performed 67 fetoscopic meningomyelocele repairs. 97% of these were completed without conversion to an open hysterotomy. All operations occurred at a gestation age between 24 weeks and 25 weeks and 6 days. The average gestational age at delivery was 35 weeks and 1 day. There were no fetal or perinatal deaths. All cases utilize umbilical cord patch for neural tube coverage. Primary skin closure was performed when feasible. Alternatively, skin was closed by a secondary umbilical cord patch based on surgeon discretion. The accompanying video summarizes access to the uterus, placode dissection, patch repair, and closure.

Conclusion: Our experience with fetoscopic meningomyelocele repair to date has been safe and effective utilizing novel 3-port technique and umbilical cord patch.

Abbreviations: No abbreviations used

APSA 118

BIOENGINEERED HYDROGEL WITH PLACENTAL MESENCHYMAL STEM CELL DERIVED EXTRACELLULAR VESICLES RESCUE AMBULATION IN AN OVINE MYELOMENINGOCELE MODEL

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Abstract: Purpose: Myelomeningocele (MMC), results from the incomplete closure of the neural tube and is the most common congenital cause of lifelong paralysis in the United States. Placental derived mesenchymal stem cells seeded on extracellular matrix (PMSC-ECM) have been shown to be a viable therapy for MMC in utero surgical repair using the well-established ovine model, rescuing ambulation, and improving neurologic function. The regenerative effects of PMSCs are likely due to paracrine effects, hence investigating an alternative cell-free therapy that mimic the paracrine functions of PMSCs to protect neurons is worthwhile. Extracellular vesicles (EVs) play an important role in cell-to-cell communication making them an excellent candidate for cell-free therapy. Our objective is to develop a bioengineered hydrogel with PMSC-EVs and assess its neuroprotective functions in vivo using the ovine myelomeningocele model.

Methods: Extracellular vesicles derived from PMSCs were mixed with 1mL solution of 2mg/mL rat tail collagen at a density of 5 X 1010 EVs/mL and incubated 1h at a gelation temperature of 37°C. Fetal MMC lambs were treated with the PMSC-EV-ECM product at median 106 days gestation after surgical defect creation, as previous described. The lambs were delivered at term via cesarean section and assessed at 24 hours for motor function and ambulation using the Sheep Locomotor Score (SLR). Histological analysis of the spinal cords is ongoing to evaluate the density of motor neurons and spinal cord compression.

Results: Four lambs survived and underwent SLR scoring. Three lambs scored a 15, indicating normal motor function and one lamb scored a 13. All lambs treated with PMSC-EV-ECM were able to ambulate. These lambs were compared to historical control lambs that received ECM only which scored a median SLR score of 4 (n=6) and were unable to ambulate. Lambs treated with PMSC-EV-ECM had significantly higher SLR scores in comparison to ECM only lambs (p=0.0095).

Conclusion: We present PMSC derived EVs as a novel potential cell-free therapy to augment in utero repair of myelomeningocele in an ovine model. We have demonstrated that bioengineering a cell-free EV-based hydrogel is feasible and can rescue ambulation as previously observed with use of a PMSC-ECM cell-based product.

Abbreviations: PMSC-placental mesenchymal stem cell
ECM-extracellular matrix
EV-extracellular vesicle
MMC-myelomeningocele

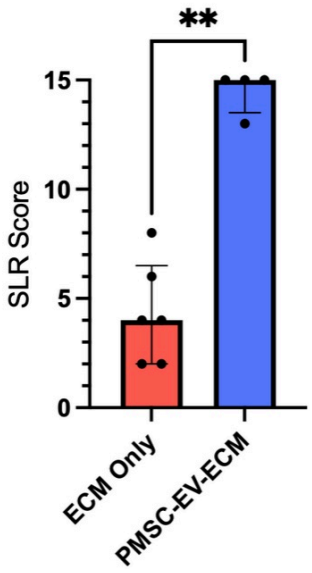

Figure 1. PMSC-EV-ECM therapeutic product improved locomotor outcomes in fetal lambs. All lambs were scored with SLR. PMSC-EV-ECM treated lambs (n=4) scored from 13 to 15 (13, 15, 15, 15). ECM only lambs scored from 2 to 8 on the SLR score (2, 2, 4, 4, 6, 8). Lambs treated with PMSC-EV-ECM had significantly higher SLR scores in comparison to ECM only lambs (p=0.0095).

APSA 119

IN-VIVO AND EX-VIVO TARGETING OF THE FETAL PULMONARY SYSTEM FACILITATES ORGAN-SPECIFIC OPTIMIZATION OF THERAPEUTIC VECTORS

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Abstract: Introduction
The fetal pulmonary system is an attractive target for gene therapy due to a tolerant immune system, absent mucous barrier, and abundance of progenitors. We screened a panel of lipid nanoparticles (LNP) to select a candidate for lung delivery, optimized fetal murine intratracheal (IT) delivery to deliver gene editing mRNA, and characterized cellular targeting. We then generated precision-cut lung slices (PCLS) from neonatal human and fetal sheep, pig, and mouse lobectomies to evaluate the transduction efficiency of the optimized NP.

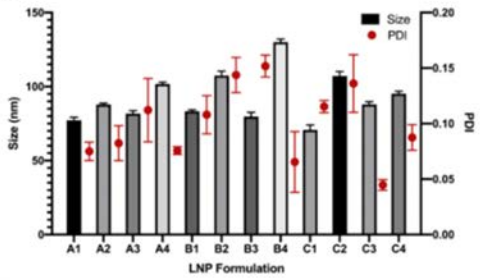
Methods
Time-dated mice underwent uterine exposure. Embryonic day 17 fetal heads were exteriorized. Tracheae were dissected and injected with 30ul NP representing a panel of 14 LNPs containing luciferase mRNA. Fetuses were analyzed 4-hours later. Time-dated mTmG dams underwent fetal IT injections of Cre-recombinase mRNA. After delivery, cell populations were evaluated for GFP expression at day of life 1. The optimal vector was compared to adenovirus, adeno-associated virus (AAV) 1, 6, and 9 with respect to transduction of PCLS derived from 8-week-old human neonatal lobectomy specimens and the tracheobronchial trees of gestational day (gd) 20 C57/B6 mice, gd107 sheep, or gd105 pigs. Left lower lobes were embedded in agarose, sectioned, and incubated with vector and evaluated at 96h.

Results
The top performing formulation outperformed the commercially available C12-200 by multiple fold (Figure 1). In PCLS, GFP expression was detectable via fluorescence microscopy in 18 of 33 and via flow cytometry in 31 of 33 conditions. The most robust transduction (10-20% of total lung cells) across species was observed in adenovirus, AAV6, and LNP. Flow cytometry demonstrated GFP expression ~4% overall that was most pronounced in epithelial (11.6%) followed by endothelial (2.2%) and mesenchymal cells (1.6%).

Conclusions
Here we optimize a LNP for delivery to the fetal lung. Fetal intratracheal delivery of mRNA is feasible in the mouse model and efficiently targets epithelial cells, a critical target for pulmonary diseases. PCLS from human surgical specimens and whole animal lungs are a powerful platform to assess vector delivery for gene therapies targeting congenital pulmonary disease. LNPs have differential affinity for organ-specific delivery.

Abbreviations: LNP lipid nanoparticle
IT intratracheal
PCLS precision cut lung slices
AAV adeno associated virus

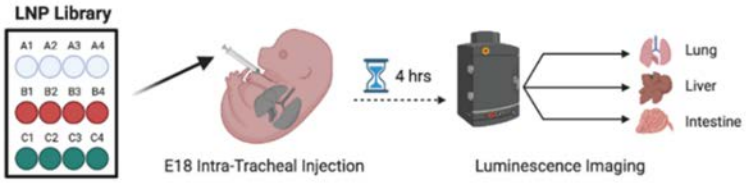
A



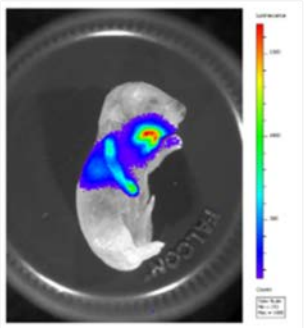
B

	pK_a
A1	6.81
A2	5.57
A3	5.97
A4	6.76
B1	7.14
B2	5.79
B3	5.94
B4	6.60
C1	6.87
C2	5.83
C3	5.05
C4	6.01

C



D



APSA 120

MATERNAL TREPROSTINIL AND FETAL TRACHEAL OCCLUSION HAVE SYNERGISTIC EFFECTS ON LUNG DEVELOPMENT IN THE RABBIT MODEL OF CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose: To evaluate the benefit of adding antenatal maternal treprostinil administration to fetal tracheal occlusion (TO) in rabbits with surgically induced congenital diaphragmatic hernia (CDH).

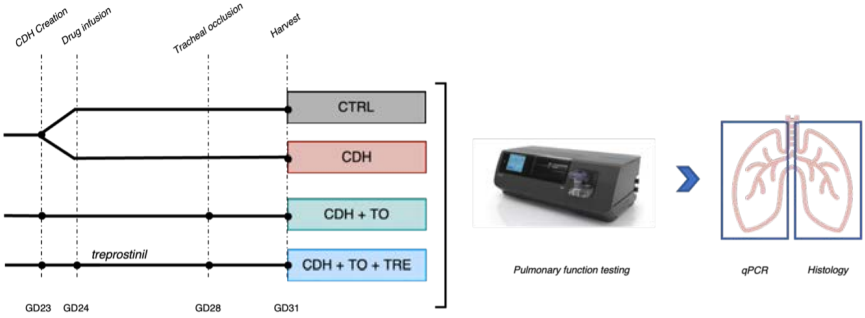
Summary Background Data: Fetal TO improves alveolar development, lung hypoplasia and pulmonary mechanics in rabbits with CDH, however, not abnormal pulmonary vascular development. Prenatal maternal treprostinil reduces the proportional wall thickness of pulmonary arterioles in pups with CDH.

Methods: This was a superiority trial investigating the use of treprostinil added to TO in pups with CDH. CDH was surgically created on gestational day (GD) 23 (term= GD31) and in randomly selected does a subcutaneous pump was implanted in the neck to administer treprostinil starting on GD24. On GD28, TO was performed in selected fetuses with CDH. At term, fetuses were delivered, ventilated, and lungs harvested for molecular and histological analyses. Unoperated littermates served as controls.

Results: In CDH fetuses, addition of treprostinil to fetal TO significantly reduced the pulmonary arteriolar proportional medial wall thickness (CDH+TO vs CDH+TO+TRE, 42.53±3.95 vs 34.48±3.62%, p< 0.0001), and increased alveolar surface area (11.33±4.09 vs 24.22±9.34 cm2/mL, p< 0.0001), dynamic lung compliance (0.0234±0.0097 vs 0.0401±0.0123 mL/cmH2O, p=0.0282) and ipsilateral lung volumes (0.019±0.007 vs 0.031±0.010 mL, p=0.0002). Treprostinil did not change the TO-associated suppression of surfactant protein expression.

Conclusions: We conclude that prenatal maternal treprostinil and TO have synergistic effects improving lung development in the surgical rabbit model of CDH.

Abbreviations: TO = tracheal occlusion
CDH = congenital diaphragmatic hernia
GD = gestational day



APSA 121

PERINATAL VACCINATION BY TRANSAMNIOTIC FETAL MRNA DELIVERY: IMMUNIZATION AGAINST HUMAN CYTOMEGALOVIRUS IN A RODENT MODEL

Kamila Moskowitzova, MD[1], Abbie Naus[1], Savas Tsikis[1], Tanya T. Dang[2], Shuqi Lin[1], David Zurakowski, MS,PhD[3], Dario O. Fauza, MD, PhD[4]

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Abstract: Purpose: Gestational cytomegalovirus infection is a prevalent disease with significant fetal and neonatal morbidity, including long term neurological deficits. Vaccines based on mRNA have emerged as safe and powerful alternatives for active immunization postnatally. It has been recently shown that mRNA delivered into the amniotic fluid can reach the fetal circulation via the amnio-placental interface. We investigated whether transamniotic mRNA delivery could be a viable strategy for perinatal immunization, first analyzing its response to a human cytomegalovirus (hCMV) antigen in a rodent model.

Methods: Six pregnant Sprague Dawley dams underwent volume-matched intra-amniotic injections in all their fetuses (n=103) of either a suspension of a custom-made mRNA encoding for the hCMV envelope glycoprotein B (gB) antigen encapsulated by a semi-synthetic composite lipopolyplex (mRNA group; n=56), or of the same lipopolyplex without mRNA (Control group; n=47) on gestational day 17 (E17; term=E21-22). Fetuses were either survived until term or for 7 or 14 days after birth (respectively P7 and P14). Term placentas were screened for host mRNA incorporation and local production of hCMV gB antigen by western blot. Serum levels of antigen-specific hCMV gB antibodies of the IgG class were measured at term, P7 and P14 by ELISA. Statistical analyses included Wilcoxon rank sum test and Fisher's exact test (significance at $p< 0.05$).

Results: There was no maternal mortality or premature labor. Overall fetal/neonatal survival was 86% (89/103), with no significant differences between the groups. Western blots showed presence of hCMV gB in term placentas in the mRNA group ($p=0.008$ vs. Control; Figure 1A,B). No hCMV gB antigen-specific IgG was detected in the serum of term fetuses, i.e., 4 days following transamniotic delivery. However, significantly increased serum levels of hCMV gB antigen-specific IgG were present in mRNA pups at P7 ($p=0.008$) and P14 ($p=0.006$) when controlled by mRNA-free injections (Figure 1C), i.e., 11-19 days after transamniotic administration.

Conclusions: Transamniotic fetal mRNA delivery of a human cytomegalovirus antigen can induce a humoral immune response into the 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: hCMV - human cytomegalovirus
mRNA - messenger ribonucleic acid
gB - glycoprotein B
ELISA - enzyme-linked immunosorbent assay

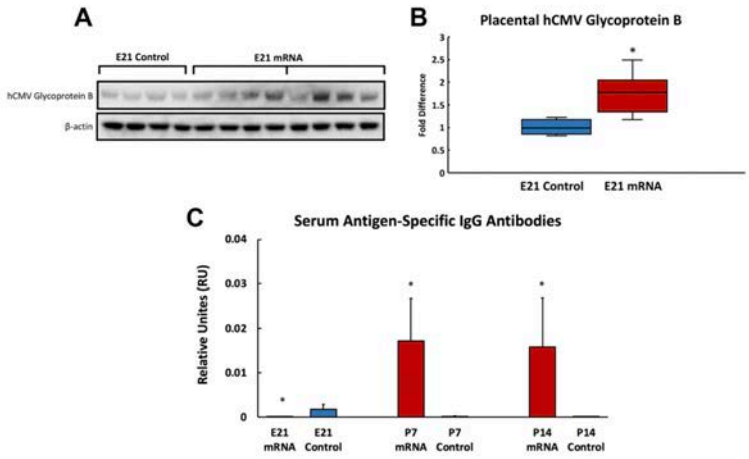

Figure 1: (A, B) Western blots of term (E21) rat placentas for human cytomegalovirus (hCMV) glycoprotein B in the Control and mRNA groups. **(C)** Anti-hCMV glycoprotein B IgG antibody levels in the serum at term (E21), and 7 (P7) and 14 (P14) days after birth. Data presented as median ± interquartile range for placenta and as mean ± SEM for serum.* $p<0.05$ vs. Control, E = gestational day.

APSA 122

IN UTERO INTRA-AMNIOTIC DELIVERY OF LIPID NANOPARTICLES FOR DELIVERY OF MRNA THERAPIES

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Abstract: Introduction: In utero gene editing institutes therapy prior to the onset of pathology by targeting progenitor cells of organs that are difficult to access after birth. Current in utero therapies typically rely on intravenous delivery via the vitelline vein, which effectively targets the liver and heart but offers limited access to other organs such as the skin and lungs.

Purpose: In this study we assess the biodistribution of lipid nanoparticles (LNPs) delivered to the amniotic cavity in a fluorescent reporter mouse model at different gestational time points.

Methods: We performed intra-amniotic injection of LNPs containing Cre-recombinase mRNA (LNP.Cre) in mTmG fetuses at gestational days E9, E12, and E16. mTmG mice express GFP in all cell types following Cre mediated excision of the mT gene. After birth, mice were harvested at day of life P30 with the heart, liver, lungs, skin, and brain assessed for GFP expression by stereomicroscopy and immunohistochemistry with a GFP stain.

Results: Mice injected with LNP.Cre at E9 demonstrated robust GFP expression of the skin, heart, and liver, as well as mild expression of the brain [Figure 1]. Mice injected at E12 demonstrated milder expression in the heart, liver, and skin, with no expression in the lungs or brain. Mice injected at E16 demonstrated GFP expression only in the lungs with no expression in other organs.

Conclusion: In utero intra-amniotic lipid nanoparticle injection offers an alternative means to deliver mRNA therapies for genetic diseases of the skin, liver, and heart. Targeting efficiency is highly dependent on the gestational age of LNP injection, with relative efficacy reflecting the timing of organ development and normal gestational barriers.

Abbreviations: LNP: Lipid Nanoparticle

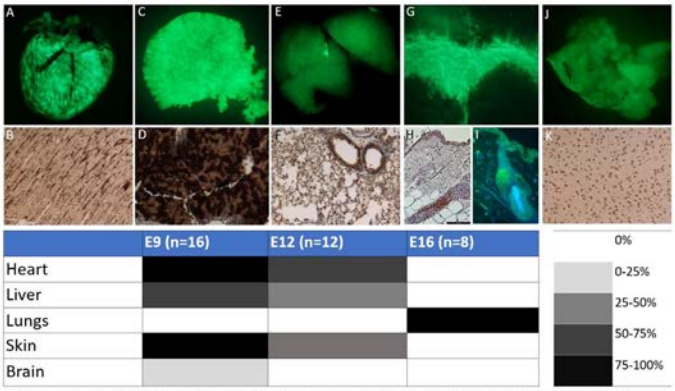

Figure 1. Distribution of LNP-Cre after intra-amniotic delivery at different gestational time points. A,B: stereomicroscopy and IHC GFP stain, heart, E9 injection. **C,D:** Stereomicroscopy and IHC GFP stain, liver, E9 injection. **E,F:** Stereomicroscopy and IHC GFP stain, lungs, E16 injection. **G,H,I:** stereomicroscopy and IHC and IHF with GFP stain, skin, E9 injection. **I,J:** stereomicroscopy and IHC GFP stain, brain, E9 injection. **Below:** distribution of GFP staining after LNP-Cre injection at different gestational time points.

APSA 123

PULMONARY HYPOPLASIA SECONDARY TO OLIGOHYDRAMNIOS: NEW INSIGHTS INTO PATHOPHYSIOLOGY AND POTENTIAL STEM CELL-BASED THERAPY

Fabian Doktor, MD[1], Lina Antounians, MSc[1], Rebeca Figueira[2], Mikal Obed, MD[1], Kasra Khalaj[1], Augusto Zani, MD, PhD, FACS, FAAP[3]

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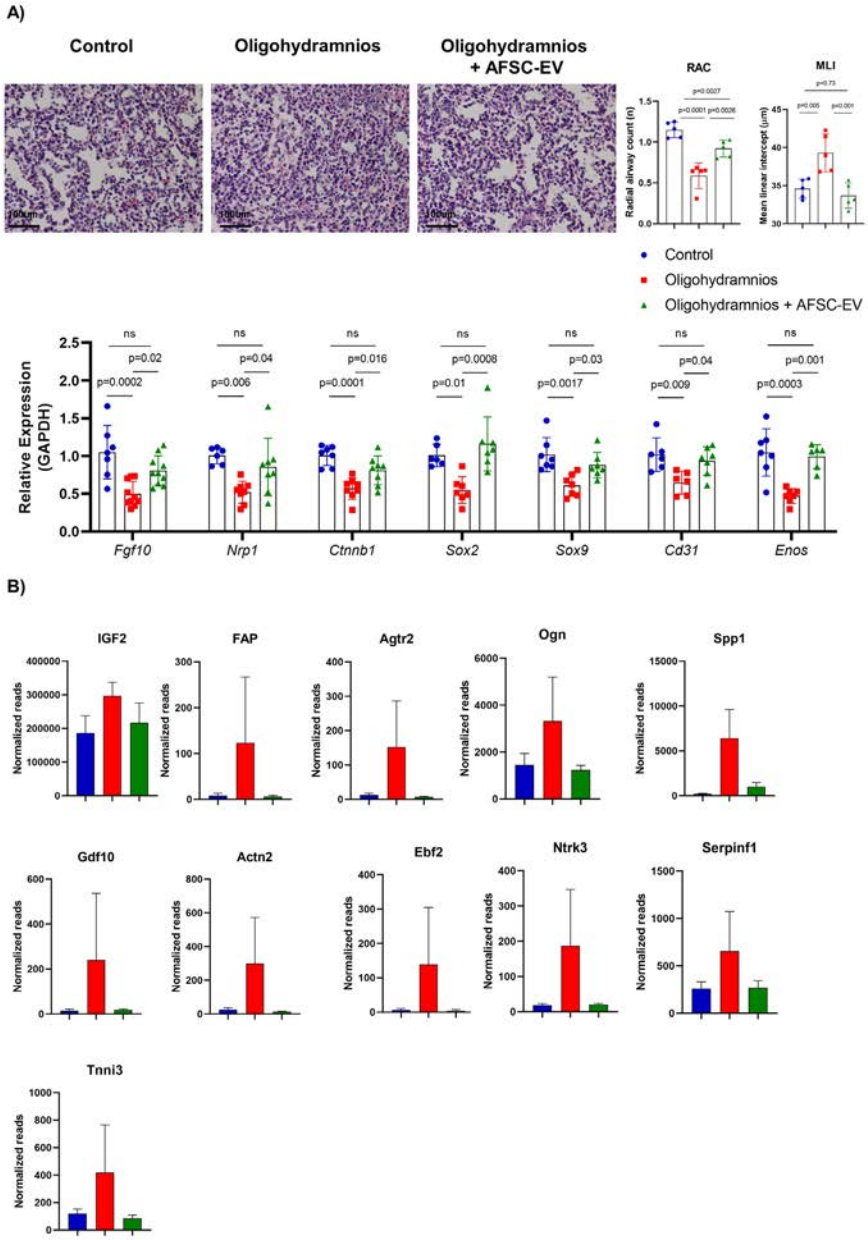
Abstract: Purpose: Oligohydramnios is a devastating condition, whose mortality and morbidity remain high and are mainly due to pulmonary hypoplasia. Currently, there are no effective treatment options for hypoplastic lungs secondary to oligohydramnios. We previously reported that amniotic fluid stem cell extracellular vesicles (AFSC-EVs) have regenerative potential in hypoplastic lungs secondary to congenital diaphragmatic hernia. Herein, we aimed to investigate 1) molecular changes induced by oligohydramnios in the lung and 2) if AFSC-EVs could improve arrested lung development secondary to oligohydramnios.

Methods:
AFSC-EVs: isolated via ultracentrifugation, characterized for size (Nanosight), shape (electron microscopy), and EV canonical markers (Western blotting).
Animals: The uterus was exposed via laparotomy in rat dams and oligohydramnios was induced via aspiration of amniotic fluid (at least 175-200uL) at embryonic (E) day 16.5 (AUP#49892). Control dams underwent laparotomy without amniotic fluid aspiration. On E19.5, pups were sacrificed, lungs harvested and grown for 24h as lung explant cultures. Lung explants were treated with medium alone (OH+medium) or with AFSC-EVs (OH+AFSC-EVs).
Outcome measures: Lungs were compared for branching morphogenesis using mean linear intercept (H&E), and expression of progenitor cell and angiogenic factors by RT-qPCR (Fgf10, Ctnnb1, Nrp1, SOX2, SOX9, eNOS, CD31).
RNA sequencing: Three biological replicates per group were used for library preparation (Ribo-ZeroPlus) and sequencing (Illumina-NovaSeq2). DESeq2 and Reactome were employed for differential gene expression analysis.
Statistics: ANOVA/Kruskal-Wallis.

Results:
Compared to controls, oligohydramnios reduced the number of airspaces and decreased the expression of progenitor cells and angiogenic factors. Treatment with AFSC-EVs rescued the number of airspaces and the expression of progenitor cells and angiogenic factors back to control (Fig.1A). Differential gene expression analysis revealed that the expression of 11 genes was up-regulated in OH+medium lungs and rescued back to control level in OH+AFSC-EV lungs. These 11 genes are involved in mesenchymal tissue remodeling (Igf2, Fap, Agtr2, Ogn, Spp1, Gdf10, Actn2, Tnni3 and Ebf2) and lung vascularization (Ndrk3, Serpinf1) (Fig.1B).
Conclusions: This study shows for the first time that hypoplastic lungs secondary to oligohydramnios undergo mesenchymal tissue remodeling and have impaired vascularization. An EV-based therapy could be a potential cell-free approach to promote lung development in fetuses with oligohydramnios.

Abbreviations:


A)
Control
Oligohydramnios
Oligohydramnios + AFSC-EV
RAC
MLI
Radial airway count (n)
Mean linear intercept (µm)
Control
Oligohydramnios
Oligohydramnios + AFSC-EV
Relative Expression (GAPDH)
Fgf10
Nrp1
Ctnnb1
Sox2
Sox9
Cd31
Enos
B)
IGF2
FAP
Agtr2
Ogn
Spp1
Gdf10
Actn2
Ebf2
Ntrk3
Serpinf1
Tnni3
Normalized reads

APSA 124

REPURPOSING AN ENDOGENOUS MRNA PACKAGING PROTEIN FROM THE MATERNAL-FETAL INTERFACE FOR IN UTERO GENE THERAPY

Steven T. Papastefan, MD[1], Hee K. Kang, PhD[2], Catherine Redden[3], Lucas Turner[3], Morgan M. Langereis, MSc[2], Katherine Ott, MD[4], Masato Ohtsuka, PhD[5], Amir Alhajjat[3], Channabasavaiah B. Gurumurthy, PhD[6], Aimen Shaaban[3]

[1]Department of Surgery, Northwestern University Feinberg School of Medicine Division of Pediatric Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA, [2]Ann and Robert H. Lurie Children's Hospital, Chicago, IL, USA, [3]Center for Fetal Cellular and Molecular Therapy, Ann and Robert H. Lurie Children's Hospital, [4]Center for Fetal Cellular and Molecular Therapy, Ann and Robert H. Lurie Children's Hospital, Chicago, IL, USA, [5]Tokai University, Shibuya City, Tokyo, Japan, [6]University of Nebraska Medical Center, Omaha, NE, USA

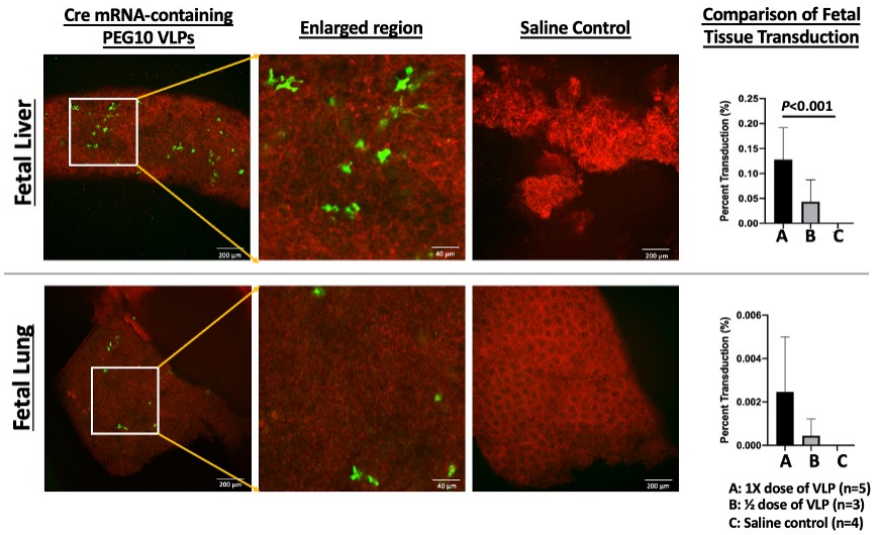
Abstract: Introduction: Nanoparticle-based in utero mRNA delivery permits expression of therapeutic proteins and gene editing enzymes, with the collective potential to treat a wide variety of fetal diseases. The mammalian capsid-like protein PEG10, which is highly expressed in the placenta and fetus, can be programmed to package specific mRNA within endogenous "virus-like" particles (VLPs) and pseudotyped to guide cell tropism. In this study, we challenged the hypothesis that pseudotyped PEG10 VLPs can target mRNA delivery to embryonic precursor cell lines in vitro and to the fetus in vivo.

Methods: PEG10 VLPs encapsulating Cre cargo mRNA were isolated from supernatant of transfected HEK293FT cells via clarification and differential centrifugation. VLPs were pseudotyped with VSVg (a viral fusogen conferring broad cell tropism), myomaker (an endogenous muscle fusogen conferring tropism to myoblasts), or no fusogen (nonpseudotyped). Cre mRNA-containing VLPs were co-cultured with Lox-STOP-Lox reporter N2A neuroblast cells and C2C12 myoblast cells respectively, and cells examined for transduction via fluorescence microscopy and flow cytometry at 24-96 hours. In vivo, VLPs were delivered to time-dated Rosa-mT/mG dams, which constitutively express red fluorescence and switch to green fluorescence upon cleavage at LoxP sites. Fetal intrahepatic injection of Cre mRNA-containing VSVg-pseudotyped PEG10 VLPs or saline was performed at E14, and fetal tissues were analyzed at 24-72 hours post-injection via stereomicroscopy and flow cytometry.

Results: In vitro, efficient transduction of N2A cells was achieved via delivery within VSVg-pseudotyped VLPs (56.0 +/- 12.5%) compared to nonpseudotyped VLPs (3.3 +/- 1.4%, P<.001). Detectable transduction of reporter myoblasts was achieved via myomaker-pseudotyped VLPs (10.7 +/- 8.7%), indicating myomaker mediates functional mRNA transfer within VLPs composed entirely of native proteins. In vivo, VSVg-pseudotyped VLPs mediated detectable levels of transduction within fetal liver and lung (Figure) with no difference in fetal absorption compared to controls (P=.460).

Conclusion: We conclude PEG10 VLPs mediate mRNA delivery to neuroblasts and myoblasts in vitro and to the fetal liver and lung in vivo. To our knowledge, this study demonstrates the first evidence of in vivo mRNA delivery via endogenous proteins. As a native placental/fetal protein, PEG10 may be an ideal mRNA delivery vector for in utero gene therapy.

Abbreviations: mRNA: Messenger RNA
PEG10: Paternally-expressed gene 10
VLP: Virus-like particle
VSVg: Vesicular stomatitis virus G
E: Embryonic day


Cre mRNA-containing PEG10 VLPs
Enlarged region
Saline Control
Comparison of Fetal Tissue Transduction
Fetal Liver
Fetal Lung
Percent Transduction (%)
P<0.001
A
B
C
A: 1X dose of VLP (n=5)
B: ½ dose of VLP (n=3)
C: Saline control (n=4)

APSA 125

SINGLE CELL-GUIDED PRENATAL DERIVATION OF PRIMARY FETAL EPITHELIAL ORGANOIDS FROM HUMAN AMNIOTIC AND TRACHEAL FLUIDS FOR CONGENITAL DISEASE MODELLING AND THERAPIES

Mattia FM Gerli, PhD[1], Giuseppe Calá[1], max Beesley, PhD[1], Beatrice Sina, MEng[1], Lucinda Tullie[2], Kylin Yunyan Sun[1], Francesco Panariello, PhD[3], Federica Michielin[4], Joseph davidson[1], Francesca Russo[5], Brendan Jones[1], Dani Do Hyang Lee[1], savvas savvidis[1], Theodoros Xenakis[1], Ian Simcock[1], Anna Straatman-Iwanowska[6], Anna David[1], Christopher O'Challaghan[1], Alessandro Olivo[1], Simon Eaton[7], Stavros Loukogeorgakis[1], davide Cacchiarelli, PhD[3], Jan Deprest[5], Vivian Li, PhD[2], Giovanni G. Giobbe, Doctorate[1], **Paolo De Coppi, MD, PhD**[8]

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Abstract: Purpose

Despite advances in prenatal diagnosis, it is still difficult to predict severity and outcomes of many congenital malformations. New patient-specific prenatal disease modelling may optimise personalised prediction. Using single cell analysis, we characterised the cellular identities in amniotic fluid (AF) and identified viable epithelial stem/progenitor cells of fetal intestinal, renal and pulmonary origin. With relevance for prenatal disease modelling, we investigated if these cells could be cultured to form primary clonal epithelial amniotic fluid-derived organoids (AFO) autologous to the fetus. We investigated the possibility of generating organoids with small intestine, kidney and lung identity.

Methods

Through single cell transcriptomics we identified epithelial stem/progenitor cells in the human AF. We cultured these cells in extracellular matrix in 3D droplets in a media permissive for organoids formation. Clonal AFOs were picked, expanded, and characterised for gene and protein expression to assess their tissue identity. Validation was conducted using assessing tissue-specific maturation potential, enzymatic activity and protein function.
Results

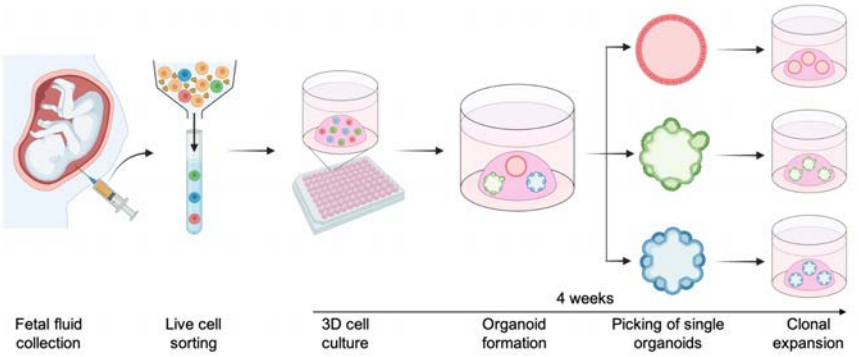
We derived AFO from 27 AFs ranging 15 to 34 GA weeks. We expanded and characterised over 200 clonal AFO lines to assess their tissue identity. AFOs manifested intestinal, renal and pulmonary identity, validated at both gene and protein level. Moreover, AFO demonstrated differentiation potential, enzymatic activity and morphological hallmarks of their tissues of origin. Importantly, significant phenotypical alterations were detected in AFOs derived from congenital malformation cases recapitulating some pathological features of the conditions. This highlighted the potential use of our platform for disease modelling.

Conclusion

This work shows the prenatal derivation of primary fetal organoids. AFO allow investigation of fetal epithelial tissues at clinically relevant developmental stages, compatibly with the continuation of pregnancy with a timeline that would allow prenatal modelling, and without requiring tissue biopsies. AFOs are autologous to the fetus, manifesting intestine, kidney and lung identity. Functional assays highlighted the potential use of AFO to model congenital conditions and implement novel predictive diagnosis and regenerative medicine strategies. Overall AFO may enable the development of therapeutic

tools tailored to the fetus, as well as to predicting the effects of such therapies.

Abbreviations: AF: Amniotic Fluid
AFO: Amniotic fluid-derived organoids
GA: Gestational age



Scientific Session VI - Quality and Stewardship
10:00 AM – 11:15 AM

APSA 20

HEEDING THE BLACK BOX: LEVERAGING NATIONAL SURGICAL QUALITY IMPROVEMENT PROJECT-PEDIATRIC FOR HOSPITAL-LEVEL ASSESSMENT OF OPIOID PRESCRIBING

Mallory N. Perez, MD[1], Lynn Huang, MS[2], Willemijn L.A. Schafer, PhD[2], Alison Lehane, MD[3], Charesa J. Smith, MD, MS[1], Sarah Kennedy, RN, MSN, MS[4], Charles J. Aprahamian, MD[5], Srikumar Pillai, MD[6], Bethany J. Slater, MD, MBA[7], Mehul V. Raval[8]

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Abstract: PURPOSE
Despite Food & Drug Administration (FDA) "black box" warnings to reduce potentially harmful opioid use in children, both hospital-level pediatric surgical opioid prescribing practices and compliance with FDA guidance are not nationally benchmarked. This study aimed to 1) demonstrate the feasibility of expanding existing registry data to evaluate surgical opioid prescribing practices and FDA compliance across hospitals and 2) identify factors contributing to hospital-level variation in opioid use.

METHODS
This cross-sectional, retrospective study utilized expanded National Surgical Quality Improvement Project-Pediatric (NSQIP-P) data collection at 4 hospitals from 2021-2023. The cohort included children, 5-18 years old, who underwent any operation included in the NSQIP-P sampling frame (N=1700). Additional data were obtained by chart abstraction. The primary outcome was the total morphine milligram equivalents (MMEs) prescribed at discharge. FDA compliance was assessed for contraindications and warnings related to codeine, tramadol, and benzodiazepines. Using hierarchical multivariate linear regression, patient- and procedure-specific factors associated with increased total MMEs prescribed at discharge were identified ($p< 0.05$).

RESULTS
Complete data was retrieved for 1,691 patients undergoing surgery. The proportion of patients prescribed opioids at discharge varied significantly by hospital from 25.8% to 44.4% ($p< 0.001$). FDA compliance report cards were successfully generated for each hospital. Most hospitals were 100% compliant with FDA contraindications, except for one where codeine was among the opioids chosen for analgesia (Table). All hospitals violated the FDA warning on concurrent prescription of benzodiazepines and opioids (6.6%-53.7%). Among those prescribed opioids, mean total MMEs prescribed were 31.5 (SD=14.4). After adjustment, orthopedic surgery and use of preoperative non-opioid analgesia were significantly associated with increased total MMEs prescribed at discharge ($p< 0.05$).

CONCLUSION
Leveraging expanded surgical registry data is a feasible method to evaluate and provide feedback on hospital-level variation in opioid prescribing practices and compliance with federal agency guidance. Expansion of this pilot to all National Surgical Quality Improvement Project-Pediatric hospitals is currently underway. This work provides the foundation for future investigations, including exploring when deviation from federal guidance is warranted, creating learning collaboratives to improve opioid stewardship, and establishing evidence-based best practices such as procedure- and population-specific standards.

Abbreviations: FDA: Food & Drug Administration
NSQIP-P: National Surgical Quality Improvement Project-Pediatric
MMEs: morphine milligram equivalents

APSA 21

INCREASING CAUDAL BLOCK UTILIZATION TO PROMOTE OPIOID STEWARDSHIP IN THE NICU POPULATION

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Abstract: Introduction: Neonates undergoing surgery are vulnerable to deleterious effects of narcotics on respiratory, gastrointestinal, and neurocognitive function. Regional anesthesia techniques are safe and effective in reducing pain and the need for opioid analgesia but may be underutilized in neonatal intensive care unit (NICU) patients. We developed an opioid stewardship pathway aimed at reducing the use of opioid analgesia in neonates by increasing caudal block utilization from a baseline of 46% to 90% within 18 months.

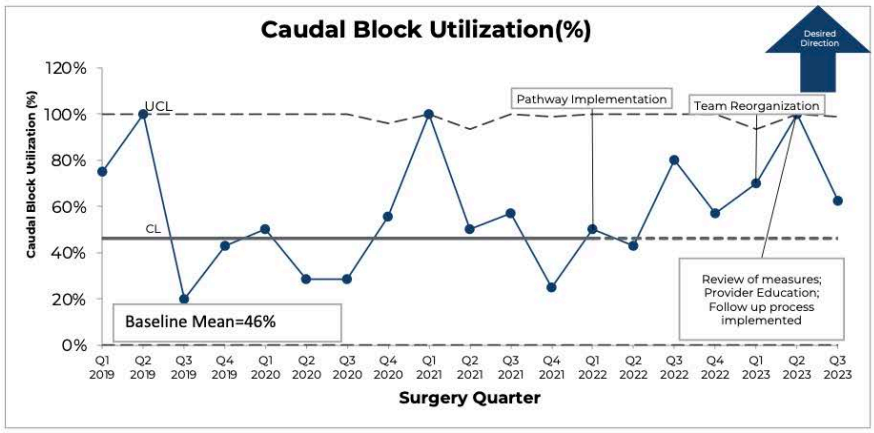
Methods: We convened stakeholders to create a pathway for NICU patients undergoing elective abdominal surgery to receive caudal blocks to reduce opioid utilization and increase post-operative extubation rates. We tracked intraoperative opioid utilization in morphine milliequivalents per kilogram (MME/kg) and immediate post-operative extubation rates. Unrelieved pain (defined as 2 consecutive Neonatal Pain, Agitation & Sedation Scale (NPASS) score >/= 4), and reintubation within 24 hours were tracked as balancing measures.

Results: There were 77 surgical encounters in the baseline pre-intervention group and 45 in the post-intervention group. Caudal block utilization increased from 46% to 60% (Fig 1A). Intra-operative opioid utilization decreased to 0.211 MME/kg from 0.463 MME/kg (Fig 1B), and extubation rates increased from 63 to 73% (Fig 1C). No patients required reintubation within 24 hours. There were no increases in unrelieved pain (pre 25% vs post 26.7%). Compliance with caudal utilization improved over the latter part of the implementation phase after additional provider education and initiation of a real-time feedback mechanism for non-compliant cases.

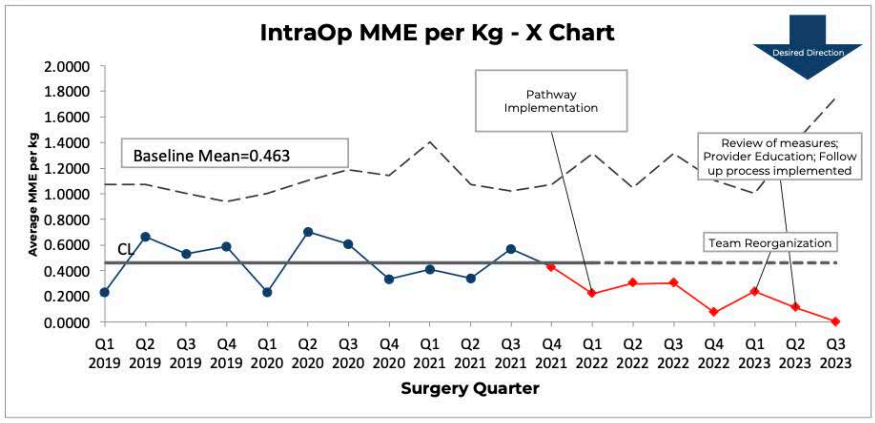
Conclusion: Despite missing the target of 90% caudal utilization, the increase to 60% has led to reduction in intra-operative opioid use and increased post-operative extubation rates without compromising pain control. Efforts are underway to further improve caudal block compliance to reduce opioid use and increase extubation.

Abbreviations: NICU
MME/kg
NPASS

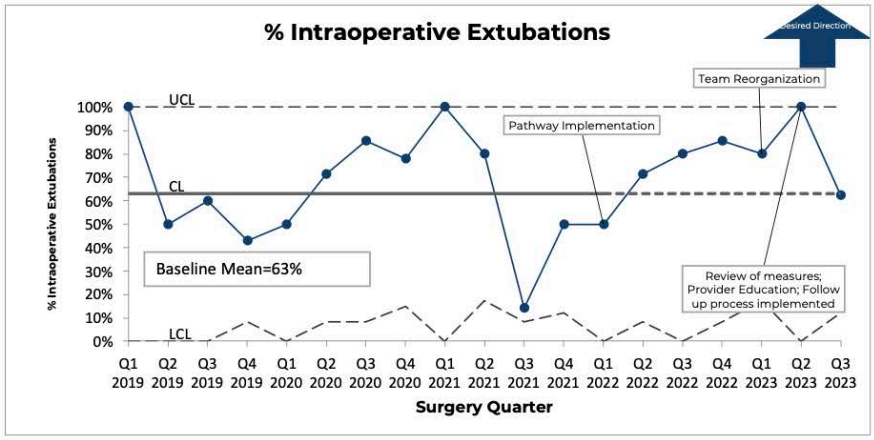
A


Caudal Block Utilization(%)
Desired Direction
Caudal Block Utilization (%)
120%
100%
80%
60%
40%
20%
0%
UCL
CL
Pathway Implementation
Team Reorganization
Baseline Mean=46%
Review of measures; Provider Education; Follow up process implemented
Q1 2019
Q2 2019
Q3 2019
Q4 2019
Q1 2020
Q2 2020
Q3 2020
Q4 2020
Q1 2021
Q2 2021
Q3 2021
Q4 2021
Q1 2022
Q2 2022
Q3 2022
Q4 2022
Q1 2023
Q2 2023
Q3 2023
Surgery Quarter

B


IntraOp MME per Kg - X Chart
Desired Direction
Average MME per kg
2.0000
1.8000
1.6000
1.4000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
Pathway Implementation
Baseline Mean=0.463
Review of measures; Provider Education; Follow up process implemented
CL
Team Reorganization
Q1 2019
Q2 2019
Q3 2019
Q4 2019
Q1 2020
Q2 2020
Q3 2020
Q4 2020
Q1 2021
Q2 2021
Q3 2021
Q4 2021
Q1 2022
Q2 2022
Q3 2022
Q4 2022
Q1 2023
Q2 2023
Q3 2023
Surgery Quarter

C


% Intraoperative Extubations
Desired Direction
% Intraoperative Extubations
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
UCL
CL
LCL
Team Reorganization
Pathway Implementation
Baseline Mean=63%
Review of measures; Provider Education; Follow up process implemented
Q1 2019
Q2 2019
Q3 2019
Q4 2019
Q1 2020
Q2 2020
Q3 2020
Q4 2020
Q1 2021
Q2 2021
Q3 2021
Q4 2021
Q1 2022
Q2 2022
Q3 2022
Q4 2022
Q1 2023
Q2 2023
Q3 2023
Surgery Quarter

APSA 22

TO DELAY OR NOT DELAY: COST ANALYSIS OF EARLY VS DELAYED OUTPATIENT REPAIR OF INGUINAL HERNIAS IN PREMATURE INFANTS

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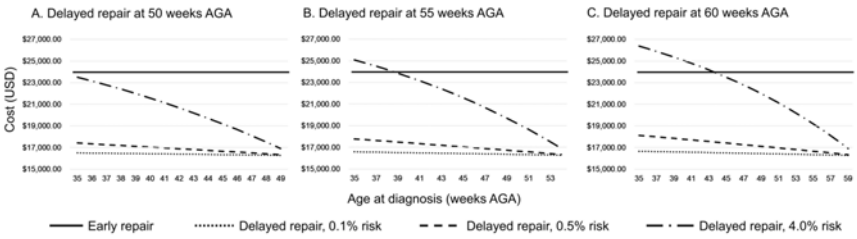
Abstract: Purpose: Premature infants diagnosed with inguinal hernias after hospital discharge require overnight observation for apnea monitoring following repair until 50-60 weeks adjusted gestational age (AGA). However, delaying repair to avoid overnight monitoring increases the risk of incarceration. These competing priorities lead to practice variation in the timing of repair. This study aimed to evaluate costs associated with early versus delayed outpatient repair of inguinal hernia in premature infants. We hypothesized that there would be an AGA before which early repair would result in lower average cost.

Methods: A decision analysis model was used to compare the cost for premature infants undergoing early vs delayed repair of inguinal hernia. Costs were estimated using the average total costs to the hospital at a single institution for three scenarios: 1) delayed repair not requiring an overnight admission ($16,267 USD), 2) early repair requiring overnight admission for apnea monitoring ($24,081), and 3) incarcerated inguinal hernia successfully reduced but requiring 48-hour delayed repair to decrease edema with postoperative apnea monitoring ($32,093). All models began at 35 weeks AGA. The base model used 50 weeks AGA as the point repair could be done without apnea monitoring and a 0.5% incarceration rate per week based on literature review. The rate of incarceration was assumed to follow an exponential distribution. Sensitivity analyses varied AGA at delayed repair to 55 and 60 weeks and weekly incarceration rate from 0.1% to 4%.

Results: In the base model, delayed repair was always associated with a lower average cost than early repair (Figure), with the average cost of a case diagnosed at 35 weeks being $1,146 lower. In sensitivity analyses, no average cost for delayed repair rose above the threshold cost of early repair until estimated incarceration risk reached >3%/week or the protocol for not requiring apnea monitoring reached 55 weeks (incarceration risk: 3%/week) or 60 weeks (incarceration risk 4%/week).

Conclusion: It is less costly to delay repair of inguinal hernias in premature infants diagnosed as an outpatient to when they no longer need apnea monitoring. This must be weighed against concerns such as strangulation risk and surgeon availability.

Abbreviations: AGA: adjusted gestational age
USD: United States Dollars


A. Delayed repair at 50 weeks AGA
B. Delayed repair at 55 weeks AGA
C. Delayed repair at 60 weeks AGA
Cost (USD)
$27,000.00
$25,000.00
$23,000.00
$21,000.00
$19,000.00
$17,000.00
$15,000.00
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
35 37 39 41 43 45 47 49 51 53
35 37 39 41 43 45 47 49 51 53 55 57 59
Age at diagnosis (weeks AGA)
Early repair
Delayed repair, 0.1% risk
Delayed repair, 0.5% risk
Delayed repair, 4.0% risk

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LESS IS MORE: IMPROVING ANTIBIOTIC STEWARDSHIP WITH SHORTENED COURSES FOR PEDIATRIC APPENDICITIS

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Abstract: Purpose
Antibiotic stewardship efforts are critically needed to balance effective treatment and combat antibiotic resistance. Abbreviated antibiotic courses have been proposed for pediatric appendicitis. In this study, we evaluated outcomes for shortened antibiotic courses for children with gangrenous and perforated appendicitis.

Methods
We performed a single institution, retrospective observational study of children aged 3-18 years who presented with gangrenous or perforated appendicitis from July 2019 to July 2023. Typical regimens included intravenous ceftriaxone and metronidazole with transition to discharge on oral amoxicillin and clavulanate. The current intervention builds upon an established intraoperative appendicitis grading protocol. The total recommended antibiotic course was decreased from 3 to 2 days (d) for gangrenous appendicitis and 7d to 5d for perforated appendicitis. Outcomes including intra-abdominal abscesses rates, total duration of the antibiotic course (d), and readmission rates were compared with univariate analyses.

Results
During the study period, 646 patients had perforated (n=414, 64.1%) or gangrenous (n=232, 35.9%) appendicitis. There were 483 (74.7%) patients treated with the “Long Course” and 163 (25.2%) patients treated with the “Short Course.” Mean antibiotic durations decreased from 3.8d to 1.6d (2.2d mean decrease, SD=2.1) for gangrenous appendicitis, 6.8d to 5.5d (1.3d mean decrease, SD=1.7) for perforated appendicitis with focal abscess, and 7.4d to 6.7d (0.7d mean decrease, SD=3.6) for perforated appendicitis with generalized abscess. The short antibiotic course had similar rates of intra-abdominal abscess compared to the long antibiotic course (n=15, 9.2% vs n=44, 9.1%, p=0.99) and reduced readmission rates (n=6, 3.7% vs n=41, 8.5%, p=0.05) (Table). Similar results were observed when stratifying by severity of appendicitis.

Conclusions
A shortened course of antibiotics for gangrenous and perforated pediatric appendicitis improves antibiotic stewardship while maintaining similar results with balancing measures such as intra-abdominal abscess and readmission rates.

Abbreviations:

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THE DEVELOPMENT OF A MULTIDISCIPLINARY GASTROSTOMY TUBE PERIOPERATIVE CARE BUNDLE IN THE NEONATAL INTENSIVE CARE UNIT DECREASES OPERATIVE ENTERAL ACCESS COMPLICATIONS

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Abstract: Problem Definition
Gastrostomy tube (G-tube) placement is one of the most common life-sustaining procedures performed in pediatric and neonatal patients. They provide a safe, long-term access for enteral nutrition. However, complications rates can range from 11-26%. Complications include peristomal leak with skin breakdown, G-tube site infections and G-tube malfunction. Some of these complications can result in increased hospital length or a secondary surgical procedure. Baseline assessment revealed a 30% complication rate within our Neonatal Intensive Care Unit (NICU). We identified the lack of a standardized perioperative care bundle contributing to a large practice variation in perioperative care including pain management, tube securement and feeding regimen. To our knowledge there are no published perioperative care bundles specific to NICU patients. We hypothesize that the creation of a bundle in the NICU will decrease operative enteral access complications.

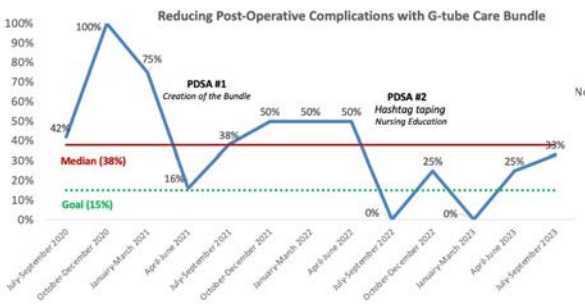
Objective
We sought to create a multidisciplinary perioperative G-tube care bundle to standardize care in our NICU and aimed to reduce perioperative G-tube complications from 30% to 15% in a 18 month period.

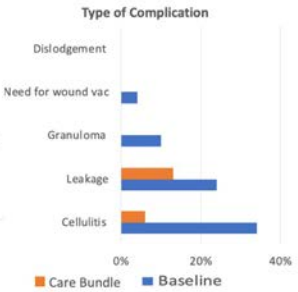
Scope
Our cohort included NICU infants who had a surgically placed gastrostomy tube with or without a fundoplication procedure. Patients with percutaneously placed gastrostomy tubes were excluded. The perioperative care bundle provided guidance from the time of anticipated surgery to 6 weeks post-op or at discharge, whichever came first.

Analysis
Pre-bundle implementation analysis revealed that most complications were secondary to cellulitis (34%) and leakage (24%) with 4% of patients requiring wound vac placement for symptom control. The first PDSA cycle, which entailed bundle creation, led to a decrease in post-operative complications. Further emphasis on standardization of gastrostomy tube securement and nursing education for securement during the second PDSA cycle led to additional improvement. Our next PDSA cycle will focus on the implementation of a unified pain regimen, with subsequent assessment of the complication rate.

Improvement
The creation of a perioperative G-tube care bundle with the collaborative efforts of a multidisciplinary team decreased gastrostomy-tube related complications from 30 to 17%. Ongoing efforts are underway to disseminate this bundle to other hospital units, and in the outpatient setting.

Abbreviations: G-tube- Gastrostomy tube
NICU- Neonatal Intensive Care Unit
PDSA- Plan, Do, Study, Act


Reducing Post-Operative Complications with G-tube Care Bundle
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
100%
75%
42%
16%
38%
50%
50%
50%
0%
25%
0%
25%
33%
PDSA #1
Creation of the Bundle
PDSA #2
Hashtag taping
Nursing Education
Median (38%)
Goal (15%)
July-September 2020
October-December 2020
January-March 2021
April-June 2021
July-September 2021
October-December 2021
January-March 2022
April-June 2022
July-September 2022
October-December 2022
January-March 2023
April-June 2023
July-September 2023


Type of Complication
Dislodgement
Need for wound vac
Granuloma
Leakage
Cellulitis
0%
20%
40%
Care Bundle
Baseline

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IMPROVING TIME TO GOAL FEEDING AND DISCHARGE AFTER SURGICAL GASTROSTOMY TUBE PLACEMENT IN CHILDREN

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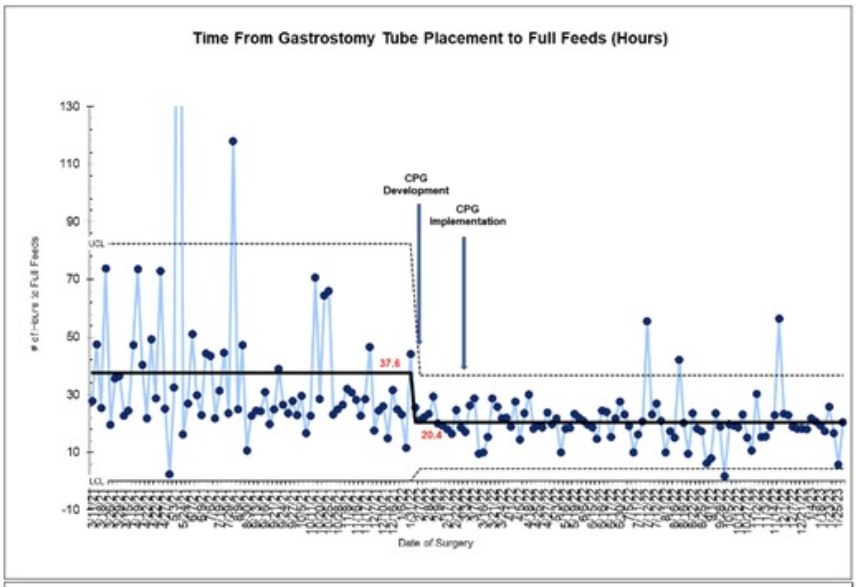
Abstract: Background: Gastrostomy tube (GT) placement is a common procedure performed by pediatric surgeons. Prior to implementation of a clinical practice guideline (CPG) at our institution, surgeon variation in care and lack of standardized timing for activating parental training and case management resulted in prolonged postoperative length of stay (PLOS) after GT. This study evaluated time to full feeding and PLOS after GT placement with implementation of a CPG. We hypothesized that CPG use decreased time to full feeding and PLOS.

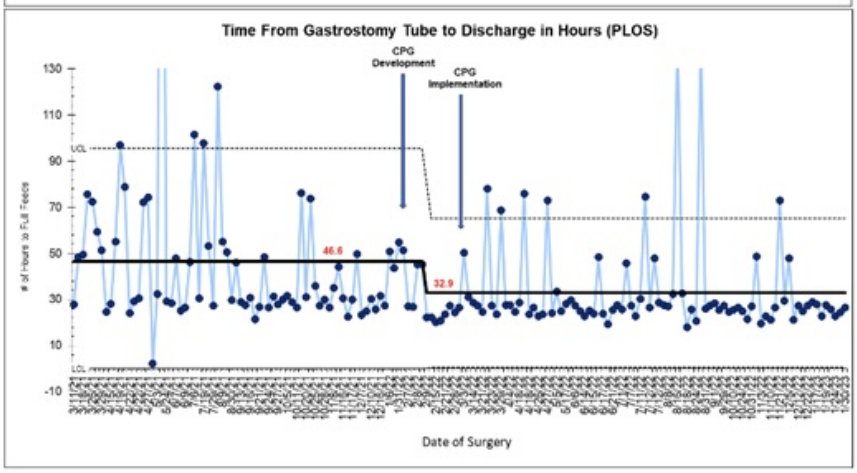
Methods: A multidisciplinary pediatric surgery quality improvement team created a CPG using best practice evidence while accounting for unique institutional workflow. The CPG implemented a standardized feeding advancement pathway and directed scheduling parental training classes and ordering home equipment immediately after surgery. We reviewed the pre-implementation and post-implementation patients, comparing time to full feeds, PLOS, vomiting, and readmission rates. This study did not require IRB review as it was a quality improvement project.

Results: Pre-implementation cohort (3/2021-2/2022, N=82) showed median time to full feeds of 25.8 hours (IQR: 13.5), median PLOS of 30.6 hours (IQR: 23.5), 20 (24%) patients with postop vomiting, 18 (22%) with readmission/ED visit. Post-implementation cohort (3/2022-1/2023, N=84) showed median time to full feeds of 19.3 hours (IQR: 6.4), median PLOS of 27.1 hours (IQR: 4.3), 12 (14%) patients with postop vomiting, 20 (24%) with readmission/ED visit. X chart showed shift in time to full feeds and PLOS after implementation.

Conclusions: Implementation of a post-GT CPG decreased time to feeds and PLOS without adversely affecting vomiting or readmission/ED visits. Collaborative CPG can positively affect patient care.

Abbreviations: Gastrostomy tube (GT)
Clinical practice guideline (CPG)
Postoperative length of stay (PLOS)
Quality Improvement (QI)
Institutional Review Board (IRB)
Emergency Department (ED)


Time From Gastrostomy Tube Placement to Full Feeds (Hours)
CPG Development
CPG Implementation
UCL
LCL
37.6
20.4
# of Hours to Full Feeds
Date of Surgery


Time From Gastrostomy Tube to Discharge in Hours (PLOS)
CPG Development
CPG Implementation
UCL
LCL
46.6
32.9
# of Hours to Full Feeds
Date of Surgery

APSA 26

ITERATIVE QUALITY IMPROVEMENT IN OPIOID STEWARDSHIP IMPROVES CARE AND PAIN CONTROL IN PECTUS EXCAVATUM SURGERY

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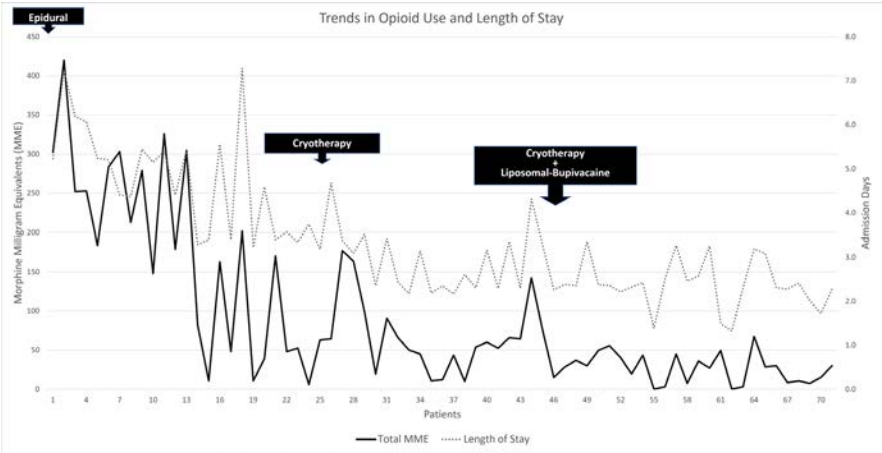
Abstract: Purpose: Minimally invasive repair of pectus excavatum (MIRPE) has historically been a painful procedure requiring multi-day hospital stays. However, multimodal pain regimens including cryoanalgesia and regional nerve blocks has been shown to improve outcomes. As a quality improvement initiative, we aimed to assess our institution's efforts to improve pain control for MIRPE.

Methods: A single-institution, retrospective cohort study was conducted of all pediatric patients who underwent MIRPE (2011-2023). Demographic, diagnostic, operative technique, opioid consumption, length of stay (LOS), and hospital cost data were collected. Treatment groups were based on pain control regimens. Descriptive statistics were used to analyze the total morphine milligram equivalents (MME) per admission, LOS, and total cost adjusted for inflation. Kruskal Wallis tests and Student's t-tests were performed.

Results: Of 71 patients, 77.9% were male, mean age of 14.8 ± 1.8 years. Groupings by chronology included: 9 (12.7%) epidural only, 2 (2.8%) epidural/patient controlled analgesia (PCA), 6 (8.5%) PCA only, 20 (28.2%) cryoanalgesia/PCA, 6 (8.5%) cryoanalgesia only, 5 (7.0%) cryoanalgesia/PCA/liposomal-bupivacaine, and 23 (32.4%) cryoanalgeisa/liposomal-bupivacaine alone. Major treatment inflection points were in the incorporation of cyroanalgesia and then intercostal liposomal-bupivacaine nerve blocks with cyroanalgesia. Interventions demonstrated gradual improvements in opioid consumption including the median total MME of 283.5 (IQR 253-303) for epidural only, 232.3 (IQR 212.6-252) for epidural/PCA, 122.6 (IQR 48-149) for PCA only, 53.3 (IQR 41.2-94.9) for cryoanalgesia/PCA, 58.5 (IQR 12-66) for cryoanalgesia only, 36.7 (IQR 30-55.5) for cryotherapy/PCA/liposomal-bupivacaine, and 28.50 (IQR 7.5-43.5) for cryotherapy/liposomal-bupivacaine (Figure 1). An overall 89.9% reduction in opioid utilization (p=.0001). Consequently, the LOS decreased from 5.25 days (IQR 5.2-5.4 days) in the epidural group to 2.3 days (IQR 2.2-2.51 days) in the cryoanalgesia/liposomal-bupivacaine alone group (p=.0001). The mean total cost for patients who did not receive cryotherapy was $19,325 ± $6,737 compared to $20,935 ± $2,2013 with cryotherapy (p =.34).

Conclusion: Opioid utilization and length of stay have dramatically decreased in our pectus patients as our pain management protocol has evolved. Cryoanalgesia with liposomal-bupivacaine intercostal nerve block significantly improves post-operative pain decreasing the need for opioids and leading to quicker discharge. Optimal enhanced recovery for MIRPE should be studied.

Abbreviations: MIRPE: Minimally Invasive Repair of Pectus Excavatum
PCA: Patient Controlled Analgesia
MME: Morphine Milligram Equivalents
LOS: Length of Stay


Trends in Opioid Use and Length of Stay
Epidural
Cryotherapy
Cryotherapy
+
Liposomal-Bupivacaine
Morphine Milligram Equivalents (MME)
Admission Days
Patients
Total MME
Length of Stay

APSA 27

IMPLEMENTATION OF A NEONATAL SURGICAL FEEDING ADVANCEMENT CLINICAL CARE GUIDELINE

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Abstract: Purpose: In 2021, our quaternary, free-standing children's hospital had overall longer neonatal intensive care unit (NICU) length of stays (LOS) compared to its peers within the Children's Hospital Neonatal Consortium. Variability in feeding advancement and delays in central venous catheter (CVC) removal after achieving full feeds (100kcal/kg/day) in surgical neonates were identified as contributing factors. The purpose of this study was to evaluate the impact of a neonatal surgical feeding advancement clinical care guideline (CCG) to standardize practice and reduce LOS for surgical neonates.
Methods: A multidisciplinary group of NICU clinicians and quality improvement specialists created a CCG after conducting a comprehensive literature review. The CCG contains clinical criteria for initiating and advancing feeds, with guardrails based on daily patient evaluation of feeding intolerance. Surgical populations were categorized into standard and high-risk groups based on weight, gestational age, diagnosis, and procedure. From initiation in 08/2022 to 07/2023, at our single-site institution, 33 surgical neonates completed the CCG and were discharged from the NICU. Outcomes including LOS, time to initiation of feeds, from initiation to full feeds, and to full feeding volume (mean days, respectively), and time to CVC removal (median days after total parenteral nutrition discontinuation) were compared to 84 pre-implementation patients. Balancing measures included development of post-surgical necrotizing enterocolitis (NEC) and increased stool output (> 20mL/kg/day) during feeding advancement. Data monitoring occurred monthly. Percent change calculations and Mann-Whitney U tests were used for analysis with $p < 0.05$ considered significant.
Results: Compared to the baseline population, neonates on the CCG algorithm had a 22.7% reduction in LOS (69.0d vs. 89.2d, p=0.51) and 5.8% reduction in time to initiation of feeds (9.2d vs. 9.8d, p=0.22). Time from initiation to full feeds increased by 17.4% (14.8d vs. 12.6d, p=0.04). Similar times were observed for time to full feeds (23.4d vs. 22.3d days, p=0.17) and CVC removal (2.0d vs. 2.0d, p=0.83). Balancing measures remained stable with no observed post-surgical NEC or increased stool output.
Conclusion: Implementation of a neonatal surgical feeding advancement CCG is feasible and initial results appear promising. Additional Plan-Do-Study-Act (PDSA) cycles are needed to optimize CCG adherence and further improve outcomes.

Abbreviations: NICU: Neonatal Intensive Care Unit
LOS: Length of Stay
CVC: Central Venous Catheter
CCG: Clinical Care Guideline
NEC: Necrotizing Enterocolitis
PDSA: Plan-Do-Study-Act

APSA 28

A UTILIZATION-BASED APPROACH TO REDUCE OPERATING ROOM COST AND IMPROVE EFFICIENCY FOR PEDIATRIC INGUINAL HERNIA REPAIRS

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Abstract: Purpose: To assess the effect of utilization-based preference cards for laparoscopic inguinal hernia repair surgery on operative cost and return rate for disposable materials.

Methods: This quality improvement project assessed 12 months of utilization data from the electronic medical record for disposable materials during a laparoscopic inguinal hernia repair amongst five surgeons at a quaternary care, academic medical center. A utilization heat map for each surgeon inclusive of item usage, item return rates, pick sheet cost, and mean cost per case was created. Each surgeon reviewed their respective cost and utilization and were asked, but not pressured or required, to consider revisions to their preference card based on utilization less than 40% and cost of alternative items. Subsequently, the revised card was reviewed by an interdisciplinary team inclusive of a surgeon, surgical technician, and nursing coordinator to ensure compliance with OR safety policies. The updated cards were implemented, and new data was collected after one, three, and 12 months of utilization with the same parameters. The number of changes and need for further revisions is tracked.

Results: Overall, 56 cases were assessed over the pre implementation phase. The mean return rate for surgical instruments across all surgeons during a pediatric laparoscopic inguinal hernia repair surgery was 45% and the mean operative cost of a case was $230.61. After preference card optimization, 10 cases at the 1-month interval showed a mean return rate of 25%, and an average case cost of $107.91. The intervention resulted in a 21% reduction in return ($p=0.003$) which correlates with a $122.70 ($p=0.04$) cost savings per case. No surgeon has requested further revision.

Conclusion: Data based optimization of surgeon specific preference cards significantly reduces return rate and operative cost of pediatric laparoscopic inguinal hernia repair.

Abbreviations:

Quickshot Session I - Clinical Pediatric Surgery

5:00 PM – 5:45 PM

APSA QS 1

IMPACT OF CUMULATIVE OPIOID EXPOSURE IN THE FIRST YEAR OF LIFE ON NEURODEVELOPMENT AMONG HIGH-RISK INFANTS

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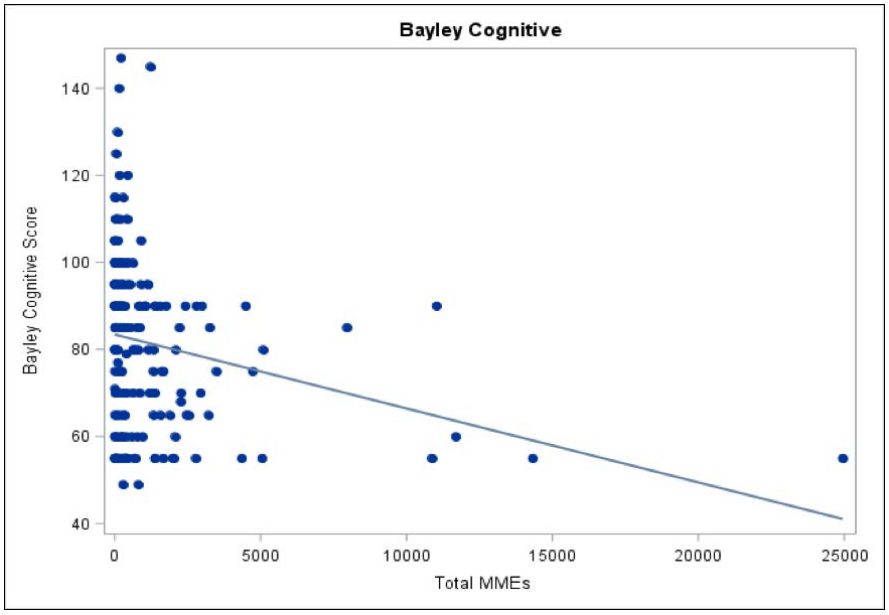
Abstract: Background: High-risk infants, defined as infants with significant neonatal-perinatal morbidities, often undergo procedures requiring opioids. Prolonged opioid exposure has been associated with decreased cerebellar growth, developmental disability, and poor socialization. Previous studies have been small, limited to infants with a single diagnosis, and do not include cumulative opioid exposure within the first year of life.

Methods: A retrospective cohort of high-risk infants < 1y admitted to a single tertiary children's hospital from 2010-2020 was identified using Pediatric Health Information System and electronic health record review. High-risk infants were identified by ICD-9/ICD-10 codes for congenital heart disease surgery, medical and surgical necrotizing enterocolitis, extremely and very low birth weight, hypoxemic ischemic encephalopathy, extracorporeal membrane oxygenation, and other abdominal surgery. Cumulative morphine milligram equivalents (MME) received in the first year of life were calculated including opioids received in the operating room and during multiple hospitalizations. Neurodevelopment was assessed with Bayley-III/IV, DAYC, or Vineland tests conducted at 18 months of age. A score < 1 standard deviation from standardized test mean was defined as impairment, encompassing mild to severe neurodevelopmental impairment. Neurodevelopment was examined using linear and logistic regressions adjusting for gestational age and presence of a neuromuscular comorbidity.

Results: Overall, 244 high-risk infants were identified. Prematurity occurred in 48%, 63.5% underwent surgery, and 70.1% demonstrated neurodevelopmental impairment. A majority were assessed with Bayley-III/IV cognitive scales (223/244, 91.4%), and a significant negative correlation with cumulative MME was identified (Figure 1). On multivariable linear regression a significant negative association was demonstrated between cumulative MME and Bayley cognitive scores (-0.001, 95% CI: -0.002, -0.0004, p=0.008). Similar results were seen for the Bayley motor and language domains ($p < 0.05$). However, on multivariable logistic regression, cumulative MMEs received in the first year of life was not associated with clinically significant impaired neurodevelopment (OR 1.00, 95% CI: 0.99-1.00, p=0.11). Decreasing gestational age (OR 0.95, 95% CI: 0.91-0.99, p=0.04) and presence of a neuromuscular comorbidity (3.14, 95% CI: 1.25-7.86, p=0.02) were associated with impaired neurodevelopment.

Conclusion: Cumulative opioid exposure in the first year of life was significantly associated with reduced neurodevelopmental scores but did not influence thresholds for clinically significant neurodevelopmental impairment.

Abbreviations: morphine milligram equivalents (MME)


Bayley Cognitive
Bayley Cognitive Score
140
120
100
80
60
40
0
5000
10000
15000
20000
25000
Total MMEs

APSA QS 2

FERTILITY PRESERVATION CHOICES IN TRANSGENDER AND NONBINARY ADOLESCENTS AND YOUNG ADULTS

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Abstract: Purpose: Gender-affirming hormones may have future effects of pediatric patients' fertility potential. Previous research suggests that stopping gender affirming hormones to pursue fertility preservation (FP) may have psychological effects on patients with gender dysphoria. The Endocrine Society and World Professional Association for Transgender Health recommend discussion of fertility and potential FP options prior to proceeding with gender affirming hormones. This study reviews the experience of a FP program in counseling transgender and nonbinary adolescents and young adults (AYA).

Methods: An IRB-exempt retrospective review of records was performed for patients referred to a fertility preservation program at a free-standing children's hospital between September 2021 and August 2023. Patient demographics, hormonal treatment, and FP intervention were collected. Univariate analysis was performed to determine data distribution and descriptive statistics are reported.

Results: Between September 2021 and August 2023 a total of 82 transgender and nonbinary AYA were referred for FP counseling. The mean age at FP referral was 15 years (range 11-22 years). Most patients referred were Tanner stage 5 at the time of referral (Table 1). Most AYA underwent fertility counseling. Fourteen AYA (38.9%) with testes (designated male at birth) underwent successful sperm banking; 1 AYA (2.8%) attempted sperm banking but did not obtain a sample for preservation. Seven AYA (15.2%) with ovaries (designated female at birth) underwent successful ovarian stimulation and egg banking. One patient with testes (2.8%) and 1 patient with ovaries (2.2%) underwent surgical removal of gonadal tissue for tissue cryopreservation.

Conclusion: Most transgender and nonbinary AYA in our cohort were interested in learning about FP prior to initiating gender-affirming hormones. Less than half of patients pursued a FP procedure, however this was an increase compared to similar reports. More patients with testes pursued fertility preservation than those with ovaries. This patient population utilized all possible standard and experimental fertility preservation options. A thorough knowledge of the spectrum of fertility preservation options is necessary to counsel these patients. Further work will continue to evaluate fertility outcomes in transgender and nonbinary patients.

Abbreviations: FP, fertility preservation; AYA, adolescent and young adult

APSA QS 3

SURGICAL TREATMENT OF OVARIAN TORSION IN PEDIATRIC AND ADOLESCENT PATIENTS: DOES EDUCATION CHANGE PRACTICE

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Abstract: Background: Ovarian torsion is a rare event in the pediatric population which may be treated by either pediatric general surgeons or gynecologists. Oopherectomy was the most common procedure performed for torsion, which can affect long-term fertility. Perceived risks of detorsion alone, including thromboembolic events and missing an occult malignancy, contributed to this practice. In response, The APSA Outcomes and Evidence-Based Practice Committee evaluated the safety and benefits of ovarian detorsion. They found no evidence of thromboembolic events, a very rare incidence of malignancy, and evidence of fertility function after detorsion alone. Of note, pediatric gynecologists were performing far more ovarian-preserving procedures. Therefore, in 2018, they recommended ovarian detorsion and preservation as the treatment of choice for ovarian torsion.

Purpose: To evaluate how education at a national meeting and subsequent publication affected the national trends in the surgical management of pediatric ovarian torsion.

Methods: The Pediatric Health Information System (PHIS) – a comparative database from more than 49 children's hospitals across the United States – was queried for patients
Results: A total of 4107 patients were identified with an age range of 0 to 18 years (median 12, +/- 4.05). Treatment was primarily provided by pediatric general surgeons (n=3403, 83%) vs gynecologists (n=704, 17%) and included oophorectomy, ovarian preservation surgery (biopsy, aspiration, drainage), or detorsion alone. The rate of oophorectomy significantly declined from 2007-2018 to 2019-2023 (36.9% vs 18.4%, $p< 0.001$). No difference was found in oophorectomy rates between specialty types after the education period (pediatric surgeons 18.2%, gynecologists 19.3%, $p=0.96$).

Conclusions: This study demonstrated that education was effective in bringing about practice change and improving patient care and outcomes. National trends in the surgical management of pediatric ovarian torsion are shifting away from oophorectomy towards ovarian preservation.

Abbreviations: APSA - American Pediatric Surgical Association

APSA QS 4

A PROSPECTIVE EVALUATION OF A NON-OPERATIVE TREATMENT BUNDLE FOR GASTROCUTANEOUS FISTULAE IN CHILDREN

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Abstract: Purpose: Gastrocutaneous fistulae (GCF) have been found to persist after gastrostomy removal in one third of children with predictable risk factors. Several non-surgical treatment options exist including the use of proton-pump inhibitors, topical fibrin glue, silver nitrate application, and collagen plugging. These options have been found to resolve GCFs in up to 80% of published reports, albeit in underpowered and uncontrolled studies. We evaluated the efficacy and tolerability of a standardized, "bundled" delivery of non-surgical adjuncts immediately after gastrostomy tube removal.
Methods: With REB approval (H17- 02821) a prospective, multi-center, pragmatic trial was undertaken (NCT # 03920306). Sample size was calculated based on the recently validated incidence rate of 33% GCF after gastrostomy removal - a 50% reduction would result in a GCF rate of 16.5%, yielding a sample size of 100 patients. Consenting individuals received one or two applications of a bundle of the following: Topical application of AgNO3 and a bioadhesive to the fistula tract as well as a short-term proton-pump inhibitor. The primary outcome was GCF persistence at 2 and 4 weeks after treatment. Factors that predicted closure/non closure were evaluated and discomfort was assessed throughout the study protocol.
Results: Enrolment was completed across three sites over 4 years (n=100), with 53 female patients included. Mean age at enrolment was 6.2 years; duration with the gastrostomy was 3.7 +/- 3.2 years (range 57 days - 12.7 years). The GCF closure rate at 2 and 4 weeks was 41.6% and 51.2% respectively. No differences in closure rates were noted in gender, age, tube type or duration of gastrostomy. Four patients spontaneously closed after 4 weeks while awaiting surgical closure; three patient, who initially closed, reopened and underwent surgical closure. Discomfort with the application of AgNO3 was experienced by 35% of patients.
Conclusion: A bundled treatment approach of non-operative adjuncts did not improve the closure rate of gastrocutaneous fistulae in children, which remains significant. Given the important incidence of discomfort associated with topical AgNO3 application without benefit, this practice should be questioned.

Abbreviations: GCF: Gastrocutaneous fistulae
REB: Research Ethics Board
AgNO3: Silver Nitrate

APSA QS 5

POSTOPERATIVE OUTCOMES IN TRISOMY 21 INFANTS UNDERGOING ESOPHAGEAL ATRESIA REPAIR: A NATIONAL PROPENSITY SCORE MATCHING STUDY

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Abstract: Purpose:
The impact of trisomy 21 (T21) on postoperative outcomes after major surgery is controversial. This study evaluated surgical outcomes in T21 infants undergoing esophageal atresia (EA) repair with a specific focus on identifying factors contributing to postoperative mortality.

Methods:
We conducted a retrospective review of patients undergoing EA repair with or without tracheoesophageal fistula (TEF) (CPT codes: 43300-43314) using the National Surgical Quality Improvement Program-Pediatric (NSQIP-P) database from 2012-2020. Patients with T21 were compared to those without. We assessed 30-day postoperative mortality, along with postoperative complications, 30-day readmission, reoperation, and length of stay (LOS). Propensity score matching (10:1) ensured balanced groups, accounting for age, weight, tracheoesophageal (TEF) presence, and congenital heart disease. Multivariate logistic regression identified factors contributing to postoperative mortality ($p < 0.05$).

Results:
A total of 2,380 EA patients were identified, with 59 (2.5%) diagnosed with T21. Patients with T21 were less likely to have TEF when compared to those without T21 (69.5% vs. 85.2%, respectively; P< 0.001) and more likely to be older at the time of surgery (median 61 vs. 2 days, respectively; p< 0.001). Cardiac risk factors were similar between the two groups (minor: 32.2% vs 26.2%; major: 52.5% vs. 49.2%, p=0.39). Following propensity score matching, patients with T21 had a higher likelihood of developing venous thromboembolism (VTE) (5.1% vs. 0.8%, p=0.03) and a higher 30-day mortality (6.8% vs. 1.4%,p=0.02). However, rates of reoperation (18.7% vs. 14.9%, p=0.87), readmission (5.1% vs. 3.7%, p=0.87), overall complications (45.8% vs. 49.1%,p=0.72), and postoperative LOS (median 17.5 vs. 16.0 days, p=0.63) were not different between the two groups. Multivariate analysis revealed that T21 was associated with increased 30-day mortality (aOR 9.27, 95%CI 2.9-29.66, p<.001) and VTE (aOR 8.67, 95%CI 2.23-33.73, p=0.002) but not overall complications (aOR 1.04, 95%CI 0.61-1.76, p=0.88)(Table). Severe cardiac risk factors was significantly associated with increased mortality (aOR 8.46, 95%CI 1.96-36.5, p=0.004) and overall complications (aOR 3.95, 95%CI 2.16-7.25, p<.001).

Conclusion:
In this propensity score matched analysis, EA infants with T21 are at increased risk for postoperative mortality even after adjusting for congenital heart disease. These data are useful in preoperative counseling discussions with affected families.

Abbreviations: aOR - Adjusted Odds Ratio
CPT codes - Current Procedural Terminology codes
EA - Esophageal Atresia
LOS - Length of stay
NSQIP-P - National Surgical Quality Improvement Program-Pediatric
T21 - Trisomy 21
TEF - Tracheoesophageal Fistula
VTE - Venous Thromboembolism

APSA QS 6

INTERCOSTAL CRYOABLATION IN MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM: NATIONAL TEMPORAL TRENDS AND PREDICTORS OF UTILIZATION

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Abstract: Purpose: Intercostal nerve cryoablation under direct thoracoscopic guidance during minimally invasive repair of pectus excavatum (MIRPE) is a highly effective pain control technique, but it requires additional operative time and special equipment. Some insurance companies deny reimbursement for cryoablation, contending that it is an "experimental procedure". This study described national temporal trends in cryoablation use for PE, examined predictors of cryoablation use, and evaluated outcomes and resource utilization associated with cryoablation.

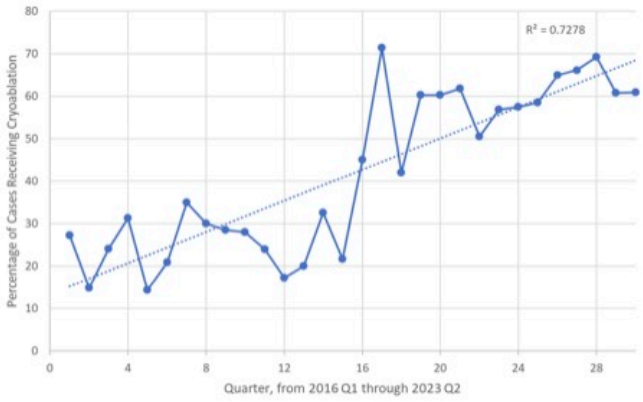
Methods: The Pediatric Health Information System (PHIS) database was queried for PE patients age 9-21 years who underwent MIRPE between 1/1/2016-6/30/23. Patients undergoing concomitant intercostal cryoablation were identified using procedural and supply/equipment codes. Quarterly prevalence of cryoablation was graphed across the study period to describe the temporal trend; linear regression was used to quantify this trend. Demographics, overall costs, in-hospital complications, length of hospital stay (LOS), and readmissions were compared for patients undergoing MIRPE with vs. without cryoablation using chi-square and Kruskal-Wallis tests.

Results: A total of 2,053 patients from 39 North American pediatric centers were included in the analysis (mean age 15 years, 87% male). The prevalence of cryoablation increased over the study period (Figure), with 65% of patients receiving cryoablation in 2022 vs 24% in 2016, and linear regression demonstrating a strong increasing trend (R-square=0.73). In the cryoablation group, complications were less frequent (14% vs 26%, $p< 0.0001$), LOS was shorter (median 2 vs. 3 days, $p< 0.0001$), and total costs were higher (median $21,531 vs. $18,847, $p< 0.0001$). The 30-day readmission rate was higher in the cryoablation group (31% vs 15%; $p< 0.0001$). Predictors of receiving cryoablation included having surgery at a high-volume center (odds ratio 3.97 for case volume quartile 4 vs 1, 95% confidence interval 1.98-8.04) and having in-state Medicaid insurance (OR 1.34 vs. commercial-other insurance, 95% CI 1.02-1.76).

Conclusion: Cryoablation in MIRPE has dramatically increased at the national level since 2016 and is now performed in nearly two-thirds of cases. When available, cryoablation should be considered a standard adjunct to MIRPE and not an experimental technique. Further study is needed to evaluate drivers of resource utilization and reasons for readmission after MIRPE.

Abbreviations: MIRPE: minimally invasive repair of pectus excavatum
PHIS: Pediatric Health Information System
PE: Pectus Excavatum
LOS: length of hospital stay

Figure: Quarterly prevalence of cryoablation among pediatric MIRPE cases, January 2016-June 2023



APSA QS 7

AN ANALYSIS OF EARLY PATIENT-DRIVEN RETURN TO ACTIVITY AFTER NUSS REPAIR OF PECTUS EXCAVATUM

Seth A. Saylors, MD, MS[1], Meredith Elman, MD[2], Pablo Aguayo, MD[3], Jason D. Fraser, MD[3], Charles L. Snyder, MD[3], David Juang[4], Tolu Oyetunji, MD, MPH[3], Shawn D. St. Peter, MD[3]

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Abstract: Purpose: Bar displacement is a dreaded complication after Nuss repair of pectus excavatum as it has been associated with significant patient discomfort and failed repair. In the worst scenario, this complication can require re-operation for fixation or bar removal. Traditionally, post-operative activity restrictions included slow return to full activity over several months and avoidance of contact sports. With advancements in technique such as using stabilizers and pericostal sutures, the role of traditional activity restrictions remains unclear. This study examined the impact of liberalizing post-operative activities in patients undergoing Nuss repair of pectus excavatum on post-operative complications including bar displacement.

Methods: A retrospective review of patients < 18 years old who underwent thoracoscopic pectus excavatum repair (Nuss procedure) between May 10, 2021-May 10, 2023 at our institution were included. Patients were instructed at 2 weeks after repair to return to physical activity as tolerated with no restrictions and were followed as needed until time for bar removal.

Results: 81 patients underwent thoracoscopic Nuss repair of pectus excavatum at a median age of 15.8 years (IQR 15.1, 17.3). The median Haller Index was 4 (IQR 3.6, 5.1) and median Correction Index was 33% (IQR 26, 47.4). 79% (n=64) of patients had stabilizers placed during repair. All patients underwent intercostal nerve cryoablation and median hospital length of stay was 25.5 hours (IQR 21.5, 30). Median time to first follow up was 24 days (IQR 16, 40) and 47% (n=37) patients reported return to full activity at that time. Median total length of follow up during this study was 115 days (IQR 41, 195). 5 patients required repeat procedures for surgical site infections. No patients required bar removal or adjustments. No patients were found to have bar displacement.

Conclusions: Of the 81 patients in this study, almost half resumed physical activity as tolerated by time of first follow up and all patients were liberalized to no restrictions at that time. No patients were found to have bar displacement or require early bar removal. We conclude that liberalized activity after Nuss repair of pectus excavatum is safe with no increased risk of post-operative bar displacement.

Abbreviations: IQR: Interquartile range

APSA QS 8

OPTIMIZED OUTCOMES FOLLOWING SURGICAL CORRECTION OF PECTUS EXCAVATUM BASED ON MEDIAL CLAVICLE EPIPHYSEAL OSSIFICATION AND WHITE LIGHT SCANNING

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Abstract: Purpose: Optimal timing of surgical correction of pectus excavatum (SCOPE) is prior to complete skeletal maturation; however, direct measures of skeletal maturity are not included in preoperative planning. White light scanning (WLS) is a non-ionizing point-of-care alternative to cross-sectional imaging for determining preoperative severity and can also be used to monitor postoperative correction. We aimed to determine if skeletal maturity at time of SCOPE is associated with postoperative complication rate and degree of postoperative correction achieved as determined by WLS.

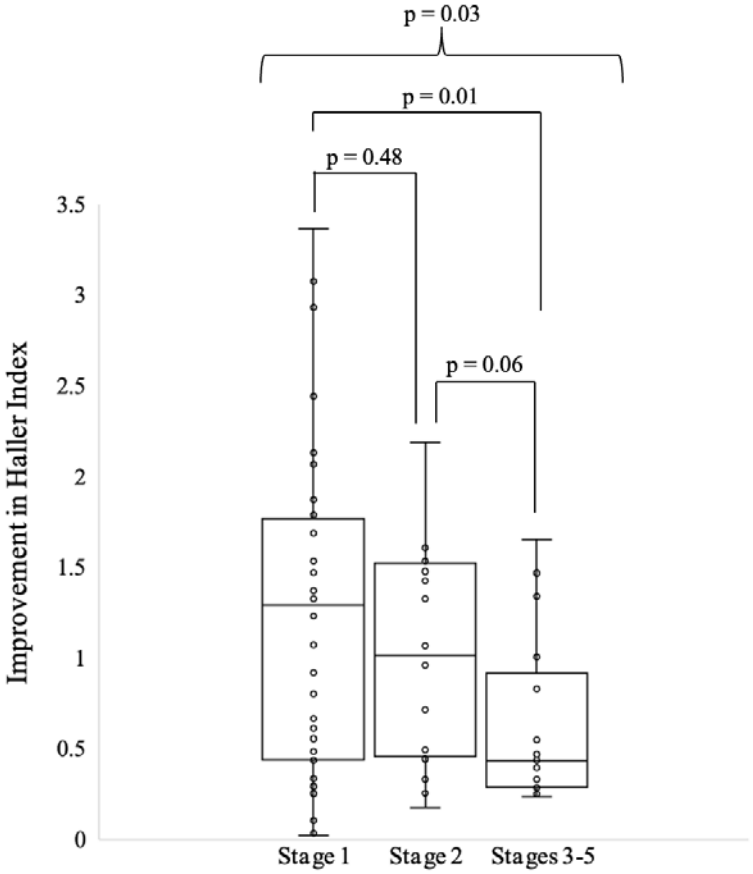
Methods: Patients who underwent SCOPE at a high-volume tertiary children's hospital between June 2015 and March 2022 were identified. Preoperative computed tomography scans within six months of procedure were reviewed to determine skeletal maturity by Schmeling-Kellinghaus (SK) classification—a validated staging system based on extent of epiphyseal ossification of the medial clavicle. SK stage and postoperative complication rate were compared. Subset analysis was performed for patients with WLS performed preoperatively and >1 year after surgical correction. The degree of surgical correction achieved was evaluated by improvement in Haller Index (HI) based on WLS measurements and compared by SK stage.

Results: One-hundred seventy-six patients were included (60.8% SK stage 1, 19.9% stage 2, 19.3% stages 3-5). Median (interquartile range [IQR]) age at insertion was 14.9 (14.3-15.9) years for stage 1, 16.3 (15.5-17.1) years for stage 2 and 17.1 (16.5-18.5) years for stages 3-5 ($p < 0.001$). Median (IQR) preoperative HI was 4.0 (3.5-4.9) and follow-up time from correction was 28.6 (21.2-36.4) months without difference between stages. There was no difference in postoperative complication rates by SK stage (all $p>0.05$). On subset analysis of 81 patients (59.3% SK stage 1, 19.8% stage 2, 21.0% stages 3-5), greater surgical deformity correction was achieved for SK stages 1-2 (median [IQR] change in HI 1.2 [0.4-1.7]) compared to stages 3-5 (0.4 [0.3-0.9], $p=0.01$, Figure).

Conclusions: Surgical correction of pectus excavatum prior to Schmeling-Kellinghaus stage 3 was found to achieve greater deformity correction without difference in postoperative complication rates. This suggests intervention during stages 1 and 2 may optimize surgical outcomes for patients with pectus excavatum, and skeletal maturity should be considered when determining timing of surgery.

Abbreviations: HI: Haller Index
IQR: interquartile range
SCOPE: surgical correction of pectus excavatum
SK: Schmeling-Kellinghaus
WLS: white light scanning

Figure: Postoperative Improvement in Haller Index based on White Light Scan Measurements and Schmeling-Kellinghaus Stage at time of Surgical Correction of Pectus Excavatum. Stage 1 *vs.* stage 2 *vs.* stages 3-5: p = 0.03; stage 1 *vs.* stage 2: p = 0.48; stage 1 *vs.* stages 3-5: p = 0.01; stage 2 *vs.* stages 3-5: p = 0.06; stages 1-2 *vs.* stages 3-5: p = 0.01.



APSA QS 9

DELAYED CHOLECYSTECTOMY FOR COMPLICATED BILIARY DISEASE IN THE PEDIATRIC SICKLE CELL POPULATION IS SAFE

Michele Young, Master of Medical Sciences, Bachelor of Science[1], Margaret Kennedy, MD[2], Tamarah J. Westmoreland, MD, PhD[3], Adela Casas-Melley[1], Teerin Meckmongkol, MD/PhD[4]

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Abstract: Introduction: Patients with sickle cell disease(SCD) are at increased risk for cholelithiasis. Vaso-occlusive crisis(VOC) is a complication of SCD and can present during illness and after invasive procedures. Cholecystectomy is the definitive surgery for biliary disease. Typically, early cholecystectomy is advocated in non-SCD patients who present with complicated biliary disease. SCD patients represent a unique population where delaying cholecystectomy may be beneficial. We sought to evaluate the morbidity of delaying cholecystectomies in this population.

Methods: A retrospective review was conducted in children less than 21 years of age with SCD who underwent cholecystectomies at three institutions from 1998-2022. We evaluated the indication for surgery, timing to cholecystectomy, operative complications, postoperative VOC, ICU admission, hospital length of stay(LOS), and hospital charges. Uncomplicated biliary disease was defined as symptomatic or asymptomatic cholelithiasis. Complicated biliary disease was defined as either acute cholecystitis, choledocholithiasis, gallstone pancreatitis, or ascending cholangitis. Semi-urgent cholecystectomy refers to surgery during the same hospital admission.

Results: A total of 155 patients(mean age=12.6y;49%male) were included in the analysis. Complicated biliary disease accounted for 38%(n=59). Patients with complicated biliary disease were more likely to receive cholecystectomies prior to discharge(67.8%,n=40). There was no difference between ICU admission rates, postoperative complications, or incidence of postoperative VOC. Patients with uncomplicated biliary disease who underwent elective cholecystectomy were more likely to receive blood transfusions($p < 0.0001$). Disease severity and urgency of surgery were associated with increased LOS. There was no difference in LOS for patient with either uncomplicated or complicated biliary disease who underwent elective cholecystectomy($p=0.75$). Hospital LOS for patients with complicated biliary disease who underwent delayed cholecystectomy was shorter than those who underwent urgent cholecystectomy(3.4+1.7vs9.2+10.0, $p< 0.05$). Hospital charges were significantly higher if they underwent semi-urgent cholecystectomy($p < 0.05$), and if they had complicated biliary disease ($p < 0.001$). Of those with complicated biliary disease who had delayed cholecystectomy, two patients(10.5%) experienced at least one cholelithiasis-related re-admission prior to definitive surgery.

Conclusions: Delaying surgery in SCD patients with complicated biliary disease is safe and associated with decreased hospital LOS and hospital charges, without an increase in ICU admissions, post-operative complications, post-operative VOC.

Abbreviations: SCD, VOC, ICU, LOS

APSA QS 10

PREVALENCE AND PREDICTORS OF GALLBLADDER DISEASE IN PEDIATRIC INTESTINAL FAILURE

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Abstract: Purpose: Intestinal failure has been associated with an increased risk of gallbladder disease. However, there is a paucity of data regarding the prevalence and risk factors for gallbladder disease in the present era of hepatoprotective PN strategies and increased patient survival. This study aims to identify the current prevalence and independent predictors of gallbladder disease in pediatric intestinal failure (PIF).

Methods: This was a retrospective review of children/young adults in an interdisciplinary intestinal rehabilitation program from 2014-2021. Those with a diagnosis of PIF (using A.S.P.E.N. consensus definition of 60 days on PN within 74 consecutive days) and an abdominal ultrasound during the study period were included. All ultrasounds performed during the study period were included. The primary outcome was the prevalence of gallbladder disease (cholelithiasis or sludge on ultrasound). Multivariable logistic regression analysis was performed to identify predictors of gallbladder disease.

Results: Of 268 patients reviewed, 87 had gallbladder disease (32.5%). Median length of follow-up was 4.7 years (IQR 2.1,8.1). The cholecystectomy rate was 18.4% (16/87) and the indication for cholecystectomy for 37.5% (6/16) of patients was acute cholecystitis, choledocholithiasis, or pancreatitis. The most common etiology of PIF in those with and without gallbladder disease was surgical necrotizing enterocolitis (NEC, 31.7%). Median percent expected bowel length was 21.3% (IQR 11,40.5) for those with gallbladder disease and 26.3% (IQR 14.7,44.3) without gallbladder disease. On multivariable logistic regression, current PN dependence (adjusted odds ratio [aOR] 2.22, 95% confidence interval 1.01,4.97) and male sex (aOR 1.98 95%CI 1.03,3.81) were associated with higher odds of gallbladder disease. A diagnosis of midgut volvulus was associated with lower odds of gallbladder disease (aOR 0.39, 95%CI 0.15,0.98).

Conclusion: In a contemporary cohort of patients with PIF, almost one-third had gallstones or biliary sludge. PN dependence or being male doubled the odds of gallbladder disease while a diagnosis of midgut volvulus was associated with a lower odds of gallbladder disease. Of those with gallstones or sludge, less than one-fifth underwent cholecystectomy indicating that expectant management is likely a reasonable initial strategy for most patients though careful long-term monitoring is warranted.

Abbreviations: parental nutrition (PN), pediatric intestinal failure (PIF), interquartile range (IQR), necrotizing enterocolitis (NEC), adjusted odds ratio (aOR)

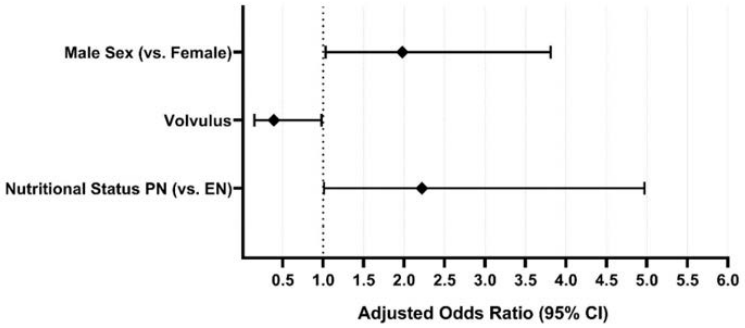

Figure 1. Significant Independent Predictors of Gallbladder Disease in Pediatric Intestinal Failure.
Forest plot of adjusted odds ratios with corresponding 95% confidence intervals showing significant variables in the multivariable model. *PN (parenteral nutrition), EN (enteral nutrition).*

APSA QS 11

SPECIALIZED TISSUE PROCESSING METHODS FOR PREPUBERTAL OVARIES FOLLOWING OOPHORECTOMY FOR FERTILITY PRESERVATION

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Abstract: Purpose:
Ovarian tissue cryopreservation (OTC) is the only fertility preservation (FP) option for prepubertal girls and represents an important FP approach for postpubertal girls. The goal of OTC is to preserve the finite reserve of primordial follicles, or bank of potential eggs. Recent gross anatomical and histological examination of ovaries across the pubertal transition demonstrated a denser distribution and deeper extension of primordial follicles into the prepubertal ovary. OTC processing methods were developed using adult ovaries, without consideration for the unique characteristics of ovaries from young children. Here, we examined our center's processing metrics to further the development of OTC processing standards in children.

Methods:
Tissue processing metrics were collected from patients who underwent OTC within an IRB-approved protocol at a single institution from December 2020 to July 2023. OTC was performed in 48 prepubertal and 19 postpubertal patients. ANOVA or bivariate analysis was performed by pubertal status as appropriate. We considered $p < 0.05$ statistically significant.

Results:
The median age of patients was 6.36 years (Range: 2 months-21.1 years). Most patients carried a diagnosis of malignancy (n=56, 83.6%). Overall, 55.2% (n=37) of patients received preoperative chemotherapy and 10.4% (n=7) underwent gonadal or hypothalamic radiation. The median cyclophosphamide equivalent dose, a measure of gonadotoxicity of chemotherapy, was 1.6 g/m^2 (Range: 0-4.6 g/m^2). Prepubertal ovaries were smaller than postpubertal ovaries (0.71 vs. 4.93 grams, $p < 0.001$). Tissue processing time was not different between groups (214 vs. 238 minutes, p=0.06). A greater percentage of tissue by weight was preserved in prepubertal patients than postpubertal patients (74% vs. 50%, $p < 0.001$). An average of 3.78 cm^2 of ovarian tissue was divided into 5.54 strips for prepubertal patients while 13.8 cm^2 was divided into 11.1 strips in postpubertal patients ($p < 0.001$).

Conclusion:
A greater percentage of ovarian tissue by weight was preserved for prepubertal patients than postpubertal patients. Centers offering ovarian tissue cryopreservation to young children should perform tissue processing techniques that consider the structural changes in ovaries across the pubertal transition. Documentation of processing metrics will help define an optimal tissue processing approach that preserves the most possible primordial follicles for children.

Abbreviations: Ovarian tissue cryopreservation (OTC)
Fertility preservation (FP)
Institutional review board (IRB)
Analysis of variance (ANOVA)
g/m^2 (grams per meter squared)

cm^2 (centimeters squared)

APSA QS 12

ORAL DELIVERY OF CNP-MIR146A REDUCES TNF IN A MURINE MODEL OF INFLAMMATORY BOWEL DISEASE

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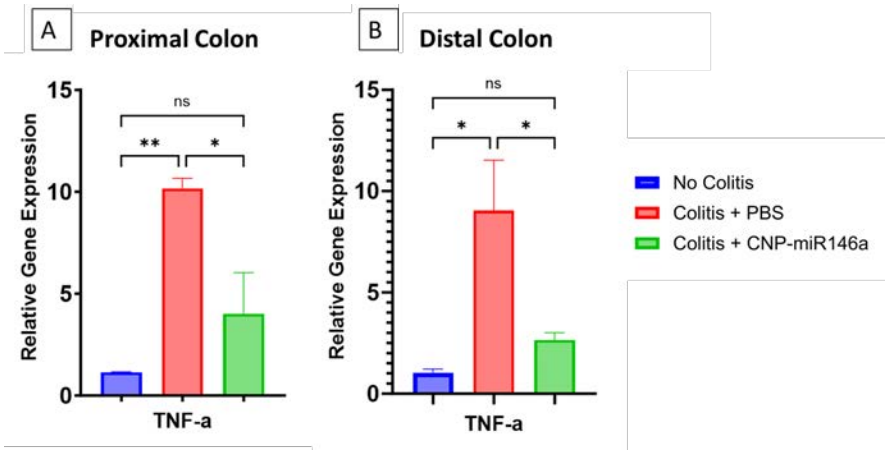
Abstract: Introduction: Inflammatory bowel disease (IBD) is a chronic inflammatory disease with a high onset rate in children and adolescents. TNF-a is a proinflammatory cytokine that is upregulated in IBD and thought to play a critical role in the disease. One biologic TNF-a inhibitor has been approved for pediatric treatment of IBD but its use is limited by loss of therapeutic effect and the undesirable side effects associated with systemic delivery. We developed a novel therapeutic from a cerium oxide nanoparticle (CNP) conjugated to microRNA-146a (miR146a) with anti-inflammatory and free radical scavenging capabilities. We hypothesized that oral delivery of CNP-miR146a would reduce TNF-a in the colons of mice in a model of chronic colitis using immunodeficient mice with adoptive transfer of naïve T-cells.

Methods: 8-week old RAG-2 deficient mice were randomly assigned to receive an intraperitoneal injection of prepared donor T-cells from matched immunocompetent mice or PBS in a volume of 0.5 ml. Mice were monitored weekly, and at 8 weeks following injections, fecal pellets were collected and measured for lipocalin-2 by ELISA. Mice with lipocalin-2 fecal levels of at least 900 ng/g were determined to have colitis and proceeded to receive daily oral gavage of 5 ng of CNP-miR146a in 200 ul of sterile PBS or the same volume of sterile PBS alone. Control mice received 200 ul of sterile PBS. Mice were euthanized at the end of five days of treatment and colon tissue was harvested and processed to evaluate gene expression of TNF-a using qPCR.

Results: Mice with colitis who received PBS showed higher levels of TNF-a as compared to control mice, in both the proximal ($p < 0.01$) and distal colon ($p < 0.01$). Oral administration of CNP-miR146a to mice with colitis decreased levels of TNF-a as compared to untreated mice in the proximal ($p=0.026$) and distal colon ($p=0.048$) and showed no significant difference from controls.

Conclusion: Oral delivery of CNP-miR146a was able to improve inflammation of the colon in a chronic colitis murine model by reducing pro-inflammatory cytokine production of TNF-a. CNP-miR146a shows promising therapeutic potential for use in IBD.

Abbreviations: Inflammatory bowel disease (IBD)
Tumor necrosis factor alpha (TNF-a)
Cerium oxide nanoparticle (CNP)
MicroRNA (miR)
Recombination activating gene 2 (RAG-2)
Phosphate buffer saline (PBS)
T lymphocytes (T-cells)
Enzyme-linked immunosorbent assay (ELISA)
Quantitative polymerase chain reaction (qPCR)


A
Proximal Colon
B
Distal Colon
Relative Gene Expression
15
10
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*
TNF-a
Relative Gene Expression
15
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0
ns
*
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TNF-a
No Colitis
Colitis + PBS
Colitis + CNP-miR146a

APSA QS 13

ASSOCIATION OF NECROTIZING ENTEROCOLITIS AND VENTRICULOPERITONEAL SHUNT FAILURE IN NEONATES: A NATIONWIDE ANALYSIS

Carlos T. Huerta, MD[1], Joshua Parreco, MD[2], Chad M. Thorson, MD, MSPH[3], Juan E. Sola, MD[4], Toba Niazi, MD[5], Eduardo A. Perez, MD[4]

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Abstract: Purpose: The peritoneum is the preferred terminus for cerebral ventricular shunt placement. However, previous concerns about ventriculoperitoneal (VP) shunt creation in neonates have been raised, given the rate of intestinal conditions in this population, such as necrotizing enterocolitis (NEC). This study used a nationally representative cohort to characterize factors and outcomes associated with VP shunt outcomes in patients with or without a previous history of NEC.

Methods: The Nationwide Readmissions Database was queried (2016-2020) for patients (< 1 years) who underwent VP shunt placement. A binary logistic regression was constructed using 30 congenital and perinatal covariates identified as statistically significant on univariate analysis ($p < 0.05$) to examine a primary outcome of VP shunt removal. Results were weighted for national estimates.

Results: There were 24,900 infants (44% female) identified who underwent VP shunt placement. Two percent (522 patients) had a previous diagnosis of NEC during the same hospitalization. No difference in the rate of VP shunt infection was demonstrated in those with (6%) or without NEC (6%). There was a significantly higher rate of VP shunt removal in the NEC cohort (33% vs. 21% without NEC; $p< 0.001$), while there was no difference in the rate of shunt revision between groups (12% NEC vs. 9% without NEC). No difference in the rate of readmission within 30 days between cohorts existed (19% NEC vs. 17% without NEC; $p=0.262$); however, those with NEC had a significantly higher rate of readmission within 365 days (44% vs. 33% without NEC; $p< 0.001$). Concomitant small bowel atresia, malrotation, hypospadias, congenital renal anomalies, abdominal wall defects, extremely low birth weight (ELBW), very low birth weight (VLBW), and NEC were associated with the highest odds of inpatient VP shunt removal upon binary logistic regression (Table 1).

Conclusion: Neonates with NEC and subsequent VP shunt placement have a higher rate of VP shunt removal and overall readmission rates. NEC persisted as an independent predictor associated with VP shunt removal. This information should be considered in surgical planning in the neonatal population undergoing VP shunt placement.

Abbreviations: Ventriculoperitoneal (VP)
Necrotizing Enterocolitis (NEC)
Extremely Low Birth Weight (ELBW)
Very Low Birth Weight (VLBW)

APSA QS 14

COMPARISON OF CLIMATE IMPACT, CLINICAL OUTCOME, AND COST-EFFICIENCY OF PEDIATRIC TRANS-UMBILICAL LAPAROSCOPIC ASSISTED APPENDECTOMY VERSUS STANDARD 3-PORT LAPAROSCOPIC APPENDECTOMY

Colleen M. Fitzpatrick, MD, MPA[1], Christoph Meinrenken, PhD[2], William B. Eimicke, PhD[3]

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Abstract: Purpose: Healthcare is responsible for 8.5% of US greenhouse gas emissions. These impacts must be mitigated while maintaining clinically excellent outcomes. The purpose of this study is to compare the clinical outcomes, cost-efficiency, and climate impact of the trans-umbilical laparoscopic assisted appendectomy (TULAA) versus the standard 3-port laparoscopic appendectomy (LA).

Methods: Institutional Review Board approval was obtained. A review of patients (< 18 years of age) undergoing appendectomy between Jan 1, 2020 and December 31, 2022 at a tertiary children's hospital was conducted. During this time, a standard clinical treatment pathway was utilized with operative approach at surgeon discretion. Data abstracted included clinical characteristics (age, gender, pre-operative white blood cell count (WBC), and body mass index (BMI)), intraoperative findings, supplies and equipment utilized, and post-operative complications. Operative approach was recorded: TULAA, LA, or TULAA converted to LA. For analysis TULAA was combined with converted cases (TULAA+C) as conversion is a known risk of TULAA. To determine a surgical site infection (SSI) increase of < 2.5%, a minimum sample size of 479 patients per group was needed to achieve a power of 80%. Due to varied surgeon preferences, a composite "preference list" for each approach was determined by averaging the supplies from all cases reviewed. Cost-efficiency was calculated off the composite "preference list" for each approach. The technique of life cycle assessment was used to determine the cradle-to-grave carbon footprint (according to ISO 14067) of surgical supplies and equipment used for each operative approach.

Results: Analysis was performed on 1,611 appendectomies: 497 LA and 1,114 TULAA+C (932 TULAA, 182 converted). Except for BMI, there were no clinically significant differences between groups. SSI did not increase with TULAA+C (n=15, 1.3%) versus LA (n=6, 1.2%), p=0.81. TULAA+C ($369.21/case) was more cost efficient than LA ($879.30/case) and TULAA+C (26.2 kg CO2e) produced fewer emissions than LA (29.0 kg CO2e). (See table.)

Conclusion: While patient safety and excellent clinical outcomes must remain the top priority in healthcare, the current environmental crisis demands consideration of climate impacts. When clinical non-inferiority can be demonstrated between treatment options, those with a fewer greenhouse gas emissions should be chosen.

Abbreviations: TULAA - Trans-umbilical laparoscopic assisted appendectomy
LA - 3-port laparoscopic appendectomy
WBC - White blood cell count
BMI - Body mass index
TULAA+C - Trans-umbilical laparoscopic appendectomy + cases converted to 3-port appendectomy
ISO - International Standard for Organization
kg CO2e - Kilogram of Carbon dioxide equivalents

Quickshot Session II - Basic Science and History

5:00 PM – 5:45 PM

APSA QS 15

TO CUT OR NOT TO CUT: HISTORY OF NONOPERATIVE MANAGEMENT OF THE APPENDIX IN PEDIATRIC SURGERY PROCEDURES

Sophia Schermerhorn, MPH MD[1], Joseph Lee, MD[1], Utsav M. Patwardhan, MD[2], Gerald Gollin, MD[3], Timothy J. Fairbanks[2], Hari Thangarajah, MD[2], Pamela M. Choi, MD[1], Romeo C. Ignacio, MD[2]

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Abstract: Purpose: Operative versus non-operative approaches to the appendix have been a subject of deliberation among surgeons. This historical review looks at the ongoing debate on the management of the appendix.

Methods: A literature review was conducted using Google Scholar, Pubmed, and Scopus to investigate changes in nonoperative versus operative interventions for the appendix in pediatric surgery.

Results:
Although Leondardo Da Vinci first depicted the appendix in the 16th century, appendicitis wasn't described as a pathological entity until 1753 during an autopsy by Lorenz Heister.1 The inaugural appendectomy was performed by Claudius Amyand when a perforated appendix was incidentally found in an inguinal hernia.1,2 Over a century later, Dr. McBurney popularized the open appendectomy through the right lower quadrant.2 This approach would eventually be replaced by the laparoscopic appendectomy, first described by gynecologist Kurt Semm.
Throughout history, there have been dissenters regarding the surgical treatment of appendicitis. In the early 20th century, Drs. Ochsner and Sherren advocated narcotics and bowel rest as an alternative to surgery.1 In an era pre-dating antibiotics, mortality of this approach was high.2 This debate has resurfaced again in the past decade, with multiple trials advocating for the safety of antibiotic-only treatment.3–6
The addition of an incidental appendectomy during other pediatric operations has also oscillated. Traditionally, Ladd's procedure for malrotation includes an appendectomy to mitigate the diagnostic ambiguity of the appendix's unusual location in the left hemi-abdomen.7 Intriguingly, Dr. Ladd did not include an appendectomy in his original 1936 description.8 There is now renewed interest among pediatric surgeons to exclude the appendectomy from the procedure.9,10 Similarly, in the 1950s, incidental appendectomy was advocated during open reductions of intussusception to avoid diagnostic dilemmas in cases of recurrence.11 This practice has come into question with improved diagnostic imaging, with some surgeons recommending against this prophylaxis.12,13

Conclusion: The original management of the appendix was non-operative due to a lack of knowledge, but the advent of the appendectomy ushered in an era of operative advances. In the 21st century, equipped with increasing understanding and technology, the question remains: When is appendectomy the answer?

Abbreviations:

APSA QS 16

PATCHING THE HOLE IN THE HISTORY OF CONGENITAL DIAPHRAGMATIC HERNIA

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Boston Children's Hospital, Boston, MA, USA

Abstract: Background:
Neonates with congenital diaphragmatic hernia (CDH) have remained among the most challenging surgical patients. How did our predecessors diagnosis and treat patients with CDH before the modern day advances of mechanical ventilation and extracorporeal membrane oxygenation? This synopsis describes the earliest pioneers of CDH discovery.

Synopsis:
In 1701, Charles Holt of London described the first CDH in neonatal autopsy: “this foramen [hernia] seemed to be formed by nature...for transmitting the guts into the thorax” as well as a physical finding: “crawling around the ribs…as if a knot of small eels…had been penned up within the cavity [thorax].” Subsequent autopsies described pulmonary hypoplasia, including McCauley’s report in 1754: “The diminished size of the lungs results from the bulk of abdominal viscera in the thorax.” Most famously, the anterior form of the diaphragmatic defect was then described by Morgagni in 1761. The posterolateral defect continues to be known by anatomist, Bochdalek, who described it in 1848.

Clinical diagnosis of CDH, prior to the era of radiology, was described by the inventor of the stethoscope, Laennec who noted the “absence of respiration and presence of boryborygmi.” The physiologic implications of CDH was then correlated to hernia size by Cooper in 1827: “when the unnatural opening of the diaphragm is small, the consequences are not immediately fatal.” It would not be until 1847, that Henry Bowditch would stress surgical intervention: “ought we not to undertake the more serious operation of the scalpel?”

Surgeons attempted abdominal and thoracic approaches: the first infant repair was in 1889 by O’Dwyer; the first repair within 24 hours of life in 1946 was by Gross. These physicians have laid the foundation for the basis of CDH management: timely diagnosis, surgical repair, size classification, and appreciation of pulmonary sequelae.

Historical Significance:
In 1920, one physician commented on neonates with CDH: “nothing is to be hoped for from treatment.” Fortunately, other pioneers of the past century have disagreed and advanced the management of this complex disease. These neonates challenge the limits of surgery and medicine, and the pediatric community will continue to push the boundaries of our capabilities in response.

Abbreviations: CDH: Congenital Diaphragmatic Hernia

APSA QS 17

SHORT BOWEL, LONG HISTORY: THE HISTORY OF BOWEL LENGTHENING SURGERY

Alyssa Joachim, MD[1], Simone Hyman, MD[2], Utsav M. Patwardhan, MD[3], Karen M. Kling, M.D.[3], Timothy J. Fairbanks[3], Benjamin Keller, MD[3], Romeo C. Ignacio, MD[3]

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Abstract: Purpose: Short bowel syndrome (SBS), while rare, has devastating nutritional and metabolic consequences on those affected. This review chronicles the innovations and adaptation to new technologies in the practice of bowel lengthening surgery throughout the last 40 years.

Methods: A literature review was conducted using Google Scholar, Pubmed, and Scopus to identify surgical interventions used to treat SBS and further outline their historical contributions.

Results:
While early surgical treatment of SBS focused on enhancing bowel absorption, in 1980 Dr. Adrian Bianchi first published his work describing a technique to treat SBS that aimed to lengthen bowel. The “Bianchi procedure”, formally known as longitudinal intestinal lengthening and tailoring (LILT), was initially tested in pigs. It involves bisecting the bowel longitudinally along the divide of the mesenteric blood supply followed by anastomosis to create a thinner, longer segment of bowel. While an effective method and the most popular surgery for SBS at the time, LILT has limitations that inspired the development of new bowel lengthening procedures.
The Kimura procedure, also known as the Iowa procedure, was developed to circumvent the reliance that LILT has on mesenteric blood supply. Both the LILT and Kimura procedures have technical limitations, which inspired the development of serial transverse enteroplasty (STEP) in 2003 as a means of lengthening the bowel without requiring a long handsewn anastomosis and without reliance on mesenteric blood supply.
Since that time, STEP has been the most common bowel lengthening procedure performed. However, despite its benefits, it too has limitations that spurred new technical innovation. The spiral intestinal lengthening and tailoring (SILT) method involves spirally cutting the intestine, which allows for elongation of bowel that is not dilated. Recent animal studies by Dunn et al. have investigated the role of self-expanding springs to lengthen intestine through distraction enterogenesis. These latter methods demonstrate the ongoing evolution of surgical practice for bowel lengthening.

Conclusion: Dr. Adrian Bianchi pioneered bowel lengthening surgery as a treatment for short bowel syndrome, and while no longer the primary procedure performed today, it paved the way for the development of new surgical techniques for bowel lengthening.

Abbreviations: SBS: short bowel syndrome
LILT: longitudinal intestinal lengthening and tailoring
STEP: serial transverse enteroplasty

APSA QS 18

TRACING THE TIMELINE: A HISTORICAL PERSPECTIVE OF THE TREATMENT OF INTUSSUSCEPTION

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Abstract: Purpose: Intussusception is one of the most common causes of small bowel obstruction in infants. Here, we provide a synopsis of how the treatment of intussusception has progressed since its initial description.

Methods: A review of the literature was performed using Google Scholar to collect information regarding the evolution of intussusception treatment.

Results: Current treatment of pediatric intussusception in hemodynamically stable patients consists of multiple trials of pneumatic reduction. This now standard clinical practice represents the results of countless research efforts and publications spanning multiple generations of pediatric surgeons.

Johann Peyer provided one of the first descriptions of intestinal invagination in 1677. Throughout the 19th century, multiple operations for intussusception were described, including manual reductions first performed in an adult by John Wilson in 1831 and in a child by Jonathon Hutchinson in 1871. During this time, attempts at non-operative management were also undertaken, with air enema reduction of a pediatric intussusception completed by Samuel Mitchell in 1836. In the early 1900s, Harald Hirschsprung cataloged his experience using hydrostatic enemas to treat intussusception, documenting a 70% survival rate. Despite mounting evidence of the efficacy of non-operative management, many practitioners still proceeded with surgery as first-line treatment. The paradigm shifted following the 1948 publication of barium enema protocols by Ravitch, leading to shorter hospitalizations, fewer complications, and a success rate approximating 75%.

In 1977, Burke described sonographic “target sign” of intussuscepted bowel, and ultrasound became the preferred modality for diagnosing intussusception. In 1986, Guo reported a 95% success rate using air-pressure enemas in over 6,000 patients. Finally, in 1994, a publication from New Zealand revealed that repeated pneumatic enemas could be successful in children with intussusception that proved irreducible on the first attempt.

Conclusion: Management of intussusception has evolved significantly over the past century. Pneumatic reduction is currently the mainstay of treatment, with non-operative management boasting a success rate as high as 91%. Ironically, the dogma of intussusception management has come full circle, with current protocols reflective of the proposal of Hippocrates to try inflating the bowels with air in cases of persistent intestinal obstruction.

Abbreviations:

APSA QS 19

UNEARTHING HISTORICAL MILESTONES: PIONEERS AND CONTRIBUTIONS TO NECROTIZING ENTEROCOLITIS

Joseph Lee, MD[1], Sophia Schermerhorn, MPH MD[1], Utsav M. Patwardhan, MD[2], Simone Hyman, MD[3], Karen M. Kling, M.D.[2], Stephen W. Bickler[2], Donald J. Lucas, MD, MPH[1], Pamela M. Choi, MD[1], Romeo C. Ignacio, MD[2]

[1]Naval Medical Center San Diego, San Diego, CA, USA, [2]Rady Children's Hospital San Diego, San Diego, CA, USA, [3]UCSD, San Diego, CA, USA

Abstract: Background: Necrotizing enterocolitis (NEC) is a devastating gastrointestinal condition affecting most commonly premature infants, marked by persistently high morbidity and mortality rates. Over centuries of dedicated research, surgeons and researchers have significantly contributed to improving the treatment of NEC.

Methods: PubMed and Google Scholar databases were reviewed to identify surgical and medical contributions to the management of NEC.

Results: Exactly two centuries ago, in 1823, Charles Billard provided the first documented case report of NEC, describing it as "gangrenous enterocolitis" in a frail, neonate afflicted with "infection, inflammation, and necrosis of the gastrointestinal tract." In 1888, Dr. Arnold Paltauf, an Austrian pathologist, again described intestinal necrosis and perforation in newborns, providing early insights into its pathology.

In 1939, American pediatrician Dr. Hulda Thelander presented cases of newborn perforations and recognized the growing body of reports describing NEC's findings. As prematurity emerged as a survivable condition in the 1960's, American radiologist Dr. Walter Berdon, in 1964, published 21 cases delineating the clinical, surgical, and postmortem features of NEC in premature infants. Since then, numerous investigators observed rising incidence of NEC with decreasing gestational age and birth weight. Now, prematurity and low birth weights are known significant risk factors for NEC.

Perhaps the greatest clinical contribution was by Dr. Martin Bell who, in 1978, developed a clinical staging method, which remains widely used, with suspected (Class I), definitive (Class II), and advanced (Class III) NEC, now modified with therapeutic guidance, based on the patient's history, systemic status, abdominal examination, and imaging results.

Current NEC treatments are influenced by contemporaries such as Dr. R. Lawrence Moss, identifying metabolic acidosis as one diagnostic parameter aiding in predicting disease progression, and Dr. Henri Ford, contributing knowledge of intestinal microbiome and infectious pathogens of NEC. Regarding surgical outcomes, multi-center trials now indicate that laparotomy with bowel resection has clear benefits compared to peritoneal drainage in NEC management.

Conclusion: The understanding and treatment of necrotizing enterocolitis have significantly evolved due to the tireless contributions of physician-scientists. Their work spans from extensive research of pathological findings, diagnostics, risk factor recognition, and exploration of optimal surgical interventions.

Abbreviations: NEC = necrotizing enterocolitis

APSA QS 20

SURGICAL MANAGEMENT OF GASTROSCHISIS: THEN AND NOW

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Abstract: Purpose: Gastroschisis is one of the most common fetal abdominal wall abnormalities. Historically, gastroschisis resulted in high morbidity and mortality. However, advances over the last few centuries have improved patient outcomes and reduced the risk of complications. We aimed to explore the evolution of gastroschisis management.
Methods: Current and historic literature was reviewed regarding gastroschisis and the progression of surgical management into the staged, sutureless closure that is now commonly used.
Results: James Calder first described gastroschisis in 1733. In 1775, William Hey documented a neonate who died within hours after reducing the entire bowel immediately after birth. It was not until 1878 that William Fear was able to successfully completely restore the bowel by using the umbilical cord to pull the abdomen into a conical shape. In 1943, the first successful primary closure was performed by Dr. Edward Watkins after he extended the defect to fit all the visceral components. The early depictions of gastroschisis management left the surgical community with two major challenges: obtaining adequate abdominal wall domain and difficulty evaluating bowel viability while placed in an opaque fabric. Many attempted to solve these issues until the advent of the transparent silicone silo with a compressible ring, which Shermeta et al. introduced in 1975. This allowed for the eviscerated bowel to be monitored while serially reduced into the peritoneal cavity. This was followed by returning to the operating room for primary abdominal closure. In 2004, Sandler et al. introduced the staged, sutureless closure, which is commonly utilized today. This technique uses the remnant umbilical cord to cover the abdominal wall defect once the bowel is completely reduced. There is evidence that this approach reduces general anesthesia, mechanical ventilation, surgical site infections, and time to enteral feeding.
Conclusions: Gastroschisis previously had a high mortality rate. Management has matured over time to significantly decrease neonatal demise. Additionally, with the current approach of staged, sutureless closure, critical care requirements, general anesthesia use, and time to closure have all been significantly reduced.

Abbreviations: Not applicable

APSA QS 21

UTILIZATION OF VA AND VV ECMO IN PEDIATRIC SURGERY THROUGH HISTORY

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Abstract: Purpose: The development of extracorporeal membrane oxygenation (ECMO) has been instrumental in advancing pediatric critical care. ECMO has been used in both the adult and pediatric populations to combat what would be fatal cardiopulmonary compromise. Historically, venoarterial (VA) ECMO has been utilized in pediatrics, however there is an increase in utilizing venovenous (VV) ECMO. We sought to explore the history of VA versus VV ECMO and the associated complications throughout pediatric surgery.

Methods: Current and historic literature was reviewed regarding ECMO and the variants of cannulation utilized in pediatric patients.

Results: ECMO was first started in the 1970s by Robert Bartlett with the first successful case being performed in 1975 in a neonate. Historically, VA ECMO was utilized with a high rate of neurologic complications leading to a more recent shift of utilizing VV ECMO. VV ECMO offers several benefits for children with acute respiratory failure including retained pulsatile systemic flow, preservation of the carotid artery, and reduced neurologic complications. However, this is limited in pediatrics due to dual lumen cannula size since the femoral vessels are often too small to utilize. Dual lumen single-site VV cannulas were developed in the 1980s and in recent years the OriGen® Biomedical right atrial VV cannula was the only one available and has since been removed from the market. Bicaval dual lumen cannulas were then developed and the Avalon® Elite VV cannula became available, recently the Crescent® bicaval dual lumen cannula has become available as well. Neurologic complications are reported to be significantly higher in VA ECMO, however there is a described complication of cardiac injury and perforation utilizing dual lumen VV ECMO.

Conclusions: ECMO has been utilized in critically ill patients as a last resort lifesaving strategy and continues to have improving survival rates. In pediatrics, the use of VV ECMO has increased recently. There are a variety of complications with both VA and VV, however neurologic complications remain higher in VA ECMO.

Abbreviations: Extracorporeal membrane oxygenation (ECMO)
venoarterial (VA)
venovenous (VV)

APSA QS 22

FROM WOMB TO WORLD: TRACING THE EVOLUTION OF FETAL SURGERY

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Abstract: Fetal surgery, a groundbreaking subspecialty within pediatric surgery and maternal fetal medicine, has witnessed remarkable evolution since its mid-20th century inception. The historical journey marked by pivotal advances has propelled the field to a realm of cutting-edge medical innovation, challenging once-deemed non-survivable conditions.

The genesis of fetal surgery can be traced back to the pioneering work of Dr. Michael Harrison, often regarded as the “Father of Fetal Surgery”, in the 1960s as he performed the first open fetal surgery on a fetus with a urinary tract obstruction. His visionary approach to treating congenital anomalies in utero laid the foundation for subsequent breakthroughs. Initial interventions in the 1980s focused on life-threatening conditions, such as congenital diaphragmatic hernia, where surgical intervention offered a lifeline to otherwise dire prognoses. Advancements in imaging and genetic tests played a pivotal role in refining diagnostic accuracy and surgical planning. The ability to visualize and monitor fetal structures in real-time transformed the landscape of fetal surgery, enabling surgeons to intervene with greater precision and safety.

The 1990s marked a significant milestone with introduction of minimally invasive techniques, notably fetoscopic surgery. This revolutionary approach, championed by Dr. Kypros Nicolaides of London, allowed for intervention without the need for open uterine incisions. Fetoscopic intervention paved the way for the management of conditions like twin-to-twin transfusion syndrome and spina bifida, expanding the already incredible scope of fetal surgery. The Management of Myelomeningocele Study (MOMS), a pivotal clinical trial in 2017, rebuffed the contention that risks outweighed benefits in this form of intervention, substantiating the advantages of prenatal surgery in augmenting neurological outcomes for neonates afflicted with spina bifida. Moreover, recent technological advancements illustrated by the initiation of human clinical trials in 2023 by Alan Flake of Philadelphia, for the innovative artificial placenta named EXTEND, herald a promising frontier in supporting prematurely born fetuses.

The history of fetal interventions epitomizes a relentless pursuit of progress, showcasing human ingenuity in enhancing care for the most delicate lives. Fueled by research, technology, and innovation, fetal surgery persistently expands the horizons of prenatal medicine, providing newfound optimism for families confronting complex fetal conditions.

Abbreviations:

APSA QS 23

CHEMICAL PANCREATECTOMY INCREASES BETA-CELL VOLUME AND ISLET VASCULATURE

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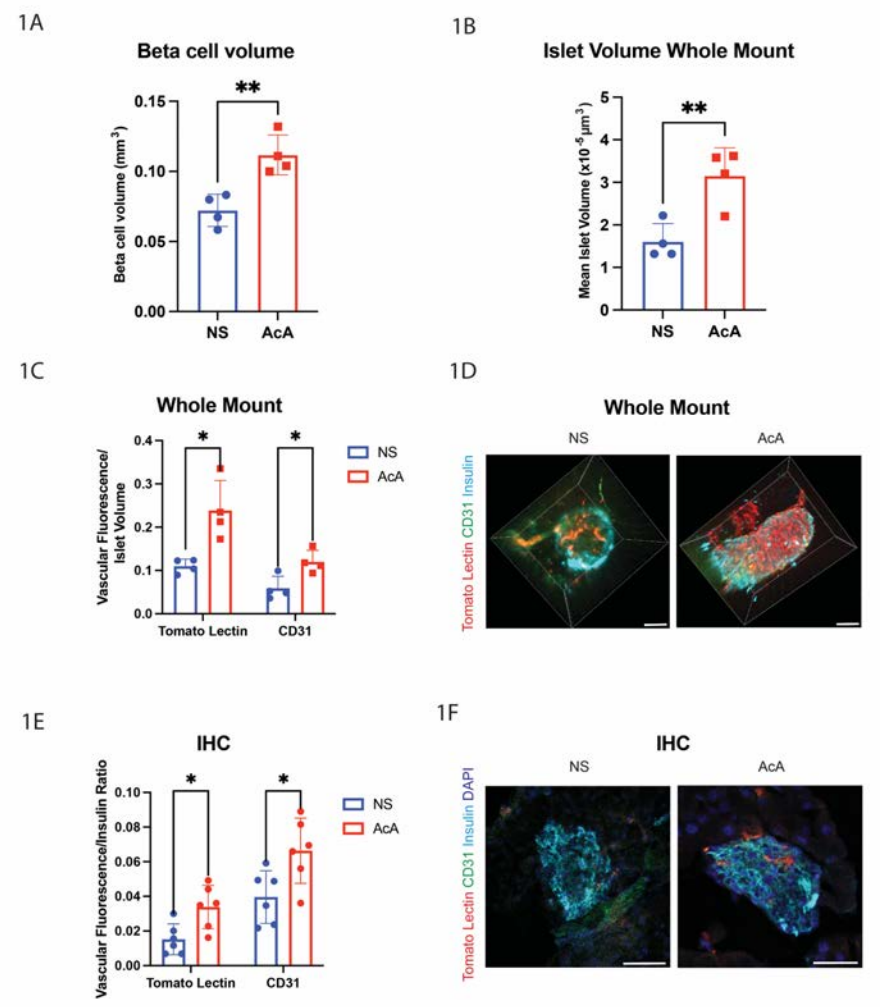
Abstract: Purpose
Chronic pancreatitis is a debilitating disease that causes chronic pain, pancreatic exocrine insufficiency, and diabetes. We have previously demonstrated that a “chemical pancreatectomy,” a single infusion of 1-2% acetic acid into the pancreatic duct, can ablate the exocrine pancreas while enhancing the endocrine pancreas, specifically increasing insulin secretion and improving glucose homeostasis. Herein, we sought to elucidate the mechanisms underlying the improved glucose homeostasis. We hypothesized that chemical pancreatectomy increases beta-cell volume and islet blood flow.

Methods
Female 8-week-old CD1 mice underwent a 1% acetic acid (AcA) or normal saline (NS) control pancreatic intraductal infusion and were sacrificed eight weeks thereafter. For beta-cell volume quantification, mouse pancreata were sectioned at 50 □m intervals throughout the whole pancreas and stained with insulin and DAPI. To evaluate islet blood flow and vasculature, mice underwent intracardiac injection of tomato lectin, labelling perfused blood vessels. Subsequently, pancreata were either sectioned for standard immunohistochemistry or underwent whole mount immunostaining using insulin and CD31 antibodies to label islets and blood vessels, respectively. We used ImageJ and Imaris software for quantification. We used descriptive statistics and a t-test for statistical analyses.

Results
Mice after chemical pancreatectomy demonstrated a statistically significant increase in beta-cell volume and mean islet volume compared with normal saline controls (Figure 1A, 1B). After chemical pancreatectomy, both whole mount immunostaining and standard immunohistochemistry showed statistically significant increases in peri- and intra-islet tomato lectin and CD31 staining, reflecting increased vasculature (Figure 1C-1F).

Conclusions
Chemical pancreatectomy improves glucose homeostasis through increased beta-cell volume and islet blood flow. Whole mount immunostaining and traditional immunohistochemistry demonstrate increased tomato lectin and CD31 in islets following chemical pancreatectomy, indicating increased islet vasculature and improved blood flow to islets, resulting in supranormal insulin secretion and enhanced glucose homeostasis. Thus, chemical pancreatectomy may benefit patients with chronic pancreatitis-related diabetes.

Abbreviations: AcA - Acetic acid
NS - normal saline


1A
Beta cell volume
Beta cell volume (mm³)
0.15
0.10
0.05
0.00
**
NS
AcA
1B
Islet Volume Whole Mount
Mean Islet Volume (x10⁻⁵µm³)
5
4
3
2
1
0
**
NS
AcA
1C
Whole Mount
Vascular Fluorescence/ Islet Volume
0.4
0.3
0.2
0.1
0.0
*
*
NS
AcA
Tomato Lectin
CD31
1D
Whole Mount
NS
AcA
Tomato Lectin CD31 Insulin
1E
IHC
Vascular Fluorescence/Insulin Ratio
0.10
0.08
0.06
0.04
0.02
0.00
*
*
NS
AcA
Tomato Lectin
CD31
1F
IHC
NS
AcA
Tomato Lectin CD31 Insulin DAPI

APSA QS 24

EVALUATION OF IRRIGATION SOLUTIONS ON INTRA-ABDOMINAL ABSCESS AND ADHESION FORMATION IN A PERFORATED APPENDICITIS MURINE MODEL

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Abstract: Purpose
Children with perforated appendicitis frequently form intra-abdominal abscesses (IAA) after surgery and intra-peritoneal irrigation for prevention remains controversial. Using a perforated appendicitis murine model, we sought to determine the effect of intra-peritoneal irrigation on post-operative abscess and adhesion formation.

Methods
Mice underwent an initial survival surgery during which a cecal ligation and puncture technique was performed to simulate perforated appendicitis. After 72 hours, the mice underwent a second survival surgery where a distal cecectomy and intra-peritoneal irrigation was performed. Mice were randomly assigned to a control group or one of three irrigation groups: normal saline (NS), 2% povidone-iodine (PVI) solution, or 2% tacrolimus solution. Mice were subsequently assigned to undergo necropsy at 2 weeks or 2 months after the second survival surgery. At time of necropsy, IAAs were counted, measured, and cultured and a parietal peritoneum sample was collected. Intra-peritoneal adhesion severity was graded on a 4-point scale. Bivariate statistical analysis was performed.

Results
In the 2-week cohort, 156 mice were divided into 39 controls, 39 NS, 40 PVI, and 38 tacrolimus. Prevalence of IAA was 79.5% (n=124) overall with variation in abscess occurrence among irrigation groups ($p=0.002$, Table). Abscess count in each mouse also varied by irrigation solution ($p < 0.001$). Irrigation with PVI resulted in greater adhesion severity while tacrolimus had decreased adhesion severity ($p < 0.001$). Irrigation did not significantly impact abscess size ($p=0.189$). In the 2-month group, 85 mice were divided into 26 control, 19 NS, 19 PVI, and 21 tacrolimus. Similar responses to the irrigation solutions were observed with decreased abscess number in the PVI group ($p=0.006$) but increased adhesion burden ($p=0.002$). The most common bacteria isolated from the abscesses was Enterococcus faecalis.

Conclusion
Povidone-iodine irrigation results in decreased intra-abdominal abscess formation in this perforated appendicitis model, but comes at the cost of increased adhesion formation. While using an immunosuppressant decreases adhesion burden, it does not decrease abscess formation. Further investigation is needed into adjustment and possible combination of irrigation solutions to decrease both abscess and adhesion formation.

Abbreviations: IAA: intra-abdominal abscess
NS: normal saline
PVI: povidone-iodine

APSA QS 25

THE ENTERIC GLIAL CELLS THAT PERSIST IN HIRSCHSPRUNG DISEASE ARE MINIMALLY NEUROGENIC

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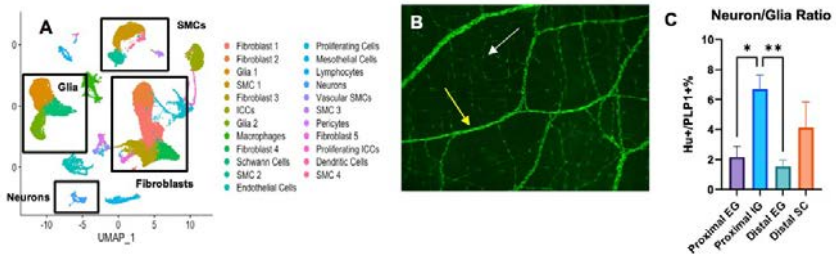
Abstract: Background: Like neurons of the enteric nervous system, enteric glial cells (EGCs) arise from neural crest-derived cells that migrate into and along the gut mesenchyme during embryologic development to form the enteric nervous system. Hirschsprung disease is a neurocristopathy, characterized by incomplete neural crest-derived cell colonization and a variable length of intestinal aganglionosis. Previous reports describe a persistent population of enteric glial cells in Hirschsprung disease, which is surprising given their neural crest-origin. In this study we aimed to characterize this population of EGCs using transcriptomics, immunohistochemistry, and in vitro assays.
Methods: Muscularis propria of the aganglionic colon was isolated from ~2-week-old PLP1GFP;Ednrb-/- mice (KO Hirschsprung mice with GFP+ glia) and the corresponding segment from wild-type (WT) controls. scRNA-seq libraries were prepared and data analyzed with the Seurat R package. Wholemounts were generated from this tissue for immunohistochemistry. Filtration and counter filtration using 20 and 70 µm filters were utilized to isolate extraganglionic and intraganglionic EGCs separately. Cells were FACS sorted for GFP expression, cultured, and stained for Hu to determine their neurogenic potential.
Results: Three clusters of EGCs were identified and labeled as follows: “extraganglionic” glia (EG), “intraganglionic” glia (IG), and “Schwann cells” (SC) based on gene signature (Figure, A). IG were absent in aganglionic colon, but both SCs and EGs persisted, which was confirmed by immunohistochemistry (Figure, B). Gfap is a specific marker for IG, whereas we identified Camk2b to be a specific marker for EG. All groups of glia were able to form neurospheres, but neurospheres generated from EG in the distal colon were minimally neurogenic when compared to neurospheres generated from IG in the ganglionated, proximal colon (1.5% vs 6.7%, p=0.002, Figure, C).
Discussion: We have identified a population of persistent EGCs in Hirschsprung disease that reside outside the enteric ganglia and have a unique transcriptional profile. While EGCs are generally believed to represent a population of neuronal progenitor cells, this specific population of extraganglionic EGCs are minimally neurogenic.

Abbreviations: EGCs - enteric glial cells
WT - wild-type
EG - extraganglionic glia
IG - intraganglionic glia
SC - Schwann cells



APSA QS 26

AUTOMATED QUANTIFICATION OF LIVER FIBROSIS AT DIAGNOSIS IN BILIARY ATRESIA PATIENTS USING A COLLAGEN MATRIX ULTRASTRUCTURE ANALYSIS

Norah E. Liang, MD[1], Jason L. Guo, PhD[2], Michelle Griffin, MD, PhD[2], Jennifer B. Parker[2], Gillian Fell, Khristian Bower-Rowe, Benjamin Pham[2], Amrita Narang, MD[3], James C.Y Dunn, MD, PhD[4], Serena Y. Tan, MD[2], Jeong S. Hyun, MD[5], Michael Longaker[6]

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Abstract: PURPOSE: To quantitatively characterize liver fibrosis in infants diagnosed with BA though automated analysis of the liver collagen ECM ultrastructure in index liver biopsies.

METHODS: A sample of infants who underwent Kasai portoenterostomy for BA between 2015 and 2022 at a single academic medical center were identified. Patients who have not required liver transplant to date (n=3) were compared to patients who had disease progression necessitating liver transplantation (n=3). Transplant-free survival after portoenterostomy was calculated. Liver biopsies obtained at the time of BA diagnosis were stained with Masson's Trichrome and subjected to an ultrastructure quantification algorithm that characterizes 147 ECM fiber features as well as global ECM architecture. The ultrastructural states of liver fibrosis were envisioned as stepwise deviations in the fiber feature matrix from less fibrotic to increasingly fibrotic liver, and pseudotime analysis was used to connect successive datapoints based on similarity in ultrastructural parameters. These data were collated with retrospective clinical data.

RESULTS: The non-transplanted cohort underwent portoenterostomy at a mean age of 62 days (SD 10.1), compared to 68.3 days (SD 28.7) in the transplanted cohort (P=0.7). At the time of study, the non-transplanted cohort demonstrated mean transplant-free survival of 1858 days (SD 1116.8), compared to 336 days (SD 125.2) in the transplanted cohort. The collagen fiber feature matrix generated by the ECM ultrastructure analysis was reduced by UMAP to visualize differences in overall matrix architecture between the two cohorts (Fig. 1A-B). Liver specimens from the transplanted cohort were associated with high mean pseudotime (25.1, SD 3.6), characterized by increased heterogeneity in collagen fiber length and diameter, compared to the non-transplanted cohort (mean pseudotime 8.4, SD 2.1; *P < 0.005; Fig. 1C). Pearson correlation suggested an inverse relationship between mean pseudotime and transplant-free survival (r=-0.66, P=0.16), and a direct relationship between mean pseudotime and total serum bilirubin 3 months post-portoenterostomy (r=0.64, P=0.17; Fig. 1D)

CONCLUSION: We present the first application of an automated ECM ultrastructure analysis to quantify liver fibrosis at diagnosis in patients with BA. Our preliminary correlation analysis suggests that higher mean pseudotime may be associated with decreased transplant-free survival and increased total bilirubin at 3 months.

Abbreviations: BA, biliary atresia; ECM, extracellular matrix; SD, standard deviation; UMAP, Uniform Manifold Approximation and Projection.

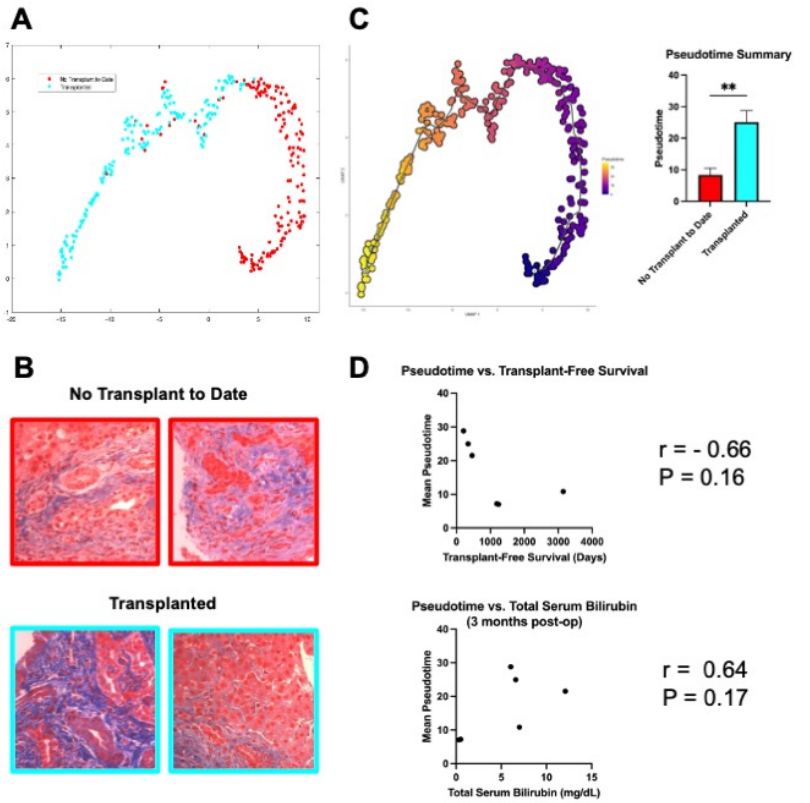

Figure 1. Matrix ultrastructural analysis of index liver biopsies in patients with biliary atresia. (A) UMAP of quantified ECM ultrastructure, stratified by liver transplantation status. **(B)** Representative Masson's Trichrome-stained images of index liver biopsy specimens from patients diagnosed with biliary atresia who have not required liver transplantation to date (top row) and those who have undergone liver transplantation (bottom row). **(C)** UMAP of liver fibrosis architecture with higher pseudotime representing increasingly heterogeneous collagen fiber length and diameter (left). Comparison of pseudotime summary between patients who have required liver transplantation for biliary atresia, compared to patients who have not (right). **(D)** Comparison of index liver biopsy mean pseudotime vs. transplant-free survival after Kasai portoenterostomy (top) and mean pseudotime vs. total serum bilirubin at 3 months after portoenterostomy (bottom)

APSA QS 28

DEVELOPMENT OF A SYNTHETIC INTESTINAL GRAFT WITH MECHANICALLY DRIVEN PERISTALSIS FOR THE TREATMENT OF SHORT BOWEL SYNDROME

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[1]Johns Hopkins University School of Medicine, Department of Pediatric Surgery, Baltimore, MD, USA, [2]Division of Pediatric Surgery, Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, USA, Baltimore, MD, USA, [3]Johns Hopkins University, Department of Mechanical Engineering, Baltimore, MD, USA, [4]Johns Hopkins University School of Medicine, Baltimore, MD, USA, [5]Johns Hopkins School of Medicine, Baltimore, MD, USA

Abstract: Purpose: Short bowel syndrome (SBS) refers to small intestinal length insufficient for nutritional requirements, and is a major cause of long-term morbidity in necrotizing enterocolitis (NEC) patients. One novel approach to restoration of enteral autonomy for patients with SBS is the implantation of an artificial intestine. We have previously achieved successful implantation of synthetic small intestinal grafts which possess absorptive capacity through laser-embedded intraluminal mucosal surfaces possessing a surface area akin to the native bowel. These synthetic grafts however remain limited by lack of peristalsis. We now demonstrate proof-of-concept for magnetically-driven peristalsis in a simple synthetic intestinal graft derived from small intestinal submucosa (SIS).

Methods: In preliminary experiments, tubular grafts were implanted into mice and piglets under general anesthesia in continuity with native ileum. Then, a tubular graft (length 5.5cm, internal diameter 5mm) was generated by tubularizing a flat sheet of CorMatrix® SIS-ECM (CorMatrix Cardiovascular, Inc., Roswell, GA) with running 8-0 nylon suture. Rigid rare earth permanent magnets of alternating polarity were secured to the external surface of the graft in a diametrically opposed configuration. Each end of the graft was then attached to a barbed fitting, allowing the graft to be suspended within a pressurized chamber simulating peritoneal pressure. An alternating external magnetic field was applied to the chamber, resulting in the rigid magnets moving in two waves with offset peaks. As the rigid magnets deformed the graft, alternating coordinated peristaltic waves were produced, facilitating propulsion of intraluminal contents. (Video 1)

Results: Prior studies showed that the implantation of tubular grafts could be successfully performed in mice and piglets with minimal morbidity (leak, infection). The propulsion of colored polystyrene microparticles was achieved with minimal intraluminal distending pressure, while holding peritoneal pressure constant at an empirically-sourced value. Successful peristalsis was quantified by measuring the percentage reduction of the graft's cross-sectional area when magnetically squeezed, which approximated 50% of the non-deformed bowel (see video).

Conclusion: We successfully demonstrate magnetically-driven peristalsis of viscous intraluminal contents in a simple tubular graft, providing proof-of-concept for implementation into more complex bio-printed models of human intestine for the treatment of short bowel syndrome.

Abbreviations: SBS - short bowel syndrome
NEC - necrotizing enterocolitis
SIS - small intestinal submucosa
ECM - extracellular matrix

Quickshot Session III - Trauma and Neonatal

5:00 PM – 5:45 PM

APSA QS 29

LONG TERM CLINICAL OUTCOMES FOR PATIENTS WITH SMALL INTESTINAL HIRSCHSPRUNG DISEASE

Haley B. Etskovitz, DO, MBS[1], Priyanka V. Chugh, MD, MS[2], Emily Nes, MD[3], Hajar Fennich, BSc[4], Mian Arsam Haroon, MBBS[3], Leah Froehle, MPH[3], Belinda H. Dickie, MD, PhD[3], Biren P. Modi, MD, MPH[5], Prathima Nandivada, MD[3], Tom Jaksic, MD, PhD[3]

[1]Boston Children's Hospital, Boston, MA, Boston, MA, USA, [2]Boston Children's Hospital, Boston, MA, USA, [3]Boston Children's Hospital, Boston, MA, USA, [4]VU School of Medical Sciences, Noord-Holland, Netherlands, [5]Boston Children's Hospital and Harvard Medical School, Boston, MA, USA

Abstract: Purpose:
Long segment Hirschsprung Disease with transition in the small intestine (SI-HD) has been reported to have significant morbidity and mortality; often due to intestinal failure associated liver disease (IFALD). Here we report clinical outcomes in a large cohort of patients with SI-HD requiring long-term parenteral nutrition (PN).

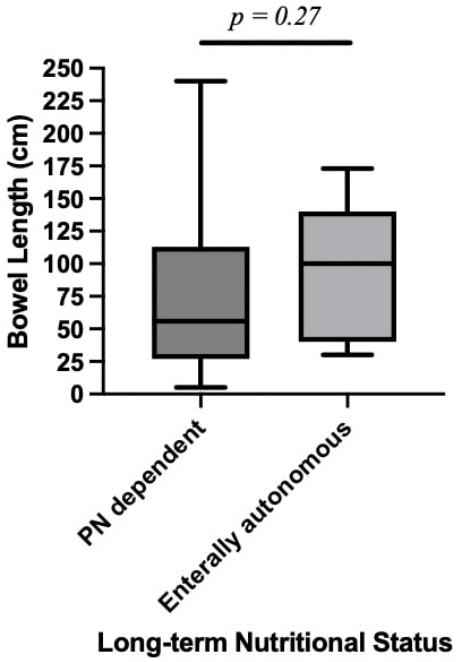
Methods:
We performed a retrospective cohort study of patients with SI-HD managed by a multidisciplinary intestinal rehabilitation program from 2013-2023. Charts were reviewed for residual bowel length, presence and severity of IFALD, duration of PN, incidence of Hirschsprung associated enterocolitis (HAEC), incidence of central line-associated blood stream infections (CLABSI), and surgical history. Statistical analysis was done with GraphPad Prism, using non-parametric Mann-Whitney tests.

Results:
Of the 588 patients in the intestinal rehabilitation program, 46 (7.8%) had a diagnosis of SI-HD with a median follow up of 84.0 months (49.4,136.0). 13 patients referred from outside institutions have an unknown length of residual small bowel. The median residual bowel length of the 33 remaining patients is 76.5cm (34.3,140.0). 44 (95.7%) patients required home PN for a median duration of 70.0 months (18.0,123.6). 27 (58.7%) patients remain PN dependent. Median bowel length did not differ between patients who achieved enteral autonomy and those still dependent on PN (Figure 1). 34 (73.9%) patients developed IFALD. 20 (43.5%) patients were treated with fish oil lipid emulsion. 20 (43.5%) patients experienced HAEC and 24 (52.2%) experienced CLABSI. 35 (76.1%) patients required intra-abdominal operations after their index procedure of leveling ostomy. 13 patients subsequently had pull through procedures, with 5 (38.5%) of them ultimately required ostomy re-creation. 4 (8.7%) patients underwent tapering enteroplasties and 6 (13.0%) underwent serial transverse enteroplasty procedures (STEP). No children died nor required liver or intestinal transplantation.

Conclusion:
Children with SI-HD require long term home PN, often for years. Enteral autonomy was achieved in nearly half of our cohort, despite similar bowel length to those who remain PN-dependent. A minority of patients underwent pull through procedure, with a high percentage requiring ostomy re-creation. No children died nor required liver or intestinal transplantation.

Abbreviations: small intestinal Hirschsprung Disease (SI-HD)
intestinal failure associated liver disease (IFALD)
parenteral nutrition (PN)
Hirschsprung associated enterocolitis (HAEC)
central line-associated blood stream infections (CLABSI)
serial transverse enteroplasty procedure (STEP)

Bowel Length in Patients who are Dependent on PN vs Patients who are Enterally Autonomous



APSA QS 30

USE OF ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY IN THE DIAGNOSIS AND MANAGMENT OF PEDIATRIC PANCREATIC INJURY

R Scott Eldredge, MD[1], David M. Notrica, MD[1], Mittun Patel[2], Brielle Ochoa, MD[3], Mark McOmber, MD[3]

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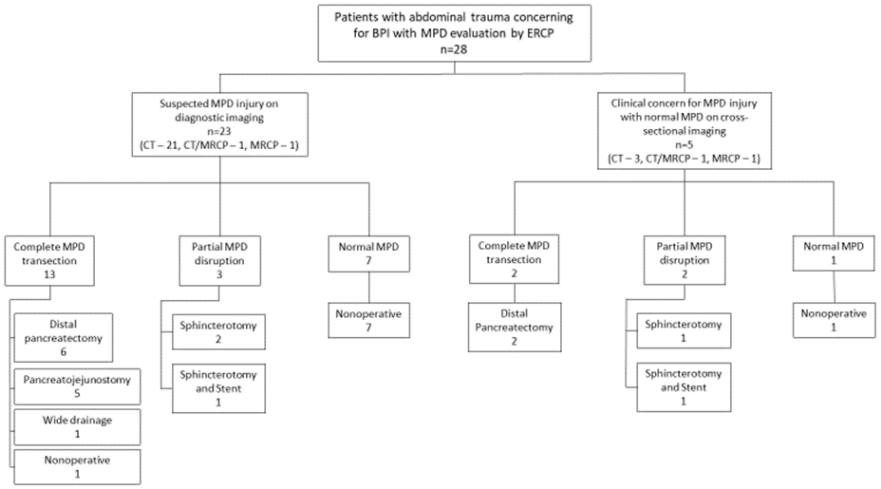
Abstract: Background:
BPI in pediatric patients is commonly diagnosed on CT. Management of BPI is based on the integrity of MPD. ERCP is the gold standard for evaluating the integrity of MPD; despite this, its use in detecting MPD in pediatric BPI is not widely performed. The purpose of this study is to evaluate ERCP findings in suspected BPI and to examine potential discordance between ERCP and imaging.
Methods:
A retrospective review of all patients < 18 years of age with BPI and ERCP was conducted at a high-volume, level I pediatric trauma center from January 2009 through May 2023. Demographic and clinical data were collected. Pancreatic injury findings were compared between imaging and ERCP
Results:
ERCP for the evaluation of MPD injury was performed in 28 patients with a median age 6.5 of years [IQR:3,11] and weight of 20.8 kg [IQR:13.7,33.9]. Of these patients, 23 had a suspected MPD injury, 4 had BPI without concern for MPD injury, and 1 had no concern for BPI on imaging. On ERCP, an intact MPD was identified in 29% (8) of patients. Among the remaining 20 patients with MPD injury, 75% (15) had complete MPD transection with 7 head/neck and 8 body/tail injuries. Roux-en-Y pancreatojejunostomy was done for 5 head/neck disruptions while all body/tail injuries underwent distal pancreatectomy. The remaining 25% (5) of patients with MPD injury had a partial disruption which were all treated with endoscopic sphincterotomy and stenting in 2, Figure 1. ERCP findings differed from imaging findings in 40% (11) of patients: 7 had imaging evidence of MPD injury without injury on ERCP, and 4 patients had no imaging evidence of MPD injury but had injury on ERCP.
Conclusion:
ERCP is a valuable tool in evaluating the MPD in pediatric BPI. Approximately 40% of patient had discordant findings between pre-ERCP imaging and ERCP evaluation. Endoscopic treatment avoided surgical intervention in 100% of partial MPD injuries. When evaluating BPI, ERCP should be considered when and where possible to assess the need for surgery and direct surgical decision making.

Abbreviations: Blunt pancreatic injury - BPI
Main pancreatic duct - MPD
Endoscopic retrograde cholangiopancreatography - ERCP



APSA QS 31

STAGED VS NON-STAGED PELVIC OSTEOTOMIES IN THE MODERN TREATMENT OF CLOACAL EXSTROPHY: BRIDGING THE GAP

Ahmad Haffar, MD[1], Alexander M. Hirsch, MD, MS[2], Chad Crigger[3], Victoria Maxon[1], Nora M. Haney, MD/MBA[3], Isam Nasr, MD[4], Paul Sponseller[5], John P. Gearhart[2]

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Abstract: Purpose

Staged pelvic osteotomy has been shown in the past to be an effective tool in the closure of the wide pubic diastasis of cloacal exstrophy. It allows for gradual reduction of this diastasis over several weeks, sufficiently mobilizing the pelvis prior to closure. The authors sought to update the outcomes and complications between staged and non-staged osteotomy in a comparative fashion in cloacal exstrophy bladder closure.

Methods

A prospectively maintained, institutionally approved exstrophy-epispadias complex database of 1510 patients was reviewed for cloacal exstrophy bladder closure events performed with osteotomy at the authors' institution. Bladder closure failure was defined as any fascial dehiscence, bladder prolapse, or vesicocutaneous fistula within one year of closure.

Results

64 closure events fitting the inclusion criteria were identified in 61 unique patients. Staged osteotomy was performed in 42 closure events and non-staged in 22 closures (65.6% and 34.4%, respectively). There were no baseline differences in sex, age at closure, or size of diastasis. The mean diastasis for patients was 6.79 cm (Std dev=2.31 cm) with a median age at closure of 609 days (IQR=403-792 days). Complications occurred in 46/64 closure events, with 16 grade III or IV complications (25.0% [16/64]). There were no associations between staged osteotomy and overall complication or grade III or higher complications (p=0.6344 and p=0.1286, respectively). Of the 46 total complications, 12 were orthopedic complications with 6 complications being grade III or higher. Staged osteotomy events experienced 10/42 orthopedic complications while non-staged experienced 2/22 orthopedic complications, however this did not reach significance (p=0.1519). 48 (75%) closures utilized the combined anterior innominate with posterior vertical iliac osteotomy with 7 using anterior innominate osteotomy (16.7%) and 6 using posterior iliac (14.3%). Of the 64 closure events, 57 (90.5%) resulted in successful closure with 6 failures and one closure with planned cystectomy.

Conclusion

This study confirms superior outcomes when using staged osteotomy in cloacal exstrophy bladder closure. Staged osteotomy was shown to be a safe alternative to non-staged osteotomy that can decrease the risk of closure failure in this group. Staged pelvic osteotomy should be considered in all patients undergoing cloacal exstrophy bladder closure.

Abbreviations:

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A FROSTBITE TREATMENT GUIDELINE FOR PEDIATRIC PATIENTS

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Abstract: Purpose

Despite the existence of guidelines for frostbite management in adults, there are no published attempts to standardize the treatment of pediatric frostbite. The purpose of this study is to describe a single institution multidisciplinary consensus guideline for the management of pediatric frostbite patients. Our outcomes were need for amputation and guideline compliance.

Methods

The pediatric intensive care, interventional radiology, general surgery, and emergency medicine departments at a 300 bed tertiary referral children's hospital developed and applied the proposed guideline for frostbite management in 2019 (Figure 1). A retrospective chart review was performed on patients who presented to the emergency department between 01/01/2012 and 7/01/2023 with a diagnosis of frostbite. Out of 68 patients identified, 17 were transferred from other institutions and excluded, leaving 51 patients. Patient demographic information, grade of frostbite injury, and characterization of hospitalization and treatment course were noted and compared to the institutional guideline.

Results

Of the 51 included frostbite patients, 20 were seen after the guideline implementation in 2019. Eleven required admission for frostbite between 2012 and 2023, of which 6 were admitted after guideline implementation. Of the admitted patients, 5/6 (83%) were treated according to the guidelines. There were 2 patients with a grade 3 injury; no patient had a grade 4 injury. One patient with grade 3 injuries was treated with catheter directed thrombolysis and eventually required a partial digit amputation. The other patient with grade 3 injury was treated with systemic anticoagulation. Twenty patients from the whole cohort were discharged from the ER with grade 1 or 2 frostbite injuries.

Conclusion

An algorithm for the treatment of frostbite in pediatric patients based on multidisciplinary consensus at a single, urban tertiary referral center is proposed. The guideline and patient discussion provide a framework to consider when evaluating treatment options for children with frostbite.

Abbreviations:

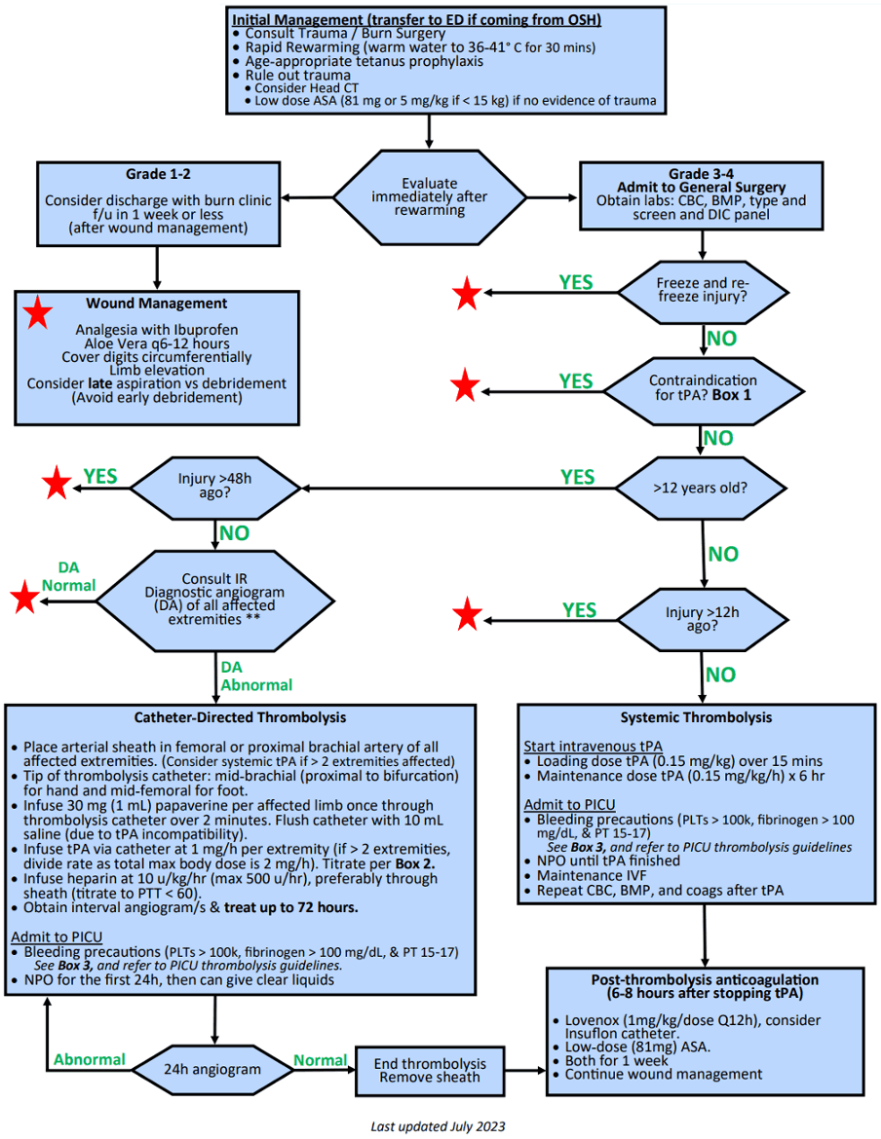

Figure 1. Treatment algorithm for pediatric frostbite patients based on multidisciplinary consensus at high volume children's hospital.

APSA QS 33

NATIONAL PRACTICE PATTERNS OF SAME-DAY DISCHARGE FOR PEDIATRIC LAPAROSCOPIC CHOLECYSTECTOMY UTILIZING NSQIP PEDIATRIC REGISTRY

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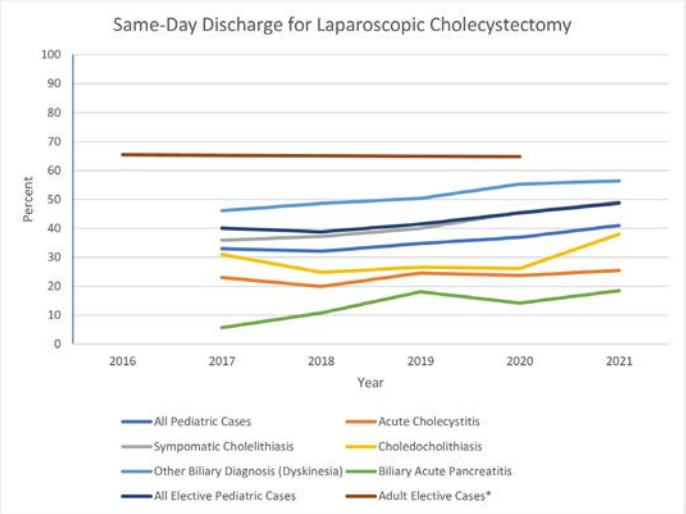
Abstract: Purpose:
Same-day discharge for pediatric laparoscopic cholecystectomy is often performed, however national practice patterns have not been well studied. Adult National Surgical Quality Improvement Program (NSQIP) data for elective laparoscopic cholecystectomy reports same-day discharge rates of 65%. The aim of this paper is to assess national practice patterns of same day discharge for pediatric laparoscopic cholecystectomy and postoperative readmission rates.
Methods:
Utilizing the NSQIP pediatric registry, patients from 2017-2021 that underwent laparoscopic cholecystectomy who were discharged in the first 24 hours postoperatively were compared to those discharged 24-72 hours postoperatively. Same-day discharge rates were determined for each year, and the data was analyzed utilizing Independent T-tests, $\chi 2$ and Fisher's exact tests. Subgroup analysis was performed on acute cholecystitis, symptomatic cholelithiasis, choledocholithiasis, biliary pancreatitis, other specified biliary diagnoses, and on all elective cases.
Results:
A total of 15,880 patients were identified with 36% of patients undergoing same-day discharge. The rate increased from 33% in 2017 to 41% in 2021. In subgroup analysis, there was minimal increase in same-day discharge for acute cholecystitis (23% to 25.5%) from 2017 to 2021; however, the change was larger for symptomatic cholelithiasis (35.9% to 49%) and pancreatitis (5.7% to 18.5%)(Figure 1). Pediatric elective same-day discharge rate was 43%. There was no significant difference in unplanned 30-day readmission between patients discharged same-day versus not for acute cholecystitis (2.8% vs 2.9%, p=0.833), choledocholithiasis (2.1% vs 4.1%, p=0.133), other specified diagnoses (used for biliary dyskinesia among others) (2.1% vs 0.6%, p=0.471), and biliary pancreatitis (1.0% vs 3.5%, p=0.345). There was a significant decrease in readmissions for those discharged the same day versus not for all cases (2.0% vs 3.0%, p< 0.001), elective cases (1.7% vs 2.5%, p=0.004) and symptomatic cholelithiasis (1.7% vs 3.0%, p< 0.001).
Conclusion:
Same-day discharge for pediatric patients undergoing laparoscopic cholecystectomy has slowly been increasing each year, without increased rates of readmission overall, and decreasing rates of readmission for some diagnoses. However, compared to previously published adult data, pediatric patients undergoing elective laparoscopic cholecystectomy are about one third less likely to be discharged same-day.

Abbreviations: National Surgical Quality Improvement Program - NSQIP

Figure 1: Trend of Percent Same-Day Discharge Compared to 24-72 Hour Discharge for Laparoscopic Cholecystectomy in Pediatric Patients Utilizing NSQIP-Pediatric Registry



*NSQIP-Adult analysis performed on 2016 to 2020 data reviewing discharge practice patterns, with same-day discharge rates reported for laparoscopic cholecystectomy: Shariq OA, Bews KA, Etzioni DA, Kendrick ML, Habermann EB, Thiels CA. Performance of General Surgical Procedures in Outpatient Settings Before and After Onset of the COVID-19 Pandemic. JAMA Network Open 2023;6(3):e231198-e.

APSA QS 34

NEIGHBORHOOD-BASED SOCIAL DETERMINANTS OF HEALTH ARE ASSOCIATED WITH DECREASED HELMET USE IN YOUNG CHILDREN

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Abstract: Purpose:
We sought to determine the association between neighborhood-level social determinants of health (SDoH) and protective helmet use for young children who underwent trauma evaluation following bicycle crashes. We hypothesized that children from disadvantaged communities would be less likely to be wearing helmets at the time of their accidents.

Methods:
A retrospective cohort study was performed of all children ≤10 years old who presented after bicycle crashes to a Level 1 Pediatric Trauma Center (7/1/2017–6/30/2021). Geocoding linked patient addresses to two neighborhood-level SDoH indices at the census tract/block level: state Area Deprivation Index (ADI) and Social Vulnerability Index (SVI). Overall SVI and its sub-themes were assessed: Socioeconomic Status (Theme 1), Household Characteristics (Theme 2), Racial and Ethnic Minority Status (Theme 3), and Housing Type and Transportation (Theme 4). Multivariable logistic regression investigated associations between neighborhood-level SDoH and helmet use, controlling for age, sex, and racialization. ADI and SVI were modeled as continuous variables, scaled to present decile change (0=least disadvantaged, 10=most disadvantaged).

Results:
In total, 228 children ≤10 years were in bicycle crashes, 56% of whom were not wearing helmets. Median age was 7.6 years (IQR 5.6–9.6), and 71% were male. Children covered by public insurance accounted for 53% of the patients, and 63% of the patients were minorities. No differences were found in presenting Glasgow Coma Score, Injury Severity Score, or Emergency Department disposition between those wearing and not wearing helmets. However, neighborhood-level SDoH indices were significantly associated with helmet use in the multivariable model (Table). For every decile increase in overall SVI, there was a 27% increase in the likelihood that the child did not use a helmet while riding their bike. These associations were maintained with SVI Themes 1, 2, and 3. Similarly, for every decile increase in ADI, the child was 23% more likely to not use a helmet.

Conclusions:
Helmet use in young children was found to be closely associated with community structural factors, such as the neighborhood's overall socioeconomic status, household characteristics, and racial/ethnic minority status. Neighborhood-level SDoH indices may be an effective tool for identifying at-risk communities for injury prevention interventions.

Abbreviations: SDoH: Social Determinants of Health
ADI: Area Deprivation Index
SVI: Social Vulnerability Index

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UTILITY OF RENAL REPLACEMENT THERAPY IN INFANTS WITH CONGENITAL DIAPHRAGMATIC HERNIA TREATED WITH EXTRACORPOREAL LIFE SUPPORT

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Abstract: Purpose:
Congenital diaphragmatic hernia (CDH) is the most common indication for extracorporeal life support (ECLS) in newborns. Limited data and no formal guidelines exist on the use of renal replacement therapy (RRT) in neonates with CDH who develop fluid overload, acute kidney injury, or renal failure while undergoing ECLS. We sought to identify any associations between RRT and outcome in this population.

Methods:
A de-identified report of clinical and demographic factors for infants with CDH who received ECLS was obtained from the Extracorporeal Life Support Organization database (2011-2020). This cohort was stratified by patients who received RRT and those who did not. Pre-ECLS clinical factors, ECLS characteristics, and surgical and survival outcomes were compared. Two-sided student's t tests were performed for continuous variables and chi-square or ANOVA tests were performed for categorical variables. To account for increased clinical severity in the RRT subgroup, a propensity score match based on probability of mortality using relevant pre-ECLS variables was performed.

Results:
Of 3091 infants receiving ECLS, 828 (26.8%) were treated with RRT (Table 1). RRT utilization was significantly associated with multiple variables including patient race, lower APGAR scores at birth, major concomitant cardiac or other congenital anomaly, degree of pre-ECLS respiratory support, worse blood gas variables prior to cannulation, choice of venovenous ECLS, and creatinine >1.5 (8.7% vs. 1.5%, $p< 0.0001$). In patients with RRT, ECLS run times were longer, even in those who survived to discharge. Patients treated with RRT were more likely to undergo CDH repair while on ECLS (57.3% vs. 40.2%, $p< 0.0001$) and had decreased rates of survival through ECLS and to discharge. The survival difference was attenuated but persistent after propensity score matching.

Conclusions:
The choice of RRT use in neonatal CDH patients on ECLS is associated with morbidity prior to ECLS initiation and higher rates of subsequent adverse outcomes including mortality, even after adjusting for covariates with propensity score matching. This study suggests that use of RRT may not confer benefit in this population and that more conservative management of fluid status or renal insufficiency may be favored.

Abbreviations: CDH = congenital diaphragmatic hernia
ECLS = extracorporeal life support
RRT = renal replacement therapy

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OUTCOMES OF A HYBRID MODEL FOR REPAIR OF INFANTS WITH CONGENITAL DIAPHRAGMATIC HERNIA REQUIRING EXTRACORPOREAL LIFE SUPPORT

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Abstract: Purpose
Timing of repair for infants with congenital diaphragmatic hernia(CDH) requiring extracorporeal life support(ECLS) remains controversial. Historically, we shifted from late to early repair followed by a hybrid model with early repair on ECLS for severe CDH and post-ECLS repair for mild/moderate CDH. This study assesses the efficacy of the hybrid model.

Methods
A single institution retrospective review (2002-2023) was performed, of infants diagnosed with CDH requiring ECLS, excluding those cannulated after repair. Patients were grouped according to institutional protocols: 1.Delayed Repair(DR; 2002-2009)[after decannulation or late in ECLS course if unable to wean], 2.Early Repair(ER; 2010-2016)[< 72h after cannulation], and 3.Hybrid Model(HM; 2017-2023)[ER for severe CDH and DR for moderate/mild based on prenatal characteristics]. Demographics, disease characteristics, and outcomes were analyzed. Chi-squared/Fisher's exact/Kruskal-Wallis tests were used, with significance of $p< 0.05$.

Results
103 infants were included– 35(34%) with DR, 32(31%) with ER, and 36(35%) using HM. No significant differences in patient sex, gestational age or birthweight were identified. Defect types were similar with majority classified as Type C/D(68%). Presence of liver herniation (69% vs 69% vs 77%,p=0.666) and rates of non-repair(5.7 vs 6.3 vs 5.6%,p=0.992) were similar. Median ECLS duration was significantly less in patients treated with HM (10days, IQR: 5-16.5) compared to DR(12days, IQR:6-17) and ER(16.5days, IQR:11-22)[p=0.019]. Survival to discharge was highest using the HM(78%) compared to DR(74%) and ER(34%) groups[$p < 0.0001$], however post-hoc analysis between the HM and DR groups demonstrated no difference(p=0.786). Subgroup analysis of the HM cohort demonstrated: 47% were repaired early on ECLS(< 72h), 11% were repaired late on ECLS(>72h), and 42% were repaired after decannulation. Prenatal predictors significantly differed based on timing selected for repair(Table 1). ECLS duration was the shortest in patients repaired after decannulation(5d) compared to those repaired early(13d) or late(23.5d) on ECLS[p=0.0009]. There were no significant survival differences between repair times within the HM cohort(70.6 vs 100 vs 78.6%)[p=0.394].

Conclusion
Our data demonstrate a physiologic spectrum across infants with CDH who require ECLS and suggests utility of a hybrid model. This approach may be beneficial in discerning patients of mild/moderate severity who could be successfully decannulated prior to repair to mitigate bleeding complications.

Abbreviations: CDH: congenital diaphragmatic hernia
ECLS: extracorporeal life support
DR: delayed repair
ER: early repair
HM: hybrid model

APSA QS 37

PRENATAL DIAGNOSIS IN THE EXSTROPHY-EPISPADIAS COMPLEX: SPECTRUM OF SUCCESS

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Abstract: Introduction: Bladder exstrophy-epispadias complex is a spectrum of genitourinary malformations encompassing classic bladder exstrophy (CBE) and cloacal exstrophy (CE) that requires surgical repair after birth. Repairs are ideally performed by a pediatric urologist in concert with general pediatric surgery, orthopedics, and even neurosurgery. Earlier presentation to a high-volume exstrophy center leads to improved outcomes, but patients are often diagnosed at birth due to poor prenatal screening. The authors hypothesize that increased prenatal diagnosis of CE and CBE are associated with increased rates of delivery at high-volume centers and improved success rates of primary closure.
Methods: A prospectively maintained institutional database of exstrophy-epispadias patients was retrospectively reviewed for patients with prenatal diagnostic imaging since 2000. 280 patients with classic bladder exstrophy and 37 cloacal exstrophy patients who underwent primary closure at an identifiable institution were included. Gestational age at diagnosis, ultrasound findings, confirmatory fMRI, institution of closure, and outcome of primary closure attempt were recorded. Results were compared between diagnostic groups.
Results: The cohort included 280 CBE patients and 37 CE patients. 73% (27) of the CE patients and 39% (110) of the CBE patients were diagnosed prenatally. The median gestational age at diagnosis was 20 weeks (inter-quartile range [IQR]: 8 – 36.5) for CE patients and 22 weeks (IQR: 18 – 24.5) for CBE patients. Both CE and CBE patients were significantly more likely to undergo primary closure at exstrophy centers of excellence when diagnosed prenatally (p=0.049 and p=0.0004, respectively). When diagnosed prenatally, primary closures were successful more often in both CE (75% vs. 57%) and CBE patients (74% vs. 69%), but neither comparison was statistically significant (p=0.38 and p=0.78, respectively).
Conclusion: Both CE and CBE patients are often undiagnosed at birth, and rates of prenatal diagnosis are worse for CBE than CE patients. When successfully diagnosed before birth, patients with either CE or CBE are more likely to undergo closure at a high-volume exstrophy center and may have an improved chance of successful primary closure. These results illustrate the importance of specific prenatal imaging protocols to improve rates of prenatal diagnosis in this population.

Abbreviations: CBE: classic bladder exstrophy; CE: cloacal exstrophy; IQR: inter-quartile range

APSA QS 38

MATERNAL CONSUMPTION OF HIGH FAT DIET IMPAIRS SUSCEPTIBILITY TO NEONATAL SEPSIS AND IMPAIRS INTESTINAL GOBLET CELL DIFFERENTIATION IN UTERO

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Abstract: Purpose: The influence of maternal diet on offspring health is of great interest, yet the impact of dietary components on maturation of the fetal intestine is not well studied. We hypothesized that maternal high fat diet (HFD) might adversely affect neonatal intestinal immunity by modulating cell differentiation in utero.
Methods: Pregnant C57 mice were placed on an HFD starting at 8 weeks of age prior to mating with males who had been fed a normal diet (ND). Pregnant mice were then maintained on HFD for 8 weeks after conception. 24 hours after delivery, sepsis was induced in neonatal mice by administration of lipopolysaccharide from gram-negative bacteria (2.5 mg/kg intraperitoneal). Six hours following the injection, samples, including newborn intestinal specimens, were harvested for PCR and histologic assessments.
Results: HFD-fed mothers gained weight significantly after 8 weeks of diet intervention (23.3 vs. 30.7g, p=0.007). Neonates from the HFD group displayed no differences in birth timing or weight compared to the ND group. However, neonates from the HFD mothers had distinctly reduced blood glucose levels (114 vs. 67 mg/dL) followed by a decrease in average glucose levels 6 hours after inducing endotoxemia (102 vs. 45 mg/dL), consistent with the clinical picture seen in humans. Importantly, HFD-exposed neonatal mice exhibited significantly elevated pro-inflammatory cytokine levels (IL6, IL1b, LCN2) compared to ND controls (LCN2; 130.3 vs. 250.6, p=0.003). HFD offspring showed an increased goblet cell in histological Alcian-Blue staining at the baseline compared to ND. Strikingly, after six hours of LPS-induced sepsis, goblet cell count in the HFD offspring significantly reduced, while such alteration was not observed in the ND group.
Conclusions: Maternal HFD increases susceptibility to abdominal sepsis in the offspring, in part via a significant reduction in cellular differentiation within the developing intestine towards goblet cells. Such alteration in the intestinal cell lineage in utero could affect the vulnerability of neonates from HFD-fed mothers, offering insights into potential underlying mechanisms of high risk of intestinal disorders in infants from HFD mothers.

Abbreviations: HFD: High fat diet, ND: Normal diet, IL6: interleukin 6, IL1b: interleukin 1-beta, LCN2: lipocalin 2

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INTESTINAL FATTY ACID BINDING PROTEIN AND LIPOPOLYSACCHARIDE BINDING PROTEIN AS DUAL BIOMARKERS TO DEFINE DISEASE SEVERITY IN NECROTIZING ENTEROCOLITIS

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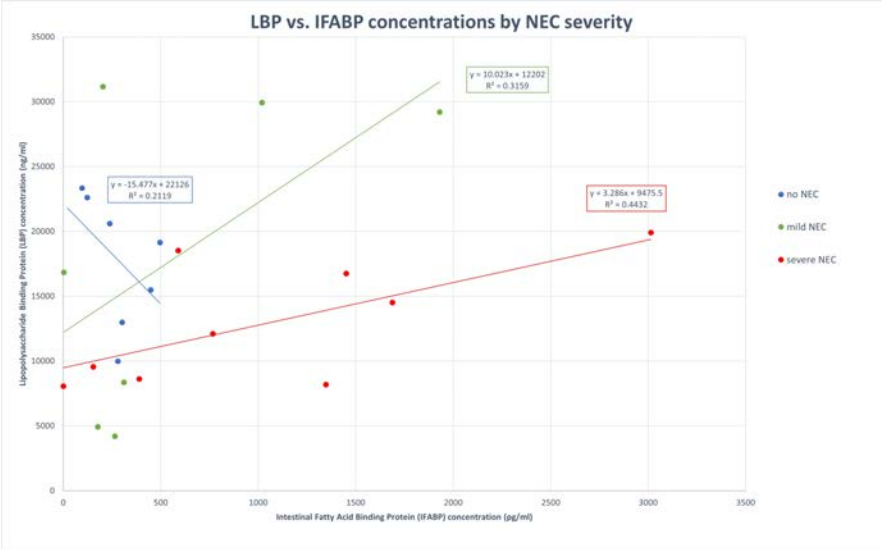
Abstract: Purpose: Necrotizing enterocolitis (NEC) causes major gastrointestinal morbidity and mortality in preterm neonates. We have previously demonstrated that intestinal fatty acid binding protein (IFABP) levels are elevated in pre-term piglets with NEC. Here, we investigated the utility of serum lipopolysaccharide binding protein (LBP) & intestinal fatty-acid binding protein (I-FABP) as dual biomarkers of disease severity in a preterm piglet model of NEC. We hypothesized that the combination of serum IFABP and serum LPS will identify the presence of NEC and discriminate between the mild and severe forms of NEC.

Methods Using our established pre-term piglet model of spontaneous NEC, preterm piglets delivered at 103-107 days (term = 115 days) were fed and monitored for signs and symptoms of NEC over a 4-day period and euthanized. We assayed blood collected at delivery and at necropsy. The presence or severity of NEC was assessed postmortem and graded using a previously established histologic scoring scale.1 Initial and final serum concentrations of IFABP and LBP were determined via enzyme-linked immunosorbence assays (Hycult Biotech HK406 and HK503 respectively). Data were analyzed using GraphPad Prism software (version 9.0.0). A Kruskal-Wallis test was performed to assess differences in the change in IFABP concentration among disease groups.

Results:
Among the 33 piglets studied, 21% had no NEC, 27% developed mild NEC and 52% had moderate/severe NEC. There was a significantly higher increase in the IFABP concentration at necropsy in the animals that had moderate/severe NEC (859 ± 897 pg/ml) versus the mild NEC (318.5 ± 578 pg/ml) and no NEC (25.89 ± 273.5 pg/ml) groups (p=0.0146). While the change in LBP did not independently discriminate between the groups, there was a mild to moderate correlation between serum IFABP and serum LBP levels in animals with NEC which strengthens with disease severity (Figure 1).

Conclusions:
Our results suggest that IFABP can distinguish between mild and moderate/severe NEC. Pairing serum IFABP with serum LBP can help further distinguish disease severity. Our findings suggest the potential utility of serum LBP and I-FABP as dual biomarkers that together may improve diagnostic sensitivity and specificity of diagnosing and determining the severity of NEC.

Abbreviations: NEC - necrotizing enterocolitis
I-FABP - intestinal fatty acid binding protein
LBP - lipopolysaccharide binding protein


LBP vs. IFABP concentrations by NEC severity
y = 10.023x + 12202
R² = 0.3159
y = -15.477x + 22126
R² = 0.2119
y = 3.286x + 9475.5
R² = 0.4432
no NEC
mild NEC
severe NEC
Lipopolysaccharide Binding Protein (LBP) concentration (ng/ml)
Intestinal Fatty Acid Binding Protein (IFABP) concentration (pg/ml)
0
5000
10000
15000
20000
25000
30000
35000
0
500
1000
1500
2000
2500
3000
3500

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IMPACT OF INFECTIOUS SOURCE ON PEDIATRIC ECMO OUTCOMES IN SEPSIS

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Abstract: Purpose: Sepsis is an increasingly common indication for ECMO (Extracorporeal Membrane Oxygenation). Although utilization of ECMO in pediatric patients with refractory septic shock improves mortality, there is little known on whether the infectious etiology/source of sepsis impacts outcomes. The aim of this study is to compare ECMO outcomes in children with sepsis based on culture data.

Methods: A retrospective review was done of ECMO patients with septic shock from 2013-2022 at a quaternary children's hospital. Respiratory and blood cultures were reviewed to determine source of sepsis. Mortality for all groups was compared using univariate and multivariate models.

Results: A total of 155 patients were included. Overall mortality on ECMO was 36% and mortality at discharge was 51%. Patients with both a bacterial/fungal pneumonia and viral respiratory illness had a trend towards higher ECMO mortality than those with only a bacterial/fungal pneumonia (34.2% vs 16.7%, OR 2.6, p=0.07). There was no significant difference in mortality at discharge between the two groups (p=0.53). Mortality on ECMO and mortality at discharge was highest for patients with positive blood cultures. Using a Cox proportional-hazards regression model to control for age, sex, race, medical co-morbidities, pre-ECMO lactate, oxygenation index, weight, dialysis, type of ECMO and eCPR, patients with both positive blood cultures and positive respiratory cultures at time of cannulation had an adjusted HR (Hazard Ratio) for mortality on ECMO of 7.65 (CI: 1.92-30.44, p=0.004) and adjusted HR for mortality at discharge of 4.48 (CI: 1.69-11.88, p=0.003) compared to those with only positive respiratory cultures.

Conclusions: ECMO outcomes in septic pediatric patients differ based on the infectious source. Children with both positive blood and respiratory cultures at time of cannulation have significantly higher mortality. This information is important when discussing prognosis with families prior to cannulation.

Abbreviations: ECMO = Extracorporeal Membrane Oxygenation
HR= Hazards Ratio

APSA QS 41

HYPERINFLAMMATORY STATE SEEN IN ACTIVE NECROTIZING ENTEROCOLITIS REMAINS EVEN POST RECOVERY

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Abstract: Background: Necrotizing enterocolitis (NEC) is the leading gastrointestinal cause of death of premature neonates. NEC is associated with prematurity and a hyperinflammatory response. We hypothesize that NEC patients will have, and continue to have even after recovery, an increased hyperinflammatory intestinal response compared to those without NEC.

Methods: Neonatal intestinal specimens were collected from patients with NEC, without NEC, and those that have recovered from NEC and snap frozen or generated into enteroids. Enteroids were treated with lipopolysaccharide (LPS), subjected to 24 hours of hypoxia, then compared with untreated controls. Expression of Tumor Necrosis Factor (TNF-α) and interleukin 8 (IL-8) were evaluated via RTqPCR and ELISA. RNA sequencing was performed. ANOVA determined statistical significance ($p < 0.05$).

Results: There was no difference in inflammatory markers in recovered NEC tissue compared to non-NEC tissue. Active NEC tissue has elevated levels of TNF- α and IL-8 compared to recovered NEC tissue (RTqPCR p=0.014 TNF- α and p=0.049 IL-8). Following NEC inducing in-vitro treatment, recovered NEC enteroids demonstrate elevated levels of inflammatory markers compared to non-NEC enteroids on RTqPCR (p=0.0485 TNF-α, p=0.0057 IL-8) and ELISA (p=0.0354 TNF-α, p=0.0011 IL-8) and no difference compared to active NEC enteroids that underwent treatment. There is a significant increase in recovered NEC enteroids after treatment compared to recovered NEC enteroids without treatment (RTqPCR p=0.0045 TNF-α, p=0.0002 IL-8) (ELISA p=0.034 TNF-α, p=0.0002 IL-8). RNA sequencing shows significant upregulation of hyperinflammatory genes in the treated enteroid groups compared to controls ($p < 0.0001$).

Conclusion: Following the in-vitro second hit with NEC induction treatment, there is a significant upregulation of hyperinflammatory genes in enteroids from patients that have recovered from NEC. Active NEC tissue has an elevated hyperinflammatory response compared to recovered NEC tissue and non-NEC tissue. However, recovered NEC enteroids have a heightened inflammatory response in response to a second hit no different than in active NEC enteroids following the second hit NEC inducing treatment. This tendency towards an increased hyperinflammatory state may be correlated with an infant's proclivity to develop NEC and demonstrates the significance of a second hit post-recovery. This may impact the trajectory of an illness post-recovery from NEC.

Abbreviations: Necrotizing enterocolitis (NEC)
Lipopolysaccharide (LPS)
Tumor Necrosis Factor (TNF)
Interleukin (IL)
RTqPCR
ELISA

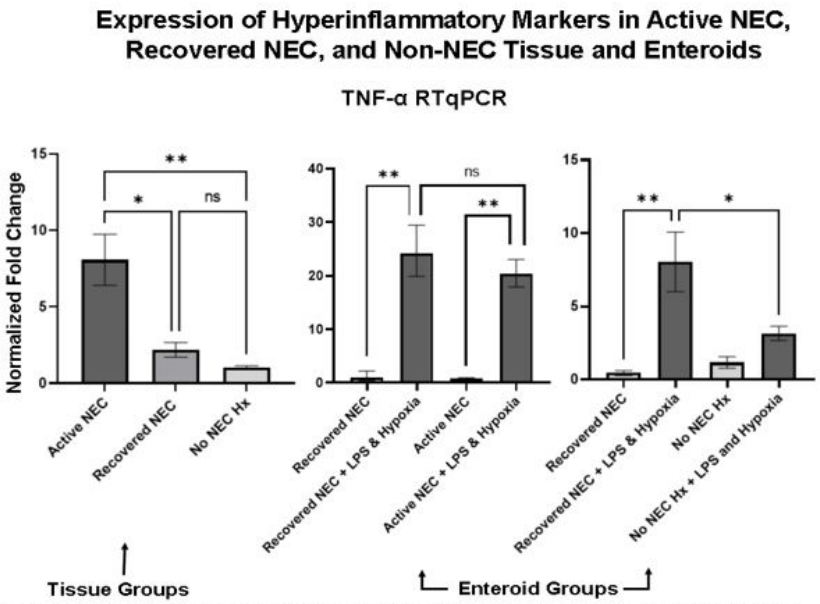

Figure 1: Active NEC tissue has a significalty elevated level of TNF-α compared to both recovered (p=0.01) and non-NEC tissue (p=0.006). There is no significant difference seen between recovered NEC enteroids and active NEC enteroids after undergoing NEC inducing treatment. There is a significant difference between recovered NEC enteroids and non-NEC enteroids after undergoing treatment (0.04).

APSA QS 42

CLINICAL PREDICTORS OF SPONTANEOUS INTESTINAL PERFORATION VS NECROTIZING ENTEROCOLITIS IN EXTREMELY AND VERY LOW BIRTH WEIGHT NEONATES

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Abstract: Purpose
Spontaneous intestinal perforation (SIP) and necrotizing enterocolitis (NEC) are distinct disease processes associated with significant morbidity and mortality, particularly in extremely low (ELBW) and very low birth weight (VLBW) neonates. Early and accurate diagnosis is important as appropriate treatment, laparotomy (LP) versus initial trial of peritoneal drainage (PD), is key to improving outcomes. However, both clinical presentations often overlap and can be difficult to distinguish preoperatively. Our study investigated clinical characteristics associated with each diagnosis and constructed a scoring algorithm for accurate preoperative diagnosis.

Methods
A cohort of ELBW (< 1000g) and VLBW (< 1500g) neonates surgically treated for suspected SIP or NEC between 07/2004-09/2022 (n=367) at two level IV NICUs were reviewed. Patients with incomplete charts, transfers or death immediately following drainage, or patients treated for NEC medically prior to diagnosis, were excluded. Clinical characteristics evaluated included gestational age (GA), birth weight, feeding history, preoperative physical exam, and laboratory/radiological findings. Intraoperative diagnosis was used to determine SIP vs NEC. Pre-drain diagnosis was used for patients treated with PD only.

Results
338 neonates were managed for SIP (n=269, 79.6%) vs NEC (n=69, 20.4%). PD was definitive treatment in 146 (43.2%) patients. Seventy-five (22.2%) patients were treated with upfront LP. There were no significant differences in birth weight, gender, or race/ethnicity. Clinical characteristics associated with SIP compared to NEC included younger GA, younger age at initial laparotomy or drainage (ALD), and history of trophic or no feeds. Abdominal wall erythema, pneumatosis on X-ray, goal or advancing feeds, and higher c-reactive protein test were associated with NEC. Multivariate logistic regression determined pneumatosis, abdominal wall erythema, higher ALD and history of feeds to be highly predictive of NEC. A 0-8-point scale based on these risk factors was designed with the area under the receiver operating characteristic curve of 0.804 (95% CI 0.737-0.871) for the diagnosis of NEC. A threshold score of 1.5 had a specificity of 0.903 and sensitivity of 0.641.

Conclusion
Utilizing important clinical characteristics associated with SIP & NEC we developed a point of care scoring system designed to assist surgeons accurately distinguish SIP vs NEC in VLBW/ELBW neonates.

Abbreviations: SIP: Spontaenous Intestinal Perforation
NEC: Necrotizing Enterocolitis
ELBW: Extremely low birth weight
VLBW: Very low birth weight
LP: Laparotomy
PD: Peritoneal Drainage
GA: Gestational Age
ALD: Age at initial laparotomy or drainage

APSA QS 43

INVESTIGATING THE OPTIMAL TIMING FOR RESECTION OF CONGENITAL PULMONARY AIRWAY MALFORMATIONS, A NSQIP STUDY

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Abstract: Introduction: Resection of congenital pulmonary airway malformations (CPAM) is recommended to reduce infection risks and malignant transformation. The optimal timing for surgery is unknown. This study evaluates the relationship between a patient's age and weight at surgery and outcomes of surgery.

Methods: We queried the National Surgical Quality Improvement Program Pediatric database (2017-2021) for CPAM resections in patients aged 0-17 years. Patients were categorized by age (0–8 months, n=868; >8 months to 17 years, n=876) and weight (0-8 kg, n=821; >8 kg, n=922).Bivariate and regression analysis were performed.

Results: Patients > 8 months had 86% lower odds of unplanned intubation (OR: 0.14, 95% CI: 0.03-0.62, p=0.0092) and 57% lower odds of other bleeding/transfusion events than those 0-8 months old (OR: 0.43, 95% CI: 0.22-0.82, p=0.0100).Those >8kg had 76% reduced odds of pneumonia (OR: 0.24, 95% CI: 0.06-0.98, p=0.0467) and .11 times fewer days from operation to discharge compared to 0-8kg. (IRR: 0.89, 95% CI: 0.83-0.96, p=0.0021). Patients who were >8 months-17 years old had twice the odds of any readmission compared to 0–8-month-olds (OR: 2.02, 95% CI: 1.04-3.92, p=0.0384); however, those who were >8kg had 50% lower odds of readmission compared to 0-8kg (OR: 0.50, 95% CI: 0.26-0.97, p=0.0405). Operation times were longer for both >8 months (IRR: 1.10, 95% CI: 1.09-1.11, p<.0001) and >8kg groups (IRR:1.04, 95% CI: 1.03-1.05, p<.0001). No differences were noted in ventilator dependence, oxygen at discharge, 30-day mortality, surgical site infections, or reoperation/transfusion within 48 hours.

Conclusion: Our findings suggest benefits for pediatric patients > 8 months or > 8kg undergoing CPAM resection compared to those 0–8 months or weighing 0–8 kg. These include reduced risks of unplanned intubation, bleeding or transfusion events, pneumonia, post-surgery length of stay, and readmission rates. However, younger or smaller patients experience slightly shorter operative times. No differences were observed in ventilator dependence, oxygen at discharge, 30-day mortality, SSIs, reoperations, or transfusions in 48 hours prior to surgery. Delaying resection might offer advantages for certain patients that require CPAM resection.

Abbreviations: CPAM: Congenital Pulmonary Airway Malformations
NSQIP: National Surgical Quality Improvement Program
SSI: Surgical Site Infection

Saturday, May 18, 2024

Scientific Session IX - Practice and Innovation
11:15 AM – 12:30 PM

APSA 90

INTESTINAL STEM CELL RENEWAL AND DIFFERENTIATION IN RESPONSE TO MECHANICAL FORCE DURING EPITHELIAL REGENERATION

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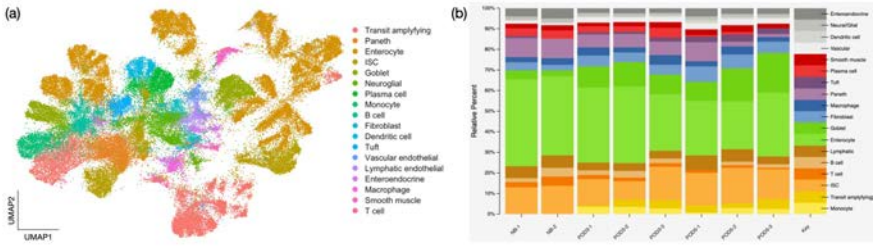
Abstract: Introduction:
The intestine epithelium continually regenerates by proliferation and differentiation of intestinal stem cells (ISC) to specific epithelial cell types, to maintain intestinal homeostasis. While ISC fate is influenced by tissue-wide signals, the impact of mechanical stimulation remains underexplored. Recent findings suggest the essential role of intrinsic mechanical force in epithelial formation during embryonic gut development. Herein, we aim to investigate the stemness and differentiation of ISC under mechanical stimulation during epithelial regeneration. We utilized a partial obstruction model in mice to provide a non-dissipative force exerted into the proximal lumen due to digesta accumulation over time.

Method:
6 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. The density and rate of bifurcation of crypts were measured. Proliferation was evaluated using Ki-67 immunofluorescence. RNA sequencing was performed, and the abundance of member cell types within each sample was imputed by CIBERSORTx. To deconvolve the high-depth tissue transcriptome, a comprehensive single-cell RNAseq atlas of the mouse intestine was utilized as a reference map, following the integration of three published data sets using canonical correlation analysis in Seurat R toolkit.

Results:
The crypt-villus length gradually increased over time. The crypt density decreased, with the maximal reduction on POD3. A significant increase in crypt bifurcation and Ki-67 expression was observed on POD5. These findings suggest that the peak of epithelial regeneration occurs on POD5, following the maximal mechanosensation on POD3. The reference single-cell atlas comprised 82000 cells and 26000 features, within 18 cell clusters (Figure a). Notably, on POD5, we observed a significant increase in the relative fraction of ISC, transit amplifying, goblet, and tuft cells, as opposed to enterocytes (Figure b).

Conclusion:
This study reveals the formation of new epithelium in response to mechanical force. These findings suggest that epithelial growth through mechanical stimulation, may not restrict the stemness of ISC. These insights enhance our understanding of intestinal epithelium regeneration and remodeling, potentially guiding diagnostic and therapeutic strategies for intestinal disorders.

Abbreviations: Intestinal stem cells (ISC),
post-operation days (POD)


(a)
Transit amplyfying
Paneth
Enterocyte
ISC
Goblet
Neuroglial
Plasma cell
Monocyte
B cell
Fibroblast
Dendritic cell
Tuft
Vascular endothelial
Lymphatic endothelial
Enteroendocrine
Macrophage
Smooth muscle
T cell
UMAP2
UMAP1
(b)
Relative Percent

APSA 91

TAPERING MEMBRANE REDUCTION TRACHEOBRONCHOPLASTY FOR WIDE POSTERIOR MEMBRANE IN TRACHEOBRONCHOMALACIA

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Abstract: Background: Tracheobronchomalacia (TBM) is characterized by excessive dynamic airway collapse due to anterior compression, posterior intrusion or malformed cartilage. Posterior tracheobronchopexy addresses TBM due to posterior intrusion but does not directly deal with a widened posterior membrane. We describe an innovative procedure to taper the posterior tracheal membrane and improve cartilage shape, as an adjunct to established TBM surgical approaches.

Methods: Review of patients who underwent tapering membrane reduction tracheobronchoplasty from November 2022 to October 2023 at two institutions. Under bronchoscopic guidance, full thickness marking sutures are placed in the midline of the posterior tracheal membrane in the portion to be tapered. A longitudinal strip of posterior membrane is resected a centimeter at a time with concurrent two-layered longitudinal closure (Figure). Patient characteristics, surgical techniques, and outcomes were reviewed.

Results: 51 patients (male 63%; esophageal atresia 65%) underwent tracheobronchoplasty at median age 28 (IQR 9.5-82) months for primary indication of recurrent respiratory infections (49%), blue spells/brief resolved unexplained events (BRUEs) (23%), inability to wean from positive pressure ventilation (PPV) (8%), prophylactic with concomitant esophageal surgery (8%), inability to extubate (4%), exercise intolerance (4%), and chronic cough (4%). On preoperative bronchoscopy, all patients had bow-shaped cartilage with wide posterior membrane and most (84%) demonstrated complete dynamic airway collapse. Tapered segment was tracheal (69%), bronchial (8%), and both (23%). 67% had resection of tracheal diverticulum included in tapered segment. Concomitant procedures included posterior tracheobronchopexy in all (78% including tapered segment), posterior descending aortopexy (8%), and esophageal repair (31%). With median follow-up 2 (IQR 0-4) months, for primary indication, there were no recurrent blue spells/BRUEs, all patients extubated or weaned from PPV, and there were significantly reduced respiratory infections ($p < 0.001$). Complications included esophageal leak (8%), vocal cord dysfunction (8%), chylothorax (6%), esophageal dilation for dysphagia (6%), revision tracheobronchopexy (2%), and tracheal dilation for stenosis (2%). There were no mortalities.

Conclusions: Tapering membrane reduction tracheobronchoplasty is an innovative technique that is feasible and safe as an adjunct treatment for TBM. In short-term follow-up, there was significant improvement in respiratory outcomes. Further studies are needed to determine its effectiveness in longitudinal follow-up.

Abbreviations:

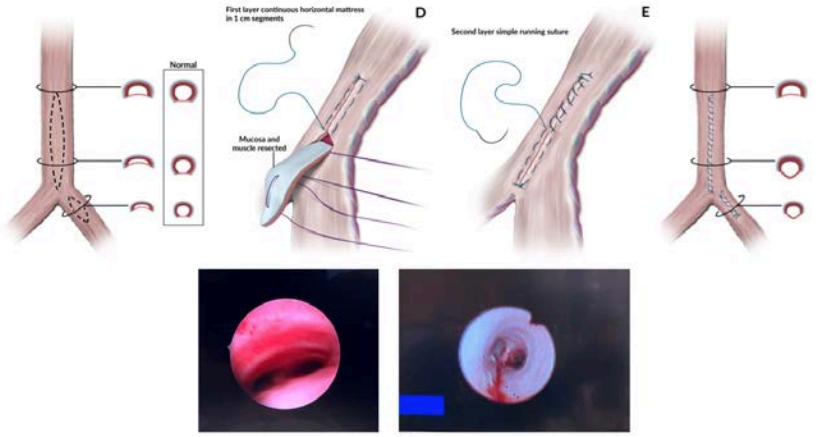

Figure. Tapering Membrane Reduction Tracheobronchoplasty – pre- and postoperative schematic and bronchoscopic views.

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IN VITRO AND IN VIVO TESTING OF A NOVEL 4-IN-1 DEVICE USED IN A PRE-CLINICAL MODEL OF NEONATAL ESOPHAGEAL STRICTURE

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Abstract: Purpose: Esophageal atresia is a congenital defect where the proximal and distal ends of the esophagus fail to connect. Surgical repair may be complicated by postoperative anastomotic stricture, which occurs in approximately 45% of cases. Current treatment involves serial balloon dilations, which require multiple anesthesia events. We have developed a multi-tubular structure with 4 functions (Figure 1): nutrition delivery, balloon dilation, effluent aspiration, and drug delivery. Our study demonstrates device compatibility with gastric and salivary fluids, and functionality and general tolerability in a rabbit model.

Methods: The 4-in-1 device was tested in gastric and salivary fluids, and phosphate buffered saline (control) for 7 weeks, with balloon dilation tests at 1 and 7 weeks. In a cadaver rabbit, the device was tested by dilating against a rubber band (stricture simulation). In a live rabbit, tube feedings were administered through the device after partial esophagectomy. Data was analyzed using student's t-test ($p \leq 0.05$).

Results: The device remained structurally and functionally intact during all experiments. Week 1 testing in gastric fluid revealed an average balloon inflation pressure of 5.98 ATM and a diameter of 6.0 mm. Week 1 salivary fluid testing revealed an average balloon inflation pressure of 7.68 ATM and a diameter of 6.3 mm. Average balloon pressures and diameters were similar at week 7 in both fluid types and the control. In the cadaveric rabbit, the balloon dilator successfully inflated a simulated stricture with an average pressure of 8.64 ATM, and a diameter of 6.61 mm. Comparatively, the commercial balloon dilator exhibited an average pressure of 5.92 ATM and a diameter of 9.22 mm. Post-operatively, the live rabbit tolerated the device and tube feedings without any physiologic complications.

Conclusion: Our novel 4-in-1 device for treating esophageal stricture in neonates exhibits stability in gastric and salivary fluids for 7 weeks, reproducible balloon dilator functionality, and tolerability in a rabbit model. We plan to optimize the device and perform long-term in vivo testing. This device will reduce the number of procedures requiring anesthesia during healing in the neonate afflicted by esophageal atresia, and may be widely applicable across many disease states in the future.

Abbreviations: ATM= atmosphere
mm= millimeter

Figure 1. Complete 4-in-1 esophageal tube. This device would be placed in a neonatal patient using radiographic guidance and would allow for immediate feeding following repair of esophageal atresia, as well as fluid sampling, drug delivery, and serial dilations- all without requiring additional anesthesia.

APSA 93

INTERNAL PROTOTYPE VERIFICATION OF A NOVEL ENDOSCOPIC TREATMENT FOR SHORT BOWEL SYNDROME

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Abstract: Purpose: Distraction enterogenesis is the application of longitudinal forces to small bowel to induce cellular turnover resulting in increased intestinal length. This is important for short bowel syndrome patients with inadequate intestinal length to support growth and development. A catheter-based double ballooned device with novel bowel-gripping ability has been developed to safely apply the distractive forces required to lengthen bowel. The device was designed to meet key user requirements of minimal insertion profile for gastrostomy insertion while minimizing bowel trauma during bowel attachment and device actuation. This experiment was to confirm the performance of, and tissue damage caused by the prototype device design within perfused intestine.
Methods: After IACUC approval (#PRO00011087) small bowel was accessed via midline laparotomy of a Yorkshire pig. The prototype double ballooned catheter-based device was deployed in its intended therapeutic configuration creating distractive strain on the intestine to test grip strength, intraluminal slippage, radial and longitudinal stress. A stand-alone attachment (without longitudinal force) was overinflated to test excessive radial force to assess blood flow bowel adaptation. Visual inspection and photography were performed every 30 minutes with notations made at each timepoint for a period of 2 hours. Intestinal segments were then excised for microscopic evaluation of presence/type/degree of intestinal damage.
Results: Grip strength reached 800g of force of longitudinal stress prior to intraluminal slip in acute testing. All attachments were deployed for 2 hours. No intraluminal slip was noted over the entire experiment with fully functioning prototype when deployed in its intended therapeutic configuration. Attachment overinflation caused blanching and decreased blood flow (Figure 1 A) which recovered at the two-hour timepoint (Figure 1 B). On histologic analysis, all damage was limited to the mucosa and was classified as mild to moderate (Figure 1C and D).
Conclusion: A novel enterogenesis prototype incorporating novel bowel-gripping material provided adequate grip strength to safely deliver the required distractive forces to induce cellular turnover in acute live animal testing. This serves as the final step to concept freeze and provided confidence to move forward with commercial manufacture under design specifications and design controls.

Abbreviations:

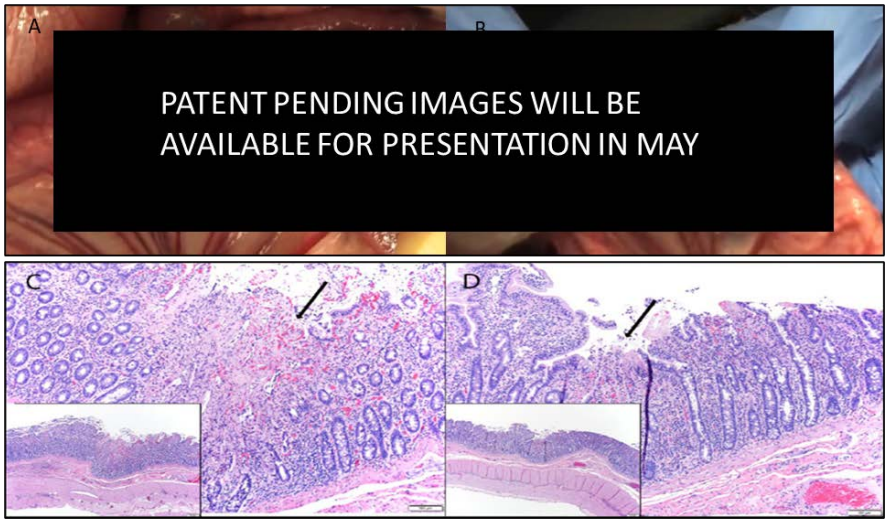

Figure 1. Overinflated attachment showing decreased blood flow (A) that recovers to full perfusion by two hours (B). Lower panel: representative microscopic images showing blunting of Villi and focal mucosal erosion at the attachment in the fully functioning prototype (C) and the overinflated attachment (D).

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TELEMEDICINE PRACTICE PATTERNS AND LIMITATIONS FOR PEDIATRIC SURGEONS POST-PANDEMIC: WHAT HAVE WE LEARNED?

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Abstract: Purpose: Telemedicine facilitated safe, ongoing patient care during the COVID-19 pandemic. Prior studies evaluating telemedicine demonstrated benefits in patient satisfaction, efficiency, and cost-effectiveness. As many elements of surgical practice return to pre-pandemic patterns, the continued role of telemedicine is unclear. We explored the current application of telemedicine among pediatric surgeons, including perceived benefits and barriers to its implementation.

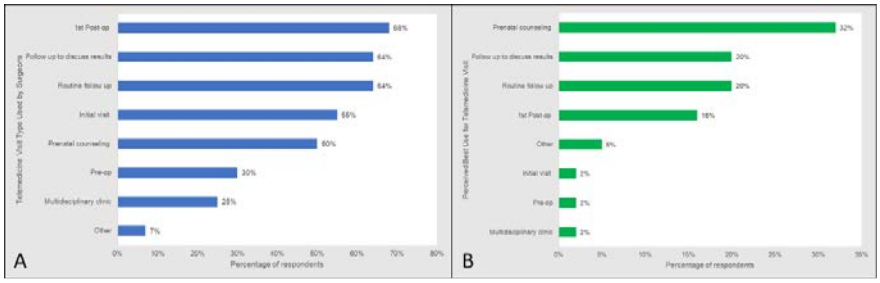
Methods: An anonymous REDCap survey was distributed electronically to 160 pediatric surgeons at 19 hospitals in a regional research consortium. Responses were collected from July to September 2023. Descriptive and thematic analyses were performed.

Results: The survey was completed by 44 surgeons (27.5% response rate), 61% of whom were female. Eighteen percent of providers regularly used telemedicine visits (>11 per month), 60% sometimes (1-6 per month) and 16% not at all. Surgeons used telemedicine across a variety of reasons (Figure 1) but felt the platform was most appropriate for prenatal counseling (32%), routine follow-up (20%), or discussion of diagnostic results (20%). The greatest perceived benefits were expanded outreach to non-local patients (80%), decreased patient cost and travel time (100%), and decreased interference with family schedule (84%). Technology issues (70%), clinical staff support (25%) and patient timeliness (20%) were the greatest limitations for surgeons. Thirty-six percent of surgeons felt telemedicine provided lower quality visits, with the main reason cited as a lack of a physical exam. Aspects of telemedicine that are most needed for successful visits include technology support (57%), patient navigator (55%), translator services (52%), and set telemedicine clinic blocks (30%). While 71% of respondents were satisfied with telemedicine and 73% would continue to offer these visits, a higher proportion of surgeons (91%) were

willing to do so if limitations were addressed.

Conclusion: While telemedicine was utilized out of necessity during the pandemic, most pediatric surgeon respondents are satisfied with telemedicine and will continue to offer it to patients. Resolving technologic issues, providing greater administrative support, streamlining translator services, and establishing virtual clinic blocks may address important impediments to more widespread adoption. Continued support of telemedicine, from the individual provider to the federal level, will increase patient access to pediatric surgical care.

Abbreviations:



APSA 95

NIH FUNDING FOR THE PEDIATRIC SURGEON-SCIENTIST: AN ANALYSIS OF CURRENT TRENDS

Colton D. Wayne, MD[1], Zachary Dumbauld, BS[2], Ethan Mills, BS[3], Diana Farmer, MD[4], Gail E. Besner, MD[5]

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Abstract: Purpose:
Previous studies a decade ago highlighted the success of pediatric surgeons in obtaining federal NIH funding. However, given increasing clinical demands on surgeons, a current concern is a potential decline of federal funding to support pediatric surgical research. This study analyzed the current state of NIH funding for pediatric surgeon-scientists.

Methods:
APSA membership in August 2023 was filtered for Regular/Associate members. These surgeons were referenced through NIH RePORTER from 1985-present. Information collected included history of prior/active funding, award type, and NIH funding institutes. Demographics collected from open-source institutional websites included level of professorship, MD vs. MD/PhD, and sex. Academic productivity was assessed using PubMed for publications from 2013-2023. Pathways to funding was noted as R01/equivalent success with/without prior training grants.

Results:
1,079 APSA Regular/Associate members were identified for analysis. 149 (13.8%) surgeons had previous or current NIH funding, with 145 having complete funding information available for analysis. There were 1,229 awards totaling $387,148,625. 52 (4.8%) surgeons had current NIH awards totaling $44,232,644. Of the 149 surgeons with previous or current funding, 31.7% held chair/chief positions, 77.9% were male, and 84.1% had MD (without PhD) degrees. 925 (75.3%) of the 1,229 awards were R01 or equivalent (non-training) grants. Of 145 surgeons with complete funding information, 98 (67.6%) obtained an R01/equivalent grant without any prior training grants, and 34 (23.4%) had prior training grants. Regarding K award training grants, 165 were K08 awards for basic science research and 10 were K23 awards for clinical research. Academic productivity measured by publications in the past decade revealed 7,197 total publications (range=0-207, mean=49.6). 30.4% of awards were from NIDDK, 20.1% from NICHD, 15.6% from NHLBI, 8.23% from NIGMS, and 5.79% from NIAID.

Conclusion:
Although percentages indicate a slight downward trend over the past 10 years in the proportion of funded APSA Regular/Associate members, the volume of funded pediatric surgeon-scientists and total active NIH funds awarded has actually increased. Progress must be made in supporting young faculty, particularly females, in research and academic pediatric surgery. Senior faculty have a responsibility to foster mentorship opportunities and protect academic/research time to promote continued success for pediatric surgeon-scientists.

Abbreviations: NIH - National Institutes of Health
APSA - American Pediatric Surgical Association
NIDDK - National Institute of Diabetes and Digestive and Kidney Diseases
NICHD - National Institute of Child Health and Human Development
NHLBI - National Heart, Lung, and Blood Institute
NIGMS - National Institute of General Medical Sciences
NIAID - National Institute of Allergy and Infectious Disease

APSA 96

IMPACT OF LOCUM TENENS PROVIDERS ON DELIVERY OF PEDIATRIC SURGICAL CARE

Lindsey L. Wolf, MD, MPH[1], Jason C. Fisher, MD[2], David E. Skarda[3], Scott S. Short, MD[4], Romeo C. Ignacio, Jr., MD[5], Hau D. Le, MD[6], Kyle Van Arendonk, MD PhD[7], Kenneth Gow, MD, MHA[8], Richard D. Glick, MD[9], Yigit Guner, MD, MS[10], Hira Ahmad, MD[11], Melissa E. Danko, MD[12], Cynthia D. Downard, MD, MMSc[13], Mehul V. Raval[14], Daniel J. Robertson, MD[15], Richard G. Weiss, MD[16], Barrie S. Rich, MD[9]

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Abstract: Purpose: Locums tenens pediatric surgeons provide essential coverage across the United States. We sought to understand the prevalence, characteristics, and impact of locums use on the delivery of pediatric surgical care.

Methods: We conducted a cross-sectional survey of pediatric surgical practices at Children's Hospital Association member sites. Anonymous electronic surveys were distributed to surgical leaders at each site via REDCap. The survey investigated locums utilization, frequency and primary reason for use, limitations on clinical activities, and variations in practice standards or quality during coverage. Chi-squared and Fisher's exact tests were used to compare categorical variables. Multivariable logistic regression was performed to evaluate for associations between site demographics and use of locums.

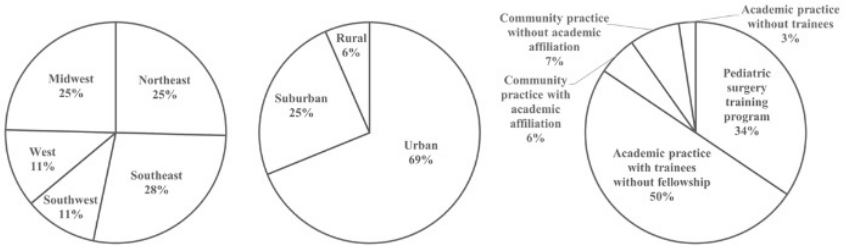
Results: Surveys were completed by 122 of 172 practices (71%) (Figure). Among respondents, median hospital size was 203 beds (IQR: 130-350). Median number of surgeons per group was 5 (IQR: 3-8). Thirty-seven groups (30%) employed locums at their primary (n=27) or satellite (n=12) practice sites. Multivariable logistic regression showed locums utilization was higher in suburban (OR=3.8; 95%CI=1.5-9.7; p=0.006) and rural (OR=5.0; 95%CI=1.1-23; p=0.04) locations. Sites with a level 4 NICU were less likely to use locums (OR=0.4; 95%CI=0.1-0.9; p=0.04). Most (51%) used locums ≥1 time per month but < 1 time per week and for ongoing or interim coverage needs (92%). Clinical activity restrictions for locums were reported in 14% of practices, including limitations on ECMO, operative trauma, and neonatal index cases. Notably, 76% of groups using locums reported variations in practice standards or quality, which were all perceived as negative (57%) or neutral (43%).

Conclusion: Locums tenens providers are utilized by nearly one-third of pediatric practices surveyed. They are more frequently employed in suburban and rural sites and in hospitals without the highest level neonatal intensive care. While locums are critical to maintaining access to pediatric surgical care where gaps exist, there is a need to improve the quality and reliability of care rendered during locums coverage.

Abbreviations: NICU: neonatal intensive care unit
ECMO: extracorporeal membrane oxygenation
IQR: intraquartile range
OR: odds ratio

CI: confidence interval

Figure. Characteristics of responding practices



APSA 97

THE ONLY CONSTANT IS CHANGE: A LONGITUDINAL ANALYSIS OF WOMEN'S REPRESENTATION ACROSS AMERICAN PEDIATRIC SURGICAL ASSOCIATION (APSA) COMMITTEE LEADERSHIP

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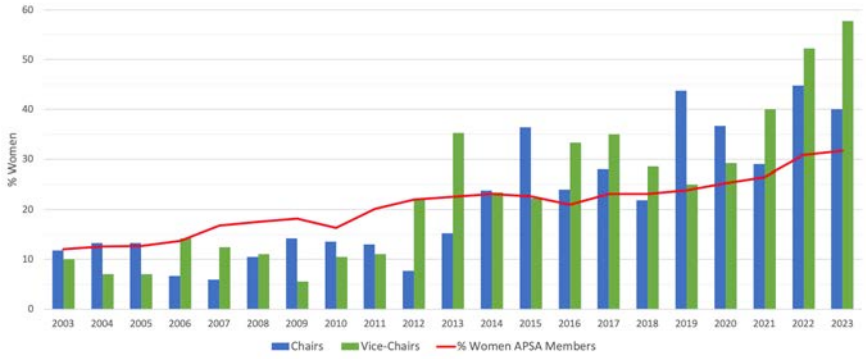
Abstract: Purpose
Women have historically been underrepresented in surgical leadership, in academia, and in specialty organizations. The purpose of this study was to examine the longitudinal gender distribution of committee leadership within the American Pediatric Surgical Association (APSA).

Methods
Annual APSA committee leadership rosters from 2003-2023 were obtained. If not self-reported in the roster, gender of committee chairs and vice-chairs was classified based upon review of publicly available data including institutional websites, social media platforms, and professional web pages. The number of women and men who served as chairs and vice-chairs were quantified by committee and by year.

Results
Overall, the proportion of women serving as APSA committee chairs and vice-chairs increased from 11% to 48% during the study period, yielding a mean annual rate of change of +1.9% [Figure 1]. The most substantial periods of diversification occurred in 2014 (+6.3%), 2018 (+11.2%), and 2021 (+14.2%). The year 2013 was the first time that the proportion of women chairs and vice-chairs (23%) surpassed the proportion of women APSA members (22%) and this pattern has persisted over the last 10 years [Figure 1]. In examining the positions separately, the proportion of women committee chairs increased from 12% to 40% while women vice-chairs increased from 10% to 58%. A total of 28 distinct committees were identified during the 20-year period. The committees with the highest cumulative proportion of women chairs were Benjy Brooks (100%), Diversity Equity & Inclusion (100%), Global Pediatric Surgery (67%), and Ethics (62%). Five committees (17.6%) have yet to be led by a woman chair – these include Trauma, Fetal Diagnosis & Treatment, Access to Surgery for Kids, Practice, and Professional Development. Five committees that traditionally have had significant impact on organizational workflow, agendas and education all had cumulative proportions of women chairs of less than 50% – Education (33.3%), Publications (28.6%), Outcomes (19%), Surgical Quality & Safety (18.8%) and Program (9.5%).

Conclusion
These results demonstrate encouraging trends in the gender diversity of APSA leadership. However, this progress does not appear to be evenly distributed; leadership of certain key committees continues to lack substantial women representation.

Abbreviations: APSA - American Pediatric Surgical Association


60
50
40
30
20
10
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% Women
2003
2004
2005
2006
2007
2008
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2011
2012
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2014
2015
2016
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2018
2019
2020
2021
2022
2023
Chairs
Vice-Chairs
% Women APSA Members

APSA 98

IMPACT OF THE FDA PEDIATRIC DEVICE CONSORTIA PROGRAM: A 15-YEAR SINGLE PROGRAM EXPERIENCE

Thomas A. Sorrentino, MD[1], Caressa Chen, MD[2], Tejas S. Sathe, MD[1], Vinith Johnson, BS[1], Usha Thekkedath, MD[1], James Wall, MD[3], Shuvo Roy, PhD[1], Michael Harrison[4], Hanmin Lee, MD[1]

[1]University of California, San Francisco, San Francisco, CA, USA, [2]Loyola University Chicago, Maywood, IL, USA, [3]Stanford University, Stanford, CA, USA, [4]UCSF

Abstract: Purpose

The development and availability of biomedical devices for children is consistently inferior to those for the adult population. To address the need for further advancements in pediatric device development the U.S. Food and Drug Administration (FDA) formed the Pediatric Device Consortia (PDC) Grant Program in 2009, an initiative that now supports five PDCs nationwide to stimulate projects and the advancement of pediatric medical devices. Here, we report the structure and impact of the only continuously funded PDC program.

Methods

Our PDC is a joint program between two academic pediatric surgery divisions and engineering departments and assists pediatric device innovators from idea through post-commercialization activities (Fig. 1). We host a weekly Innovator's Forum where teams developing pediatric devices obtain advice and connections to the extended PDC network consisting of clinicians, engineers, regulatory experts, IP attorneys, and medical technology executives. We run a yearly PDC Pitch Accelerator Competition, where teams compete for up to $100k in non-dilutive funding to develop new pediatric devices. Ongoing engineering and clinical support are offered through alliances with local universities, accelerators, and our Surgical Innovation program. Finally, we use Real World Evidence (RWE) methods to characterize off-label use of devices in pediatrics and partner with companies to expand product labeling for pediatric indications.

Results

Our PDC is the only continuously funded group since the program's inception in 2009, including a renewal in the 2023 grant cycle. Over 500 projects have been advanced via the Innovator's Forum. We have awarded $1.4 million in funding through the Pitch Accelerator Competition and facilitated $130 million in add-on funding. Twelve PDC-affiliated companies have gone from concept to First-in-Human studies, and twelve products are available in the market. One device received pediatric-specific use labeling from an RWE study. An estimated 20,000 children have been positively impacted by technologies developed through our PDC.

Conclusion

Pediatric device development remains an ongoing challenge due to small patient population and market size. Leveraging broad expertise in medical technology development and backed by the FDA, our PDC has successfully nurtured groundbreaking pediatric devices into the market and can serve as a model for others to replicate.

Abbreviations: FDA - Food and Drug Administration
PDC - Pediatric Device Consortium
RWE - Real World Evidence

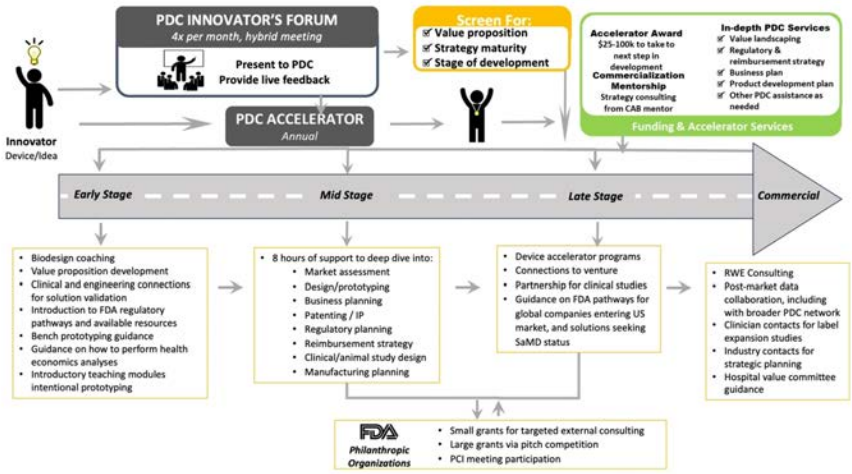

Figure 1: Overview of our Pediatric Device Consortium's intake process, direct services, and longitudinal adjunct services to assist in development of pediatric medical technologies from ideation to commercialization.

Scientific Session VII - Trauma

11:15 AM – 12:30 PM

APSA 108

ENHANCING PEDIATRIC TRAUMATIC BRAIN INJURY OUTCOMES: EVALUATING THE BENEFITS OF VENTRICULOSTOMY COMPARED TO INTRACRANIAL PRESSURE MONITORING ALONE

Utsav M. Patwardhan, MD[1], Richard Y. Calvo, PhD, MPH[2], Laurinda Jackson, MD MPH[2], Casey Erwin, MD[2], Benjamin Havko, DO[2], Andrea Krzyzaniak, MA[2], Michael Sise, MD[2], Vishal Bansal, MD[2], Benjamin Keller, MD[1], Vijay Ravindra, MD[1], Hari Thangarajah, MD[1], Romeo C. Ignacio, MD[1]

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Abstract: Purpose
There is conflicting evidence regarding the effectiveness of intracranial pressure monitoring (ICP) with or without ventriculostomy (VT) in severe pediatric brain injury. We compared outcomes between ICP only versus VT using a nationwide database of pediatric trauma patients.
Methods:
Pediatric patients (< 18 years) with severe blunt TBI who underwent ICP with or without VT were identified from the 2017–2021 ACS Trauma Quality Programs data. We excluded patients who experienced death or craniotomy/craniectomy within 48 hours of admission. Primary outcomes included mortality and discharge location. Secondary outcomes were subsequent intracranial surgery (craniotomy or craniectomy), length of stay (LOS), and infectious complications. Competing risks survival analysis was used to evaluate the multivariable association between ICP vs. VT and outcomes.
Results:
Of 1,719 eligible patients, 65.9% were male and 54.1% had VT. Between ICP and VT groups, there were no differences in mean age (11.4 vs. 11.0 years, p=0.145), injury severity score (30.9 vs. 30.9, p=0.937), or median GCS (3 vs. 3, p=0.120). VT patients demonstrated higher mean head abbreviated injury score (AIS) (4.3 vs. 4.2, p=0.048) and were more likely to have had a fall or assault (12.6% vs. 9.1%, p=0.036). Fewer VTs were placed at stand-alone Level I/II pediatric trauma centers compared to combined Level I adult/pediatric or Level I/II adult centers (24.3%, 30.8%, 30.0%, p=0.001). Multivariable analysis (Table 1) showed a robust association between VT and discharge home (compared to rehabilitation center; sHR 0.85, 95% CI 0.74–0.97, p=0.017). VT use was not associated with increased mortality compared to ICP (p=0.342). Finally, VT patients had longer median LOS (20.5 vs. 18.0 days, p< 0.001) but there was no difference in the need for subsequent craniotomy/craniectomy (8.6 vs. 6.5%, p=0.096) or risk of infectious complications (1.2 vs. 0.9%, p=0.549).
Conclusion:
Contrary to recently published literature, VT was associated with greater discharge to home after accounting for mortality. Although VT patients had a greater LOS, the risk for other secondary outcomes did not vary, suggesting that VT may have benefits for the treatment of severe TBI.

Abbreviations: ICP: Intracranial pressure monitoring. VT: Ventriculostomy. TBI: traumatic brain injury. LOS: Length of stay. GCS: Glasgow Coma Scale. AIS: Abbreviated Injury Score.

APSA 109

A STATEWIDE RETROSPECTIVE ANALYSIS OF RURAL VERSUS URBAN PEDIATRIC TRAUMA RECIDIVISM

Matthew D. Price, MD MPH[1], Katherine M. McDermott, MD[2], Charbel Chidiac, MD[2], Paul Phan, BS[3], Mark B. Slidell, MD MPH[4], Isam Nasr, MD[2]

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Abstract: Purpose: Despite increasing attention to the management of rural pediatric traumatic injury, there is a paucity of data on patterns of trauma recidivism in this population. We sought to identify differences in frequency and severity of reinjury among rural versus urban patients in a statewide pediatric healthcare database.

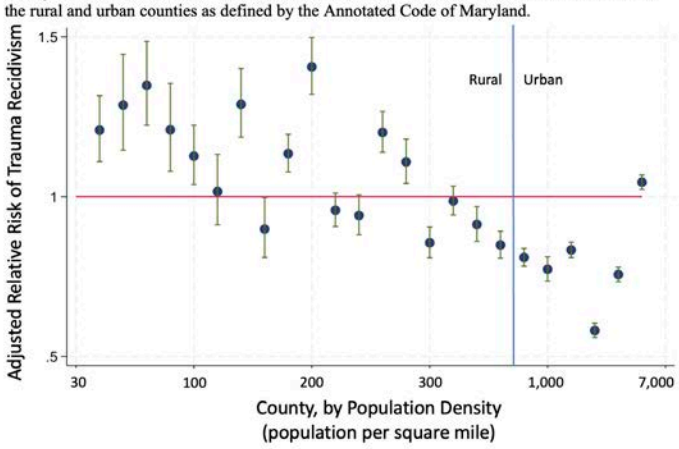
Methods: Patients 0-14 years of age who presented to any emergency department in Maryland with a traumatic injury between 2013 and 2019 were identified in the Maryland Health Services Cost Review Commission (HSCRC) Database. Urban versus rural was defined by patients' county of primary residence. Primary outcomes were one-year trauma recidivism, defined as any presentation for a new traumatic injury, and inpatient recidivism, defined by new traumatic injury requiring inpatient admission for treatment. Univariate and multivariable regressions were used to estimate the odds of recidivism associated with rural versus urban residence, adjusting for demographic and injury characteristics. County-level heterogeneity was explored using an adjusted hierarchical model.

Results: Of 388,003 traumatic injury presentations, 28% of patients lived in rural counties. Rural patients had a higher crude rate of recidivism (15.6% versus 13.1%, $p < 0.001$) but a lower rate of inpatient recidivism (0.3% versus 0.5%, $p < 0.001$). Rural residence was associated with increased odds of recidivism in unadjusted (OR 1.22 [95% CI: 1.20-1.25]) and adjusted (aOR 1.20 [95% CI: 1.19-1.23]) models. On multi-level analysis, relative risk of recidivism by county varied from 0.85 to 1.40 among rural counties and 0.58 to 1.05 among urban counties; adjusted relative risk of recidivism was equal to or higher than the state average in 83% of rural counties but only a single urban county (Figure 1). Only one county with a population density less than 300 per square mile had a lower relative risk of recidivism.

Conclusion: Trauma-related emergency department recidivism is more prevalent in rural communities of Maryland, though rarely associated with injuries severe enough to warrant hospital admission. These findings suggest that emergency department-based interventions to reduce pediatric re-injury—and/or to improve utilization of non-emergency department care settings for minor injuries—may be especially impactful in rural settings.

Abbreviations: Health Services Cost Review Commission (HSCRC) - defined in the abstract text.

Figure 1: **Population density and adjusted county-level risk of pediatric trauma recidivism relative to statewide risk of recidivism among rural and urban counties in Maryland.** Each dot represents the relative risk (95% confidence interval) of early recidivism for an individual county. The red line denotes the overall statewide risk for recidivism and the blue line divides the rural and urban counties as defined by the Annotated Code of Maryland.



APSA 110

VARIABLE IMPACT OF THE APSA SOLID ORGAN INJURY GUIDELINES: DECLINING SPLENECTOMY RATES IN PEDIATRIC CENTERS COUNTERED BY RISING SPLENECTOMY RATES IN ADULT TRAUMA CENTERS AND INJURED ADOLESCENTS

Charbel Chidiac, MD[1], Mahmoud El Baassiri, MD[2], Matthew D. Price, MD MPH[3], Daniel S. Rhee, MD, MPH[1], Shaun M. Kunisaki, MD, MSc[4], Isam Nasr, MD[1], Mark B. Slidell, MD MPH[5]

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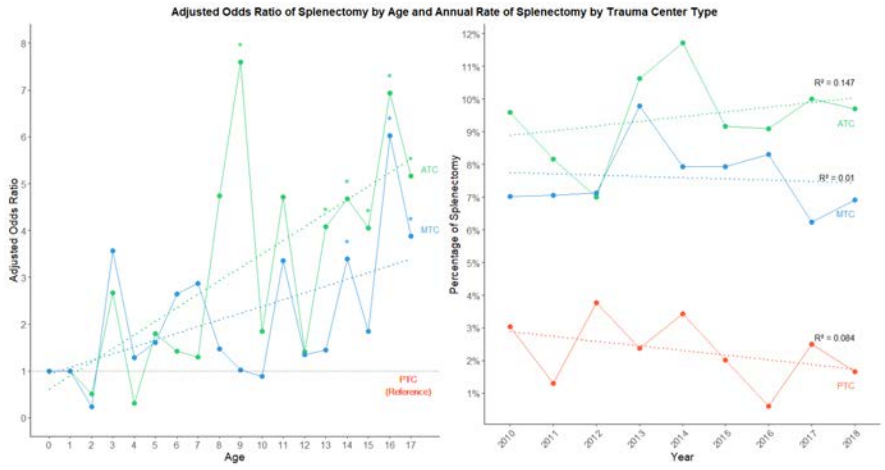
Abstract: Purpose:
Splenectomy rates for blunt solid organ injury in children have gradually declined as nonoperative management has proven successful for many patients. Wide adoption of APSA Solid Organ Injury Guidelines may play a role in this. While higher splenectomy rates have been observed for injured children treated in adult trauma centers, we hypothesized that these splenectomy rates would be in decline as nonoperative management became more widely accepted for injured children.

Methods:
Retrospective analysis of children ≤17 years in 2010-2018 National Trauma Database (NTDB) who sustained blunt splenic injury (BSI). ACS and/or state designated Pediatric (PTC), Mixed (MTC), and Adult Trauma Centers (ATC) were compared. Multivariate logistic regression by age, adjusting for injury severity score (ISS), to assess the likelihood of undergoing splenectomy.

Results:
12,843 children with BSI were included. Of those, 3,129 (24.8%) were treated at PTC, 4,524 (35.2%) at MTC and 5,190 (40.4%) at ATC. There were 4,324 (33.7%) females; median age of 14 (IQR 9-16) and median ISS of 17 (IQR 9-27). Rate of splenectomy was significantly higher in ATC compared to MTC and PTC (8.22% vs. 5.76% vs. 1.85%, respectively,$p< 0.001$). This difference was particularly pronounced at ages 13 to 17 ($p< 0.001$). On multivariate analysis, odds of splenectomy were greater at ATC (aOR 2.3, 95%CI 2.43-4.32,$p< 0.001$) or MTC (aOR 2.3, 95%CI 1.72-3.09,$p< 0.001$) compared to PTC. When stratified by age, odds of splenectomy were higher at ages 13 to 17 (aOR 4.08, 4.68, 4.05, 6.93, 5.16, respectively, $p< 0.005$) if treated at ATC, and at ages 14 (aOR 7.59,$p=0.031$), 16 (aOR 7.59,$p=0.003$), and 17 (aOR 3.88,$p=0.026$) if treated at MTC. Splenectomy rate declined in PTCs over the 9-year study period, while it rose in ATCs, though not statistical significant ($p=0.74$ ATC, $p=0.39$ MTC, $p=0.46$ PTC).

Conclusion:
Splenic salvage rates after BSI are better at PTCs and MTCs versus ATC for adolescents, 13 to 17. APSA Solid Organ Injury Guidelines may be driving a decline in splenectomies in Pediatric Centers, but this appears to be countered by rising splenectomy rates in Adult Trauma Centers and among injured adolescents. These findings may guide education efforts and State trauma guidelines and policy.

Abbreviations: aOR - adjusted Odds Ratio
ATC - Adult Trauma Center
BSI - Blunt Splenic Injury
ISS - Injury Severity Score
MTC - Mixed Trauma Center
NTDB - National Trauma Database
PTC - Pediatric Trauma Center


Adjusted Odds Ratio of Splenectomy by Age and Annual Rate of Splenectomy by Trauma Center Type
Adjusted Odds Ratio
Age
ATC
MTC
PTC
(Reference)
Percentage of Splenectomy
Year
R² = 0.147
R² = 0.01
R² = 0.084
ATC
MTC
PTC

APSA 111

HIGH VOLUME, PEDIATRIC TRAUMA CENTERS ARE ASSOCIATED WITH IMPROVED MORTALITY IN SEVERE PEDIATRIC TBI

Andreina Giron, MD[1], John Schomberg, PhD, MPH[1], Amy Lawrence, MD[2], Laura F. Goodman, MD, MPH[3], Peter T. Yu, MD, MPH[3], Yigit Guner, MD, MS[4], Alice M. Martino, MD[5], Danh Nguyen, PhD[6], Jeffry Nahmias, MD MHPE[7], Brian Hanak, MD[8], Joffre Olaya, MD[9]

[1]Children's Hospital of Orange County, Orange, CA, USA, [2]Children's Hospital of Orange County, Orange, CA 92868, CA, USA, [3]Children's Hospital of Orange County and University of California - Irvine, Orange, CA, USA, [4]Children's Hospital of Orange County and University of California Irvine, Orange, CA, USA, [5]Department of Surgery, University of California Irvine Medical Center, Orange, CA, USA, [6]University of California Irvine, [7]University of California Irvine, Orange, CA, USA, [8]Children's Hospital Orange County , [9]Children's Hospital of Orange County

Abstract: Background: Traumatic brain injury is a leading cause of death and disability among severely injured children. Management guidelines have improved outcomes, but there remains heterogeneity. High case volumes in hospitals have been linked to improved outcomes. This study aimed to explore the association between hospital case volume and traumatic brain injury (TBI) outcomes in the pediatric severe TBI population.

Methods: We analyzed 2017-2019 data from the National Trauma Data Bank (NTDB). The focus was on patients under 19 with severe TBI (Glasgow coma score <=8). Hospitals were grouped by case volumes: High-volume (n=4432) if they surpassed a median case volume of 18.3, and Low-volume (n=8178) otherwise. We further divided facilities by volume tertiles and used multivariate mixed effect logistic regression to study the link between hospital volume and mortality, considering confounding factors.

Results: Of 83,579 TBI patients, 12,268 had severe TBI. The mortality rate was 24.7%. In the mixed effect logistic regression analysis, high-volume hospitals had a 3% drop in mortality OR .97, 95% CI .95-.99, p-value=.006). Younger patients (under 10) had lower mortality risks (OR = 0.92, 95% CI = 0.90 to 0.96, p <.0001). Lack of VTE prophylaxis use increased mortality risks (OR = 1.31, 95% CI = 1.29 to 1.34, p < .0001), and so did use of blood product (OR = 1.28, 95% CI = 1.25 to 1.30, p = 0.002). Reports of abuse correlated with reduced mortality (OR = 0.85, 95% CI = 0.82 to 0.88, p = 0.03). Greater injury severity and treatment at adult-only facilities raised mortality risks (OR=1.02, 95% CI =1.00-1.03, p-value=.01). High tertile of Total volume Centers without pediatric designation also had higher mortality risks (OR: 1.06, 95% CI: 1.04-1.09, p < 0.0001).

Conclusion: In-hospital mortality was lower for pediatric severe TBI patients treated in high-volume centers with pediatric center status. There may be benefits to concentrating TBI patient care in high-volume hospital settings with pediatric designation. Further research into the underlying factors contributing to the observed mortality reduction in high-volume hospitals is warranted to optimize TBI patient outcomes.

Abbreviations: TBI: traumatic brain injury
NTDB: National Trauma Data Bank

APSA 112

WORKUP AND MANAGEMENT OF PNEUMOMEDIASTINUM IN ISOLATED BLUNT PEDIATRIC TRAUMA

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Abstract: Purpose: Children and adolescents who sustain blunt trauma to the neck and chest may present to the emergency department (ED) with isolated pneumomediastinum. Despite the generally benign course, evaluation and management of these children are highly variable.
Methods: A five-year (2016-2021) multi-institutional retrospective chart review of children (< 18-years) with a primary diagnosis of spontaneous pneumomediastinum was performed at ten pediatric hospitals. Presentation, workup, management, and outcomes were evaluated.
Results: Of 685 patients with pneumomediastinum, 50 (mean age 14.0y, SD 3.7y; 70% male) reported blunt trauma to the neck or chest prior to their ED presentation. The type of blunt trauma included 50% sports-related (n=25), 24% falls (n=12), 14% transportation (bike/motor vehicle; n=7), 12% assaults (n=6), and 8% other (n=4). In the ED, 76% of children reported pain (n=38), 28% shortness of breath (n=14), and 18% abnormal voice/swallowing (n=9). Seventy-four percent of patients (n=37) were transferred from an ED to the receiving ED, and another 10% (n=5) were direct admissions to the floor; 34% (n=17) were discharged from the ED. Pediatric surgery was involved in the evaluation of 90% of patients with blunt trauma-associated pneumomediastinum. Median length of stay was 23.9h (IQR 16.7-40.0). Two patients had intensive care admissions, both with bicycle handlebar trauma to the neck. Four patients (8%) underwent direct laryngoscopy/flexible bronchoscopy evaluating the posterior oropharynx; one small tracheal injury was identified and managed non-operatively. Imaging included multiple chest x-rays in 46% of patients (n=23), esophagram in 36% (n=18), and CT of the neck and/or chest in 66% (n=33). There were no esophageal leaks identified. Imaging demonstrated an incidental pneumothorax in 14% (n=7), none of which required intervention. No patient with pneumomediastinum from blunt trauma returned to the ED within one month.
Conclusions: Most children with isolated pneumomediastinum after blunt trauma were discharged or briefly admitted, but a few required further workup including bedside procedures and/or ICU admission while intubated. No children required surgical intervention or had esophageal injuries. Routine esophagram after blunt trauma is low yield and can be omitted from the workup for most patients. Evaluation of the posterior oropharynx for airway injury requires clinical judgement.

Abbreviations: SD - standard deviation
y - years
ED - emergency department

IQR - interquartile range

APSA 113

DOES TIME TO OPERATING ROOM AFFECT OUTCOMES AFTER PEDIATRIC BLUNT HOLLOW VISCUS INJURY? A TQIP ANALYSIS

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Abstract: Introduction: Blunt hollow viscus injuries (HVI) are relatively rare and difficult to diagnose. Whether a delay in diagnosis and operative intervention negatively impacts outcomes for pediatric patients with blunt HVI has not been investigated via analysis of large multi-center databases.

Purpose: To determine what factors might lead to a delay in diagnosis for blunt HVI and whether a delay in definitive treatment negatively impacts outcomes.

Methods: We queried the TQIP database from 2016-2020 for patients < 18 years who underwent an operation of the stomach, small intestine, large intestine, and rectum within 48 hours of emergency department arrival after blunt injury. We then excluded patients with solid organ injury, additional extra-intestinal abdominal or thoracic operations, and those taken to the operating room within 1 hour of presentation in order to isolate the effect of bowel injury. Patients were divided into groups based on the time of emergency department presentation to arrival in the operating room: 1-5 hours, 5 to 12 hours, 12-24 hours, and 24-48 hours. We analyzed baseline characteristics and surgical outcomes using ANOVA and multivariate logistic regression with $p< 0.05$ used to define significance.

Results: We identified 1,698 patients, including 145 (9%) who were operated on >24 hours after arrival. The average age was 11.2 and 64% were male, neither of which varied between groups. Patients who underwent a delayed operation demonstrated higher overall ISS scores, higher AIS scores for the head, face, and upper extremities, and were more likely to require an orthopedic operation [table 1]. Patients who received a delayed operation were less likely to have full thickness injury noted in the operating room and demonstrated longer overall hospital and ICU stays. However, there was no difference in infectious complications or mortality between groups.

Conclusion: Diagnosis and operative intervention for blunt hollow viscus injury might be delayed in the presence of distracting injuries to other body regions and in the absence of full-thickness perforation. However, while these patients tend to have a more severe injury profile and require longer hospital stays, they do not appear to have higher rates of mortality or bowel specific complications.

Abbreviations: HVI: Hollow Viscus Injury; ISS: Injury severity score; AIS: Abbreviated Injury Scale; ICU: Intensive Care Unit

APSA 114

LOW RISK OF CLINICALLY IMPORTANT TRAUMATIC BRAIN INJURY IN CHILDREN WHO TUMBLE DOWN STAIRS

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Abstract: Purpose:
Pediatric trauma management seeks to minimize use of head CT (HCT) while capturing all clinically important traumatic brain injuries (ciTBI). The Pediatric Emergency Care Applied Research Network (PECARN) scoring system stratifies patients as high- (HCT recommended), intermediate- (HCT considered) or low-risk (HCT not recommended) for ciTBI. Falls of >3 feet (age < 2y) or >5 feet (>=2y) are deemed severe mechanisms of injury and establish intermediate risk. Although designed for free falls, we noted that the criteria often are applied in cases of tumbling down stairs (TDS) and that steps are taken as 12” in height. TDS of any number of steps appeared to have low association with ciTBI in pediatric patients.

Methods:
In a retrospective chart review of pediatric TDS patients seen from January to December 2021, data was collected on mechanism of injury, clinical presentation, imaging, and incidence of anatomic head injury including ciTBI. PECARN scores were developed under three models using the free fall height criteria: TDS-12 (12” steps), TDS-8 (8” steps), and TDS-0 (TDS excluded as severe mechanism).

Results:
Of 571 putative TDS patients identified by electronic search, 344 met criteria for study inclusion. Mean age was 6.3 years (range 0.65-17.9) and 89 (26%) were younger than two years. No patient had a ciTBI (95% CI: 0-1.1%). This included 88 tumbles down a flight of stairs (=12 steps) or more. Across all models, the same 7 patients (2.0%) were at high-risk for ciTBI. Intermediate- and low-risk cohorts were 287 (83%) and 50 (15%) for TDS-12, 171 (50%) and 166 (48%) for TDS-8, and 16 (4.7%) and 321 (93%) for TDS-0, respectively for each model. Use of the more accurate 8” step height shifted 116 (34%) patients from the intermediate- to low-risk category. Under TDS-0, 271 (79%) patients shifted to the low-risk category, leaving only 23 patients (6.7%) who should have a HCT (n=7) or, based upon other clinical grounds, may have a HCT (n=16).

Conclusions:
In pediatric patients, the risk of clinically important traumatic head injury after tumbling down stairs is low. Tumble Down Stairs should not be treated as a free fall in risk assessment.

Abbreviations: ciTBI – clinically important traumatic brain injury
HCT – head CT
PECARN – Pediatric Emergency Care Applied Research Network
TDS – tumbling down stairs

APSA 115

UNNECESSARY SCANS LEAD TO UNNECESSARY RE-SCANS: AN ANALYSIS OF 464 CHILDREN WITH MILD HEAD INJURY IN A TERTIARY REFERRAL SYSTEM

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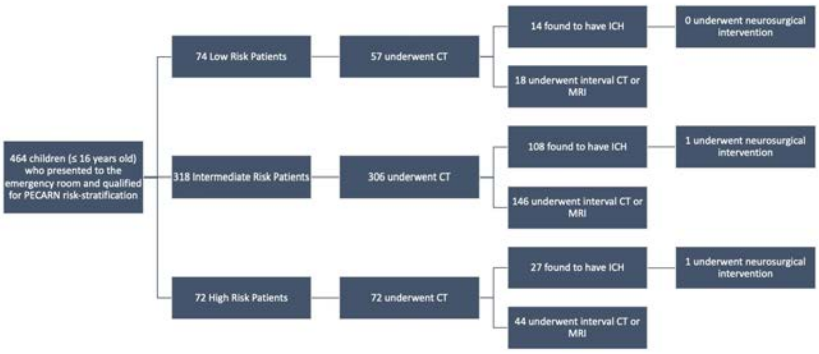
Abstract: The Pediatric Emergency Care Applied Research Network (PECARN) guidelines provide a clinical assessment based algorithm to select patients with mild head trauma at highest risk for clinically important brain injury (ciTBI) in whom CT would facilitate management. Adherence to PECARN criteria for head trauma among pediatric institutions is often low with cross-sectional imaging obtained in patients at low risk for ciTBI. These studies may identify subtle intracranial injuries which do not inform subsequent management decisions, but patients with incidentally discovered injury frequently undergo additional radiographic follow-up. Failure to follow PECARN criteria exposes children to unnecessary radiation and contributes to continued overimaging - increasing hospital costs, lengths of stay, and parental anxiety. We sought to evaluate compliance with PECARN criteria at initial imaging and downstream effects of algorithm non-compliance.

Retrospective review of 464 children ≤16 years old who presented to the emergency room within 24 hours of head injury with a GCS ≥14 between 2016-2021. Children with neurological deficits, penetrating head trauma, anticoagulation, or non-accidental trauma were excluded (222). Data collected included demographics, CT/MRI incidence and results, PECARN risk category, and need for neurosurgical intervention.

There were 74 low-risk, 318 intermediate-risk, and 72 high-risk children by PECARN criteria. Of the low-risk patients, 57 (77%) underwent CT scan among whom 14 (25%) had intracranial injury (none clinically important). Almost all (306 patients, 96%) of the intermediate-risk group underwent CT scan, in whom 108 (35%) had a radiographic finding, one patient required neurosurgical intervention. Imaging was repeated in 100% of low-risk and intermediate-risk patients with CT demonstrating intracranial injury, without clinically significant progression or change in management in any. No patients who were managed without cross-sectional imaging experienced an adverse event.

Despite efforts to improve PECARN compliance, cross-sectional imaging remains overused. Moreover, the identification of small foci of clinically non-actionable intracranial bleeding events in patients who do not meet initial PECARN criteria frequently prompts further cross-sectional imaging without benefit. This suggests that routine interval imaging, even in children with an identified ICH and/or skull fracture, may not be necessary in the neurologically stable child at low risk for clinically important injury.

Abbreviations: PECARN= Pediatric Emergency Care Applied Research Network
ciTBI= clinically important brain injury
GCS= Glasgow Coma Scale
CT= computerized tomography
MRI= magnetic resonance imaging
ICH= intracranial hemorrhage


464 children (≤ 16 years old) who presented to the emergency room and qualified for PECARN risk-stratification
74 Low Risk Patients
57 underwent CT
14 found to have ICH
0 underwent neurosurgical intervention
18 underwent interval CT or MRI
318 Intermediate Risk Patients
306 underwent CT
108 found to have ICH
1 underwent neurosurgical intervention
146 underwent interval CT or MRI
72 High Risk Patients
72 underwent CT
27 found to have ICH
1 underwent neurosurgical intervention
44 underwent interval CT or MRI

APSA 116

PRE-HOSPITAL TOURNIQUET USAGE IN ADOLESCENT AND PEDIATRIC TRAUMATIC HEMORRHAGE: A NATIONAL STUDY

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Abstract: Background: Tourniquet application is a crucial intervention to control hemorrhage. Current "Stop the Bleed" training programs lack much specific guidance for pediatric cases. There is limited literature on tourniquet use in children. This study aimed to evaluate the effectiveness of tourniquet application by different providers (i.e., Emergency Medical Services (EMS), first responders, law enforcement, bystanders) and its impact on outcomes and transport times for pediatric trauma patients.

Methods: Data from the National Emergency Medical Systems Information Systems (NEMSIS) 2017-2020 was used to examine patient characteristics among different providers and assess the outcomes of tourniquet application. We considered demographics, procedure success, timing of the procedure relative to EMS arrival, revised trauma score, time of tourniquet placement and improvement in acuity, measured in terms of hemodynamic, neurological, and respiratory status. Multivariable logistic regression models were employed to predict the initial acuity assessment and the likelihood of acuity improvement after tourniquet placement, while accounting for patient and provider-related variables.

Results: 301 patients were included with a median age of 17, of whom 79.7% were male. Tourniquet placement by EMS, first responder, or bystander before EMS transport arrival at the scene was associated with reduced odds of critical acuity upon EMS arrival (OR=0.84, CI (0.75-0.94), p= 0.002). After EMS arrival, logistic regression analysis revealed bystander and first responder placed tourniquets were associated with increased odds of improved acuity when compared to EMS placed tourniquets (OR=1.90, CI = 1.06-3.41, p= 0.03). There were non-statistically significant differences in tourniquet placement success rates based on provider type, with bystander placed tourniquets 8.3% failure n=3 compared to 2.3% n=7 in EMS. Logistic regression analysis revealed that failure to correctly place a tourniquet was associated with decreased odds of acuity improvement (OR = 0.61, CI= 0.44-0.86, p= 0.005).

Conclusion: Study shows that early tourniquet application in pediatric traumatic hemorrhage is crucial. Tourniquet failures were rare. Tourniquets placed by bystanders and first responders were associated with improved acuity when controlling for other factors including severity and EMS arrival time. These findings emphasize the importance of training and education for the use of tourniquets by EMS and bystanders in prehospital settings.

Abbreviations: EMS: Emergency Medical Services
NEMSIS: National Emergency Medical Systems Information Systems

Scientific Session VIII - CDH/ECMO
11:15 AM – 12:30 PM

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IMPACT OF A CONGENITAL HEART DISEASE DIAGNOSIS ON CONGENITAL DIAPHRAGMATIC HERNIA OUTCOMES

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Abstract: Purpose:
Congenital diaphragmatic hernia (CDH) is a complex malformation that can be associated with congenital cardiac anomalies. In the setting of congenital heart disease (CHD), the complexity of CDH management is amplified. Very limited evidence exists to clarify the management approach and consequences of infants with CDH and CHD. Our objective was to evaluate outcomes for patients with CDH plus CHD.

Methods:
Using the multi-institutional, international CDH study group (CDHSG) registry (1995-2022), patients with CDH and CHD were identified. Patient demographics, prenatal, and postnatal variables, including CDHSG stage, cardiac diagnoses, and management/operative details were prospectively collected and retrospectively analyzed to compare outcomes of morbidity and mortality. Frequentist, univariable, and multivariable analyses were performed.

Results:
13,960 patients with CDH were identified. 2,579 (18.5%) had concomitant CHD diagnoses, including 58.6% with minor cardiac anomalies (MiCA) and 26.3% with major cardiac anomalies (MaCA) (Table). Other cardiac anomalies included isolated aortic arch (11.3%) and infrequent diagnoses (3.8%). Chromosomal anomalies were present in 4.4% of isolated CDH, 15.0% of MiCA, and 20.5% of MaCA patients. Overall survival of isolated CDH was 77.4%, while survival for MiCA was 67.9% and MaCA was 37.6%. Among those with MiCA, 83.3% underwent CDH repair (including 6.5% with a concomitant cardiac repair) and 16.7% were unrepaired. Alternatively, among those with MaCA, 54.7% underwent CDH repair (including 20.6% with concomitant cardiac repair) and 45.3% were unrepaired. ECLS was used in 30.8% of those with MiCA and in only 20.6% of MaCA patients. The average length of stay for MiCA was 73.3±69 days versus 102.5±83 days for MaCA. In a multivariable analysis of MaCA patients, CDHSG defect stage, CDH repair, cardiac repair, and Apgar score at 1 minute were significantly associated with survival (all $p < 0.05$).

Conclusion:
Morbidity and mortality in CDH are significantly impacted by category of CHD. This investigation provides detailed, CHD-specific CDH outcomes, which may inform prenatal counseling and guide the development of an evidence-based framework for management of these challenging patients.

Abbreviations: Congenital diaphragmatic hernia = CDH
Congenital heart disease = CHD
CDH study group = CDHSG
Minor cardiac anomalies =MiCA

Major cardiac anomalies = MaCA
Extracorporeal life support = ECLS
Atrial septal defect = ASD
Ventricular septal defect = VSD
HLHS = hypoplastic left heart syndrome
SVV= single ventricle variant
Arteriovenous canal = AV canal
Tetralogy of Fallot = TOF
Double outlet right ventricle = DORV
Total anomalous pulmonary return = TAPR

APSA 100

IMPACT OF A CENTER'S TOTAL NEONATAL EXTRACORPOREAL LIFE SUPPORT VOLUME ON MORTALITY AND ITS RELATIONSHIP WITH CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Objective:
Recent advances in understanding case volume and mortality in Congenital Diaphragmatic Hernia (CDH) patients on extracorporeal life-support (ECLS) prompted our investigation into the impact of total neonatal ECLS volume, CDH-specific volume, and non-CDH volume on mortality, hypothesizing an inverse relationship with CDH mortality.

Methods:
We analyzed ELSO registry data, covering neonates (< 28 days old) receiving ECLS between 2000 and 2023. A mixed-effects logistic regression was performed controlling for demographics, clinical variables, comorbidities, and year of birth.

Results:

31,660 ECLS cases across 295 medical centers during a 24-year study period were included. The median number of cases per center was 42 [interquartile range (IQR): 10- 156]. Specific conditions and associated mortality rates are listed in Table 1. Risk-adjusted odds ratios (OR) of mortality for the total number of cases per center were as follows: 0.9975 for total cases, 0.9964 for CDH-specific cases, and 0.9987 for non-CDH ECLS cases ($p < 0.05$). For each 100-total-case increment per center across the study period, odds of mortality decreased by 22.22%, resulting in a Number Needed to Treat (NNT) of 4.5 to save one additional CDH patient. A decrease in odds of mortality was also observed for each additional 100 CDH cases (25.92%) and non-CDH cases (12.65%). When these data are annualized, this corresponds to 4.2 additional total ECLS cases per center each year. The risk-adjusted relationship between non-CDH case volume and mortality in the CDH-only cohort was OR 0.995 (95% CI: 0.992-0.998), indicating that increasing the non-CDH case volume by 4.2 cases per center per year is associated with an 11.91% reduction in the odds of mortality for the CDH ECLS patients.

Conclusions:
Our study demonstrates lower mortality rates for CDH patients at higher-volume ECLS centers, which likely reflects broader quality improvement efforts informed by these centers' experience.

Abbreviations: ECLS - Extracorporeal Life Support
CDH- Congenital Diaphragmatic Hernia
OR- Odds Ratio
(IQR)-interquartile range

APSA 101

CLINICAL CARE TRAJECTORY ASSESSMENT OF CHILDREN WITH CONGENITAL DIAPHRAGMATIC HERNIA AND NEURODEVELOPMENTAL IMPAIRMENT

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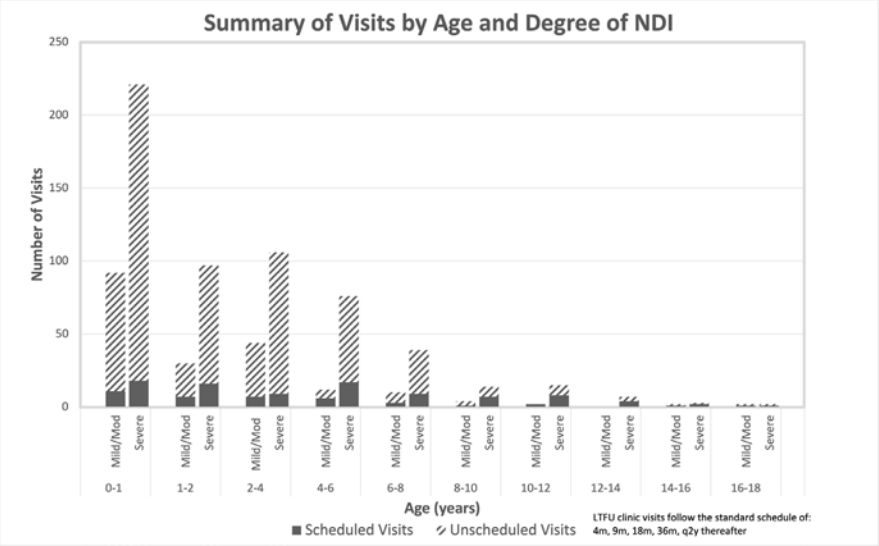
Abstract: Background: Interdisciplinary long-term health surveillance is essential to identify and mitigate CDH-related multisystem morbidity, particularly in patients with neurodevelopmental impairment (NDI). However, no studies to date have specifically assessed the impact of these morbidities on the patient/family. The aim of this study was to describe the clinical trajectory of patients with CDH and NDI (CDH-NDI) and to explore the "lived experience" of families and their satisfaction with existing support resources.

Methods: This sequential explanatory mixed-methods study (REB 2023-8964) was conducted in three phases. Phase 1: Retrospective review of clinical data for CDH-NDI patients attending a longitudinal CDH follow-up clinic; Phase 2: Satisfaction assessment of CDH-NDI families with existing hospital resources; Phase 3: Community consultation with CDH families to explore themes related to their "lived experience". Standard statistical and thematic analyses were performed for Phases 1 and 3, respectively.

Results: Of 120 patients followed, 27 had NDI and were stratified into mild (n=2), moderate (n=7), and severe (n=18) cohorts. Median ventilation (16 vs 3d; $p< 0.001$), ICU (34 vs 7.5d; $p< 0.001$) and hospital days (41 vs 10d; $p< 0.001$) were significantly longer when comparing severe versus mild/moderate groups, respectively. The severe NDI cohort required many more unscheduled visits, particularly in the first years of life (Figure 1). While family satisfaction with existing clinic resources remained high, team communication during ICU-ward transfers and preparation for hospital discharge were areas for improvement. Community consultation was congruent with satisfaction survey findings, highlighting family preoccupations with the lifelong multidimensional impact of CDH and the desire to share experiences with other CDH families.

Conclusion: This is the first study to assess the clinical trajectory and "lived experiences" of CDH-NDI children and families during long-term CDH follow-up. CDH-NDI cohorts require increased support, particularly in the first years of life. While CDH clinic satisfaction is high, suggesting a good response to patient and family needs, this study reveals additional opportunities for quality improvement based on preliminary thematic analyses of the CDH families' lived experience. This will be further explored using focus groups across our entire CDH cohort.

Abbreviations: Congenital Diaphragmatic Hernia (CDH)
Neurodevelopmental Impairment (NDI)


Summary of Visits by Age and Degree of NDI
Number of Visits
250
200
150
100
50
0
Mild/Mod
Severe
0-1
1-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
Age (years)
Scheduled Visits
Unscheduled Visits
LTFU clinic visits follow the standard schedule of:
4m, 9m, 18m, 36m, q2y thereafter

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LONG-TERM OUTCOMES FOLLOWING ON-ECMO MUSCLE FLAP REPAIR FOR CONGENITAL DIAPHRAGMATIC HERNIA

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Abstract: Purpose: Repair of congenital diaphragmatic hernias (CDH) with large defects unamenable to primary closure has historically been performed with a prosthetic patch repair, which can be associated with recurrence and musculoskeletal deformity rates as high as 30%. The abdominal wall muscle flap is a newer technique which is hypothesized to have lower recurrence rates. We have also shown flap repair to be associated with decreased short-term bleeding complications and improved survival for patients repaired while on extracorporeal membrane oxygenation (on-ECMO). Given the use of native abdominal wall tissue for flap repair, we sought to evaluate long-term outcomes including recurrence rate and musculoskeletal defects following on-ECMO CDH repair.

Methods: An IRB-approved, single-center retrospective study of patients who underwent on-ECMO CDH repair with the muscle flap technique between 2015 and 2022 was performed. To evaluate long-term outcomes, only surviving patients at the time of review were included. Recurrence rates and long-term musculoskeletal outcomes including pectus defects, scoliosis, and ventral or incisional hernias were evaluated. Descriptive statistics were performed and are reported as frequency (percentage) and mean (standard deviation) as appropriate.

Results: Thirty-four patients underwent flap repair while on-ECMO during our study period, with 19 (56%) long-term flap survivors who met inclusion criteria. Average length of time from CDH repair to most recent follow-up was five years (±2.4 years). There were no CDH recurrences within our study group. Eight flap patients (42.1%) had at least one type of musculoskeletal deformity. Pectus deformities were noted in 7/19 (36.8%), six mild and one moderate, and none requiring intervention to date. Scoliosis was present in 4/19 (21%), all of which were mild and have not required intervention. Abdominal wall hernias were noted in 3/19 (15.8%), with only one incisional hernia requiring operative repair.

Conclusions: These results suggest that the muscle flap technique for on-ECMO CDH repair is safe, with similar rates of long-term musculoskeletal complications compared to historical prosthetic patch repair complications. Additionally, the muscle flap approach has decreased recurrence rates, even on ECMO, compared to prosthetic patch repair. These results further support the muscle flap repair technique as the favored method for on-ECMO CDH repair.

Abbreviations: CDH: congenital diaphragmatic hernia
ECMO: extracorporeal membrane oxygenation
IRB: institutional review board

APSA 103

A PORCINE MODEL TO EVALUATE CEREBROVASCULAR AUTOREGULATION DURING PUMPLESS ARTERIO-VENOUS ECMO AND VENO-ARTERIAL ECMO SUPPORT

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Abstract: Purpose:
Extracorporeal membrane oxygenation (ECMO) is a life-saving intervention for patients in cardiopulmonary failure. Despite its survival benefit, conventional pump-driven veno-arterial ECMO (cECMO) bears the risk of serious neurologic complications for infants. Sequelae such as stroke, hemorrhage and adverse long-term neurodevelopmental outcomes have been attributed in part to impaired cerebrovascular autoregulation in the setting of pump-driven, non-pulsatile perfusion and the need for systemic anticoagulation. Our lab has developed a novel form of pumpless arterio-venous ECMO (pECMO) in which flow through the circuit is driven by native cardiac output, maintaining pulsatile flow to the brain. Here we describe a pediatric porcine model to study cerebral autoregulation of oxygen delivery and perfusion during ECMO support.

Methods:
Nine pediatric piglets (13-14kg) were studied, 5 in the pECMO group and 4 in the cECMO group. A noninvasive cranial optical spectroscopy probe was placed to measure local cerebral blood flow and tissue oxygenation. Invasive neuro-monitors including an intracranial pressure (ICP) probe, microdialysis probe, and Periflux laser doppler were placed through burr holes. Each piglet was cannulated to pECMO or cECMO and supported for 6 hours with continuous monitoring of vital signs, arterial blood gases, spectroscopy, and ICP.

Results are expressed as a pressure reactivity index (Prx), a measure of cerebral autoregulation measuring correlation between mean arterial pressure (MAP) and ICP, and cerebral blood flow index (CBF), which correlates MAP and laser doppler flow. Statistical analysis was performed using the Wilcoxon rank-sum test.

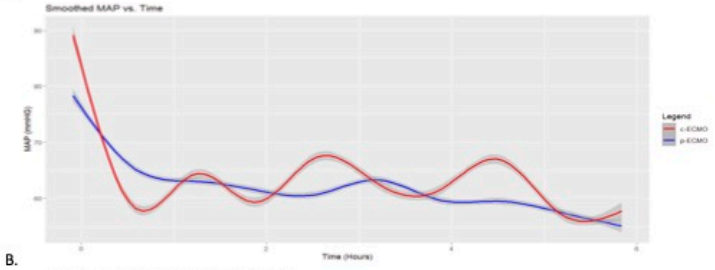
Results:
Figure 1 demonstrates trends in pressure reactivity and cerebral blood flow over the 6 hour period. Prx was significantly lower in the pECMO group, indicating superior preservation of cerebrovascular autoregulation in this cohort ($p < 0.001$) compared to animals supported on cECMO. MAP, ICP and CBF were not significantly different between study groups during steady state flow.

Conclusions:
Here we describe a novel model to assess cerebrovascular autoregulation during ECMO support. We conclude that cerebral autoregulation is better preserved in animals supported on pECMO compared to cECMO. Future studies using this model will evaluate autoregulatory responses in the setting of physiologic perturbations including elevated ICP, hypoxia and hypercapnia in ECMO-supported animals.

Abbreviations: ECMO: extracorporeal membrane oxygenation
cECMO: conventional venoarterial ECMO
pECMO: pumpless arteriovenous ECMO
ICP: intracranial pressure
Prx: pressure reactivity index
MAP: mean arterial pressure
CBF: cerebral blood flow index

Figure 1: Trends in systemic blood flow and cerebral autoregulation during extracorporeal membrane oxygenation (ECMO) therapy. 1A: MAP vs time (p=0.948); 1B: Prx vs time (p<0.001); 1C: CBF vs time (p=0.4).

A.



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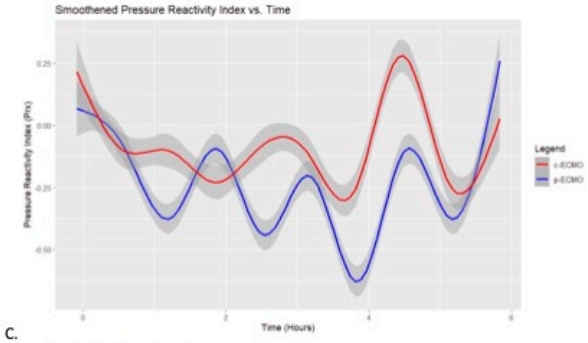

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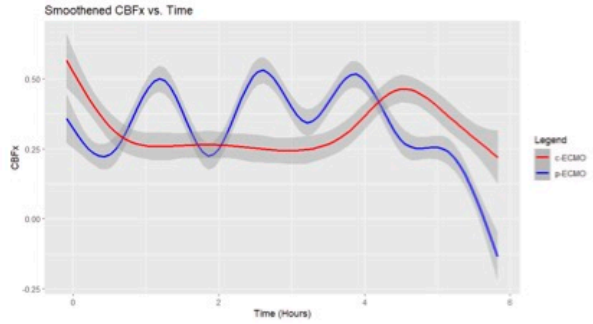

APSA 104

MEDIASTINAL SHIFT INDEX: VALIDATION OF A POSTNATAL MEASUREMENT OF MEDIASTINAL MOVEMENT THAT PREDICTS SURVIVAL IN NEONATES WITH CONGENITAL DIAPHRAGMATIC HERNIA ON EXTRACORPOREAL MEMBRANE OXYGENATION

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Boston Children's Hospital, Boston, MA, USA

Abstract: Purpose
The position of the mediastinum varies in neonates with congenital diaphragmatic hernia (CDH), reflecting contralateral shift due to mass effect or ipsilateral shift after treatment. It is unknown whether postnatal mediastinal position correlates with outcomes. We aimed to create and validate a reproducible postnatal measurement of mediastinal positioning using chest radiographs in neonates with CDH using extracorporeal membrane oxygenation (ECMO).

Methods
Chart review identified neonates with CDH who utilized ECMO between 2017-2022. Mediastinal shift index (MSI) uses the position of the venous cannula tip as a reliable marker of mediastinal position (Figure 1). MSI is the ratio of the distance between the venous cannula tip and the contralateral chest wall over the total width of the contralateral hemithorax. Lower MSI corresponds to mediastinal shift toward the lung contralateral to the CDH. A pediatric surgeon, radiologist, and research fellow completed MSI measurements on the day of cannulation. Intraclass correlation coefficients (ICC) assessed inter-rater agreement. Initial MSI and observed/expected lung head ratio (O/E LHR) were compared with Spearman correlation. Initial MSI and O/E LHR were compared between survivors and non-survivors. Receiver operative characteristic (ROC) curve analysis and area under the curve (AUC) evaluated the ability of MSI and O/E LHR to predict survival. P-value < 0.05 was significant.

Results
39 neonates with CDH on ECMO were included. MSI demonstrated excellent agreement (ICC>0.98) amongst the three raters. Initial MSI and O/E LHR had a moderate positive correlation (Spearman correlation = 0.46, p = 0.014). Median initial MSI differed significantly between survivors and non-survivors (0.52 vs. 0.32, p = 0.018) as did O/E LHR (0.36 vs. 0.26, p = 0.036). ROC analysis revealed initial MSI (AUC=0.756) and O/E LHR (AUC=0.736) were predictors of survival. Initial MSI >0.35 predicted survival to discharge with a sensitivity of 73% and specificity of 73%.

Conclusion
Mediastinal shift index, a novel postnatal indicator of mediastinal shift, was found to be reliable and correlated with O/E LHR. MSI predicted survival with a higher sensitivity and specificity than O/E LHR. Future studies will elucidate the role of trending MSI over a patient’s course to inform interventions to optimize mediastinal position.

Abbreviations: CDH: Congenital Diaphragmatic Hernia
ECMO: Extracorporeal Membrane Oxygenation
MSI: Mediastinal Shift Index
ICC: Intraclass coefficients
O/E LHR: Observed/ Expected Lung Head Ratio
ROC: Receiver operative characteristic
AUC: Area under the curve

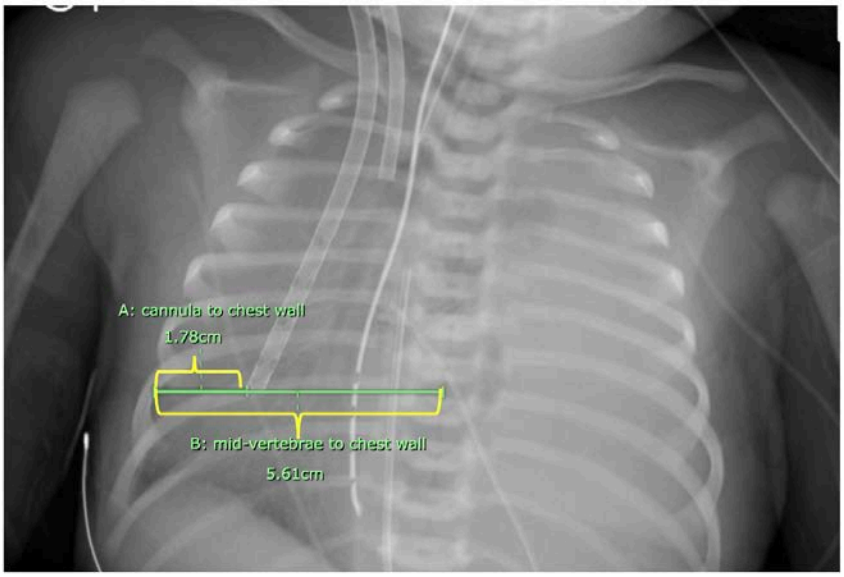

Figure 1: **Mediastinal Shift Index (MSI) in patient with left-sided CDH**
A: distance from venous cannula edge to chest wall contralateral to defect
B: distance from mid-vertebrae to chest wall contralateral to defect
MSI = (A/B) = 0.32

APSA 105

YES-ASSOCIATED PROTEIN PATHWAY SIGNALING IN A NOVEL EX VIVO FETAL LUNG MODEL OF CONGENITAL DIAPHRAGMATIC HERNIA

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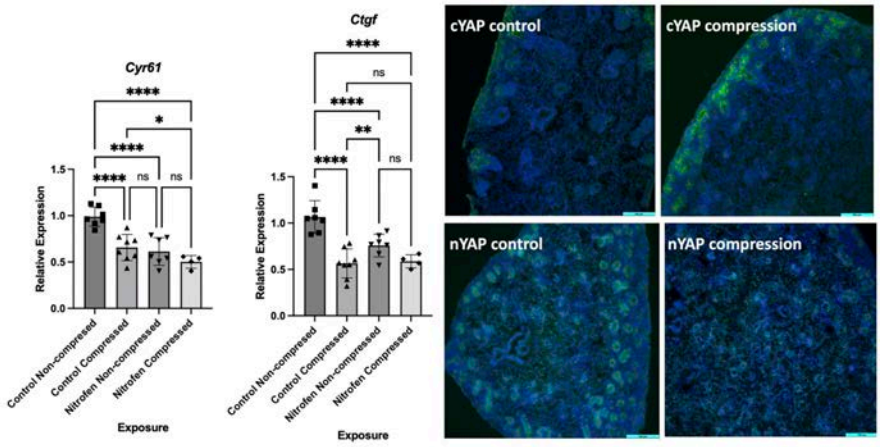
Abstract: Purpose: Recent studies have shown that mechanosensory stimuli regulate the nucleocytosolic shuttling of the transcriptional co-activator protein, Yes-Associated Protein (YAP), during fetal lung patterning and differentiation. Our group hypothesized that the proximal-distal fetal lung abnormalities observed in congenital diaphragmatic hernia (CDH) are consistent with those of YAP dysregulation. Therefore, the purpose of this study was to determine whether mechanical compression forces during the canalicular stage of fetal lung development affect YAP signaling using a novel ex vivo modeling device.

Methods: After animal welfare approval (MO20M15), timed pregnant CD1 mice were gavaged with oil alone (control) or nitrofen/4-biphenyl carboxylic acid (nitrofen) at E8.5 to induce CDH fetal lung hypoplasia. Animals were sacrificed for whole fetal lung harvesting at E15.5 (canalicular stage, E16 = physiologic diaphragm closure). To mimic the in-utero compression forces encountered in CDH, fetal lungs were cultured ex vivo for 48 hours between pre-formed 2% agarose discs within microdevices under a static compression force of 3.3kPa (Compression Plus FX-5000C, Burlington, NC). Compressed lungs were compared to non-compressed lungs by quantitative gene expression of YAP target genes (Cyr61, Ctgf) and by immunofluorescence staining for YAP proteins. P-values < 0.05 were considered significant.

Results: Control compressed lungs (n=8) demonstrated reduced expression of Cyr61 ($p< 0.0001$) and Ctgf ($p< 0.0001$) compared to control non-compressed lungs (n=7, Figure). Nitrofen-exposed, non-compressed lungs (n=7) also showed a decrease in Cyr61 ($p< 0.0001$) and Ctgf ($p< 0.0001$) compared to control, non-compressed lungs. Nitrofen-exposed, compressed lungs (n=4) were not significantly associated with reduced YAP target gene expression with compared to nitrofen-exposed, non-compressed lungs (Cyr61 p=0.17, Ctgf p=0.81). Immunofluorescent staining with inactivated/cytoplasmic YAP (cYAP) antibodies demonstrated increased expression in compressed lungs when compared to non-compressed lung (Figure). Conversely, there was reduced expression of activated/nuclear YAP (nYAP) in compressed lungs.

Conclusion: This novel ex vivo compression model of CDH lung hypoplasia suggests that mechanical forces disrupt YAP signaling as revealed by increasing cytoplasmic YAP and reduced nuclear YAP during the canalicular stage of development. Taken together, these findings advance the concept of mechanosensor-mediated pathways as potential therapeutic targets to induce lung growth in fetuses with severe CDH.

Abbreviations: YAP: Yes-Associated Protein
cYAP: cytoplasmic Yes-Associated Protein
nYAP: nuclear Yes-Associated Protein
CDH: Congenital Diaphragmatic Hernia


Cyr61
Relative Expression
Control Non-compressed
Control Compressed
Nitrofen Non-compressed
Nitrofen Compressed
Exposure
Ctgf
Relative Expression
Control Non-compressed
Control Compressed
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Exposure
cYAP control
cYAP compression
nYAP control
nYAP compression

APSA 106

PROCEDURAL BURDEN EXPERIENCED BY INFANTS WHO DIED IN NEONATAL INTENSIVE CARE UNITS

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Abstract: Background: Infants who die in neonatal intensive care units (NICUs) have been shown to experience high-intensity end-of-life care. Less is known about the specifics of procedure type, timing, and frequency. Therefore, we aim to describe the operative and procedural interventions performed on infants who died in the NICU to characterize the procedural burden experienced by children during their terminal admission.
Methods: Retrospective analysis of the Pediatric Health Information System (PHIS) database was performed from 1/1/2020 to 12/31/2021. Infants admitted with a PHIS “NICU” flag who died during their index admission were included. Interventions were categorized as either an invasive procedure (venous/arterial access, laryngoscopy/bronchoscopy, device insertion/revision, arteriography/venography, and other diagnostic/therapeutic procedures) or major operation (as defined by the PHIS “Operative” flag). Operative complications were identified by the PHIS “Surgical Complication” flag, and patient demographics, admission details, procedure codes, and date of service were utilized for descriptive analysis.
Results: During the study period, 3,095 infants died in NICUs at PHIS hospitals. Among them, 2,333 (75.4%) underwent at least one invasive procedure, while 1,039 (44.5%) underwent three or more invasive procedures. The most common procedures were venous/arterial access with tube thoracostomy having the shortest time from procedure to death. (Table 1) There were 934 (30.2%) infants who underwent a total of 2,043 major operations. There was no significant difference in operative or procedural burden based on demographics. 276 (8.7%) infants were cannulated for ECMO. Of infants who underwent a major operation, 376 (39.3%) experienced an operative complication and 684 (73.2%) died within the 30-day post-operative period. Of note, 331 (35.4%) infants died within 72 hours of a major operation with intra-abdominal operations representing 64.4% of surgeries occurring within 72 hours of death. Frequency of procedures and operations along with timing in relation to death are reported in Table 1.
Conclusion: Infants who die in the NICU experience a significant procedural burden. This study highlights the need for surgeon involvement in thoughtful multidisciplinary discussions regarding the utility, potential benefit, and goal concordance of major operations and invasive procedures for infants at the end of life.

Abbreviations: NICU = neonatal intensive care unit, PHIS = Pediatric Health Information System, ECMO = extracorporeal membrane oxygenation

APSA 107

MOVING FROM "WHAT" TO "WHY": DEVISING A PURPOSE-BASED FRAMEWORK TO DISCUSS SURGICAL INTERVENTION IN SERIOUSLY ILL CHILDREN

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Abstract: Introduction:
High quality care in serious illness is predicated on goal concordance, and goal concordance is predicated on high quality communication. Existing literature outlines pediatric surgical procedures that might be considered "palliative," but these studies are either anecdotal or rely on procedure coding without accounting for the clinical context or the purpose of the intervention as understood by the family and care team. In the absence of these data in seriously ill children (such as those receiving palliative care), a standardized framework for communicating about surgical intervention with goal-oriented, shared language has not yet been developed.

Methods:
We conducted a retrospective cohort analysis of surgical interventions in 197 children enrolled in a multicenter prospective cohort study (Pediatric Palliative Care Research Network SHARE Study). Interventions were abstracted via clinical record review and intended purposes were coded via hybrid deductive-inductive approach.

Results:
One hundred eighty-nine (of 197, 96%) patients (45% female, 35% non-White) with an average of 5.3 complex, chronic conditions (CCC) underwent 1971 surgical interventions (median=12). Of interventionalists, pediatric general surgeons perform the greatest proportion of interventions (20.4%), the most common of which are central venous access, enteral access, ileostomy/colostomy creation, and dialysis access. Patients with more CCC (p=0.0008) and of White race (p=0.04) underwent more surgical interventions. Intervention was not associated with higher mortality (p=0.049). Interventions were most commonly for diagnosis (33%) and cure/repair (32%), with many performed for supportive purposes (13%) or assistive technologies (21%), and a minority to temporize/bridge (1.2%) (Table 1). More interventions were life enhancing (37%) than life extending (26%).

Conclusions:
Seriously ill children receiving palliative care undergo surgical intervention for varying purposes and with the goal of living both longer and better. These findings will be used to create a framework for how surgical, medical, and palliative care teams approach discussions about intervention with seriously ill patients and their families.

Abbreviations: CCC=complex, chronic condition

Scientific Session X - Global and Disparities
2:00 PM – 3:15 PM

APSA 64

DEVELOPING A LOW-COST NEONATAL GASTRIC SUCTION DEVICE FOR LOW-RESOURCE SETTINGS

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Abstract: Purpose: In low and middle income countries (LMICs), automatic gastric suction is not available for neonates with gastrointestinal congenital or acquired obstruction, which often leads to aspiration and preventable deaths. Our purpose was to create a low-cost, locally-sourced, and automated suction device that can safely and effectively remove excess fluid from newborn stomachs.
Methods: Using materials that are accessible in most LMICs to enable long-term implementation, our student engineering team developed a small portable suction device with continuous low-intermittent suction cycles by writing code and integrating it into a circuit system. This circuit system operates the diaphragm pump that is connected to a Salem sump tube. The circuit is powered by a rechargeable battery which are both attached to a 3D-printed encasing (Figure).
Results: Safety testing included a stomach simulator test which was performed using adult pig intestine. The device effectively suctioned without causing any adhesion damage, reaffirming its safety for use with neonates. Duty cycle testing indicated that the device allows precise pressure adjustment through human input by modifying duty cycles, achieving low error to closely match the set duty cycle with the actual pressure output. Comprehensive safety testing demonstrated that the device's alarm system successfully activated in critical scenarios, such as low battery charge and high-pressure conditions, which could pose a fatal risk to neonates. Furthermore, the device operated quietly at less than 60 dB sound output and the battery lasted for over 80 days. The device has been shown to be compliant with International Organization for Standardization (ISO) engineering safety standards. The manufacturing cost of the device is under $150, which is significantly lower than commercially available devices.
Conclusion: We have developed and safety tested a low-cost portable suction device for neonatal gastric suctioning that has the potential to be locally manufactured in LMICs. Clinical testing is being planned for neonates in the Dominican Republic. The wide availability of such a device has the potential to prevent a large number of unnecessary neonatal deaths in both surgical and non-surgical patients across the globe.

Abbreviations: Low and middle income countries (LMICs)
International Organization for Standardization (ISO)

APSA 65

STANDARDIZATION OF CLINICAL CARE IN SUBSAHARAN AFRICA; A CASE FOR HYPOSPADIAS SURGERY

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Abstract: STANDARDIZATION OF CLINICAL CARE IN SUBSAHARAN AFRICA; A CASE FOR HYPOSPADIAS SURGERY

Introduction:
Hypospadias is the second most common congenital urologic anomaly in new-born boys. Corrective surgery is associated with a high complication rate ranging from 5-60% worldwide. African studies demonstrate a complication rate of 28-60.6%%. The complication rate is influenced by three general groups of factors. Patient factors, surgeon factors, and institutional factors. Surgeon factors mainly evolve around the degree of specialization and years of experience as determined by the learning curve. Various strategies have been used to improve outcomes. Interventions range from surgeon-specific procedures to institutionalized strategies that entail standardization and protocolization.
Methods:
The study was a retrospective study with pre- and post-intervention phases. The intervention was a protocol that was introduced, taught and implemented. In the preintervention phase i.e. before the protocol was instituted, data was reviewed going back six years (n1). The second group were the patients treated after the protocol had been instituted (n2). A total number of 424 patients participated in the study. Of these 284 in the preintervention phase and 140 (n2) in the post intervention phase (n2).
Results:
89% (252/281) were Phenotypically male; and 29(10%) had DSD (differences of sexual development). Mean age in years was 4.1± 3.9[0 – 23.9yrs] in n1 and 4.7±4.55 [0 – 19.4 yrs.], P=0.13 respectively. Overall complication rate was 51.4 % for n1 and 25 % for n2 (p=0.001) value). Among the complications urethrocutaneous fistula (UCF) was the majority (27.3% Vs 10.2 %, p=0.001); followed by Wound infection (23% vs 4%; p=0.04) and There was a significant cost reduction in the post-intervention phase with a significant difference compared to the pre-intervention phase [8684 (CI:5335,12034 KES), p=0.001].
Conclusion:
The use of a standardized protocol in hypospadias care significantly reduces the post-operative complication rate and cost.

Abbreviations: KES- Kenyan Shillings
UCF-Urethrocutaneous fistula
DSD- Differences of sexual development

APSA 66

ADDRESSING THE PROBLEM OF PEDIATRIC CENTRAL-LINE ASSOCIATED BLOOD STREAM INFECTIONS AT A RURAL REFERRAL HOSPITAL IN A LOW-MIDDLE INCOME COUNTRY

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Abstract: Purpose: Pediatric central venous catheter (CVC) placement is becoming common in low- and middle-income countries. However, there were few reports of indications and complications of central venous catheters in these countries, including central line associated bloodstream infection (CLABSI) rates. The purpose of this study was determine the baseline pediatric CLABSI rate of our institution and then pursue adherence to best practice guidelines of insertion and maintenance with ongoing CLABSI rate monitoring.

Methods: We performed a single institution prospective cohort study of all patients less than 18 years old in whom a CVC was placed from July 1, 2021 to September 30, 2023 at rural referral hospital. Patient demographics, catheter placement specifications, and indications were collected via REDCap survey. Chart review was performed after patient discharge or death. Blood cultures were performed as clinically indicated. CLABSI was defined by US CDC criteria and all positive blood cultures were reviewed. Initial data analysis was performed after 12 months, followed by education and implementation of best practice guidelines for insertion and maintenance. Subsequently, the CLABSI rate was monitored from December 1, 2022 to September 30, 2023.

Results: A total of 59 central venous catheters were inserted. Thirty-four lines were placed before the intervention and 25 after the intervention. The most common indication for placement was long term antibiotic use, followed by TPN administration. In the first 12 months of the study, 8 CLABSI events occurred in 378 catheter-days, for a rate of 21.2 per 1,000 catheter-days. A central line care bundle was then implemented, including best practices for insertion and maintenance. Pediatric surgeons, pediatricians, and nurses were educated. In the 10 months that followed, the CLABSI rate reduced to 10.5 per 1000 catheter-days, representing 3 CLABSI events in 306 catheter-days.

Conclusion: Our pre-intervention CLABSI rate was higher than reported in other low-middle income countries. We were successful in reducing the rate by 50% with multidisciplinary education on best practices. We conclude that implementation of central line care bundle significantly reduced the risk of central line associated blood stream infection for pediatric patients at our facility.

Abbreviations: CVC - Central venous catheters
CLABSI - Central line associated blood stream infections
US CDC - United States Center for Disease Control
TPN - Total Parenteral Nutrition

APSA 67

OUTCOMES OF AMBULATORY PEDIATRIC SURGICAL CARE PROVISION IN KAKUMA REFUGEE CAMP DURING A MEASLES OUTBREAK

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Abstract: Purpose:
In 2023, Kakuma refugee camp experienced multiple measles outbreaks as a result of population displacements leading to delayed provision of pediatric surgical care. In response, we implemented an ambulatory pediatric surgical protocol to minimize pediatric surgical patient exposure to measles patients. Following this intervention, our objective was to assess postoperative outcomes of ambulatory pediatric surgical care in Kakuma refugee camp.

Methods:
We conducted a retrospective analysis of ambulatory pediatric surgical care in Kakuma refugee camp. We reviewed patient charts to determine demographic information, diagnoses and procedures done, and postoperative outcomes. We calculated proportions for continuous variables and used confidence intervals to determine statistical significance.

Results:
We conducted a total of 38 ambulatory pediatric procedures in Kakuma refugee camp. Patients came primarily from South Sudan, Burundi, Somalia, and the Democratic Republic of Congo. All patients were boys and the average age was 6 years old (range 1.9 - 13 years). All patients had received their measles vaccine preoperatively (100%). 45% of the procedures were inguinal hernia repairs, 53.4% were hydrocele repairs, and 1.6% were umbilical hernia repairs. There were no postoperative deaths, and at day 30 no surgical site infections (0%) nor recurrences (0%). None of our patients contracted measles.

Conclusions:
Ambulatory pediatric surgical care provision is feasible in the refugee context, during measles outbreaks, and the outcomes were comparable to other settings. Preoperative measles vaccination and separation of surgical patients from inpatient patients was associated with zero measles cases in the pediatric surgical population. There should be future consideration to implement ambulatory pediatric surgical protocols at all times in refugee contexts.

Abbreviations:

APSA 68

NEIGHBORHOOD DISADVANTAGE IS ASSOCIATED WITH DECREASED HEALTHCARE ACCESS IN PEDIATRIC APPENDICITIS: A MULTI-SITE NSQIP-PEDIATRICS RETROSPECTIVE COHORT STUDY

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Abstract: Purpose:
Our purpose was to characterize associations between neighborhood-based social determinants of health (SDoH) and access to care for children with acute appendicitis. We hypothesized that children with acute appendicitis from underprivileged backgrounds would have decreased access to care.

Methods:
We performed a multicenter retrospective cohort study of children (< 18 years) from 7 American College of Surgeons National Surgical Quality Improvement Program-Pediatric hospitals (1/2016–12/2021). Two national SDoH indices (Social Vulnerability Index (SVI) and Area Deprivation Index (ADI)) were scaled to present decile change (0=least disadvantaged, 10=most disadvantaged). Access to surgical care for children with acute appendicitis was assessed by 1) advanced disease at the time of appendectomy (complicated appendicitis, preoperative sepsis, or systemic inflammatory response syndrome (SIRS)), and 2) lack of radiation stewardship (pre-operative computed tomography (CT) use without ultrasound (U/S) or magnetic resonance imaging (MRI)). Mixed-effect multivariable modeling, controlling for age, sex, racialization, comorbidity (yes/no), and hospital facility (random effect), was used for statistical analysis. Body mass index (BMI) was included as a confounder in the analysis of CT use.

Results:
Of the 7,000 included children who underwent appendectomy for acute appendicitis, the average age was 11.1 years (SD 3.7), 12% had pre-operative comorbidity, and 37% were from minority group racialization. Insurance coverage included 45% commercial and 37% Medicaid. In total, 26% of patients had complicated appendicitis, 64% had pre-operative sepsis or SIRS, and 26% underwent pre-operative CT without other imaging. Associations were found between both SDoH indices and all outcomes at the time of appendectomy (Table). Odds ratios indicated a 5% increased risk of complicated appendicitis and sepsis/SIRS, and a 14% increase in CT use for every decile increase in ADI. Similarly, risk of complicated appendicitis (4%), sepsis/SIRS (3%), and CT use (7%) were increased per decile increase in SVI.

Conclusions:
Neighborhood-based SDoH are associated with access to care for pediatric acute appendicitis. Children from disadvantaged neighborhoods have increased risks of presenting with more advanced disease and exposure to ionizing radiation from preoperative imaging. To address health inequities, interventions are needed to improve negative health outcomes due to presentation with advanced disease and potentially avoidable radiation exposure.

Abbreviations: SDoH: Social Determinants of Health
SVI: Social Vulnerability Index
ADI: Area Deprivation Index
CT: Computed Tomography
U/S: Ultrasound
MRI: Magnetic Resonance Imaging
BMI: Body Mass Index

APSA 69

PEDIATRIC TRAUMA MORTALITY DIFFERS BY NEIGHBORHOOD OPPORTUNITY LEVEL

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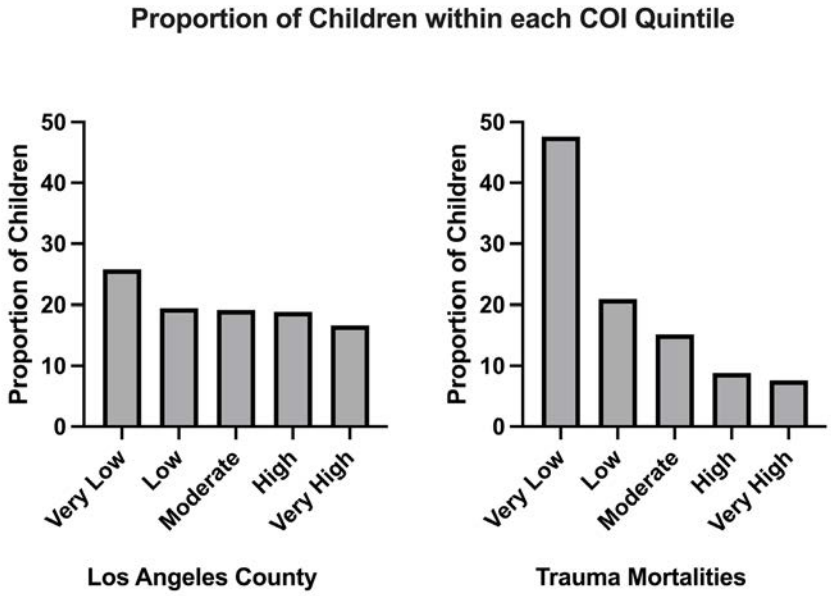
Abstract: Purpose: Traumatic injuries such as motor vehicle collisions and firearm injuries continue to be the leading cause of death in children. There is growing evidence that a child's neighborhood characteristics are a risk factor. We characterize pediatric traumatic mortalities as well as describe the association of mechanism of injury and the Childhood Opportunity Index (COI).

Methods: A multicenter, retrospective cross-sectional study from 2010 to 2021 was conducted within a large metropolitan county to evaluate fatal trauma activations involving children < 18 years old following IRB approval. Data from the county trauma registry included patient demographics, mechanism of injury, and clinical characteristics. COI, a measures neighborhood level resources and conditions critical for children's development, was designated using the COI 2.0 zip code data and patient home zip code. The proportion of mortalities within each COI quintile was compared to the proportion of children within each quintile for this county. The distribution of injury mechanisms for each COI quintile was then assessed. Analysis was performed using Kruskal-Wallis and chi-square tests (α=0.05).

Results: Of the 31,702 pediatric trauma activations, 513 (1.62%) fatal encounters were included. Mortalities mostly resulted from assaults (37%), pedestrian injuries (26.7%), and motor-vehicle collisions (18.7%). Of all mortalities, 32.6% were firearm related, either from an assault or self-inflicted. A greater proportion of mortalities were children from very low (47.6%) and low (20.9%) opportunity neighborhoods with fewer from high (8.8.%) and very high (7.6%) COI-neighborhoods compared to the county's proportion of children within these quintiles ($p< 0.001$) (Figure). The injury mechanisms were significantly different across COI quintiles with more fatal assaults in children from very low COI-neighborhoods ($p=0.005$) and more self-inflicted fatalities in children of moderate, high, and very high COI neighborhoods ($p=0.003$). Further, mortalities in very low and low opportunity neighborhood more frequently involved a firearm than other COI quintiles ($p=0.001$).

Conclusion: Lower COI neighborhoods have a higher incidence of pediatric trauma mortality. Mechanisms of injury leading these fatalities were disproportionate across COI quintiles as assault was greater in lower COI quintiles and self-inflicted mechanism in higher COI quintiles.

Abbreviations: COI= Child Opportunity Index; IRB=Institutional Review Board


Proportion of Children within each COI Quintile
Proportion of Children
50
40
30
20
10
0
Very Low
Low
Moderate
High
Very High
Los Angeles County
Proportion of Children
50
40
30
20
10
0
Very Low
Low
Moderate
High
Very High
Trauma Mortalities

APSA 70

THE CHILD OPPORTUNITY INDEX IN GASTROESOPHAGEAL REFLUX DISEASE MANAGEMENT: ANALYSIS OF SOCIOECONOMIC STATUS IN ANTI-REFLUX SURGICAL PROCEDURES

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Abstract: Purpose: The child opportunity index (COI) is a score that indicates the quality of resources, conditions, and opportunity available to children within their neighborhood. A lower COI score indicates social vulnerability. Children who undergo surgical intervention for medically refractory gastroesophageal reflux disease (GERD) may have residual or ongoing care needs that require unanticipated visits to the hospital, which places stress on patient and families with fewer resources and poor access. The purpose of this study was to evaluate the impact of the COI on postoperative health care visits in children undergoing surgical treatment for severe GERD.

Methods: Using a large multi-institutional research collaborative of ten hospitals, we performed an IRB-approved retrospective review of patients less than 3 years old who underwent Nissen fundoplication or post-pyloric enteral feeding tube procedures, including surgical jejunostomy or gastrojejunostomy, for GERD between 2010-2020. A multivariable Poisson regression model was constructed to evaluate whether COI and other factors were associated with unplanned healthcare visits during the first year post operation, accounting for preoperative symptoms, comorbidities, and hospital as random effect.

Results: There were 1201 patients, including 1104 (91.9%) Nissen fundoplications and 97 (8%) post-pyloric enteral tubes. The average COI amongst patients that underwent Nissen was 37, indicating a low COI in this patient population. In comparison, the post-pyloric enteric tube group had a statistically significantly higher COI of 57 ($p=0.0002$). In a multivariate analysis, patients with a lower COI had significantly more unanticipated postoperative visits, even when accounting for choice of surgery, race, insurance, preoperative symptoms, and major comorbidities ($p< 0.0001$). Additionally, the choice of a post-pyloric tube also had a significantly higher number of postoperative visits ($p< 0.0001$).

Conclusion: In patients undergoing surgical treatment of refractory GERD, the COI is an independent risk factor for increased postoperative visits. These findings are consistent with previous research that

correlates COI with increased need for pediatric readmissions and emergency room visits. This study is the first to look at COI and resource utilization in the postoperative period for general pediatric surgery As pediatric surgeons, choice of operation should be carefully weighed to improve outcomes after hospital discharge.

Abbreviations: Child Opportunity Index - COI
Gastroesophageal relux disease - GERD
Gastrojejunostomy - GJ
Surgical jejunostomy - SJ

APSA 71

PATIENT FACTORS ASSOCIATED WITH ACCESS TO OUTPATIENT PEDIATRIC GENERAL SURGICAL CARE IN A RURAL STATE

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Abstract: Purpose:
There are known gaps in access to pediatric general surgical care, especially in rural areas. We sought to understand factors impacting timely access to outpatient pediatric general surgical care in a state with a substantial rural population.

Methods:
We conducted a single-center retrospective cohort study at a tertiary facility, evaluating all patients < 18 years referred for outpatient pediatric general surgical evaluation from 11/1/2017-7/31/2023. Outcomes included obtaining an appointment, completing an appointment, and undergoing an operation. Time to appointment and operation were calculated. Delay to appointment was defined as three standard deviations above the mean. Chi-squared tests were used to compare categorical variables. Multivariable logistic regression was performed to evaluate for associations between patient factors and the primary outcomes as well as delay to appointment.

Results:
We included 6,296 patients with a pediatric surgical referral (Table). Mean age was 7.3 years (SD=6) and 58% were male. Of these, 5,337 (85%) had an appointment scheduled and 4,498 (71%) completed an appointment. Thirty-five percent (n=2,205) of those referred underwent an operation. Mean times from referral to appointment and surgery were 22 days (SD=32) and 80 days (SD=138), respectively. In multivariable regression, there were no demographic factors associated with likelihood of obtaining an appointment. Patients who identified as Black/African American (OR=0.54, 95%CI=0.38-0.78, p< 0.001), had self-pay (OR=0.16, 95%CI=0.11-0.23, p< 0.001), or lived >100 miles away (OR=0.68, 95%CI=0.53-0.86, p=0.002) were less likely to complete appointments. Patients with the highest household income (OR=1.45, 95%CI=1.11-1.88, p=0.006) and private insurance (OR=1.66, 95%CI=1.36-2.02, p< 0.001) were more likely to complete appointments. Delay to appointment was associated with lower household income (p=0.007). Patients with private insurance (OR=1.28, 95%CI=1.13-1.45, p< 0.001) and those living ≥25 miles away (p=0.016) were more likely to undergo operation.

Conclusion:
Nearly one-third of patients referred for outpatient pediatric general surgical evaluation did not complete an appointment. There was substantial variability among patients in time to clinic appointment and operative encounter. Household resources, insurance coverage, and distance to care were associated with completing appointments. Information about groups that have disparate access to care will inform interventions to improve this access in the future.

Abbreviations:

APSA 71 B

RACIAL AND ETHNIC DISPARITIES IN PEDIATRIC FIREARM DEATHS PERSIST IN 2022

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Abstract: Purpose: The leading cause of death in the pediatric population age 0-19 years became firearms in 2019, and this trend has persisted in subsequent years, with firearm deaths continuing to increase into 2021, with widening racial disparity. This study aims to determine whether this trend continues, and what aspects of firearm violence predominantly contribute to these trends.

Methods: The Center for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (CDC WONDER) was queried for mortalities in the pediatric population, defined as age 0-19 years, including data from 2021-2022. Crude death rates were reported, defined as number of deaths per 100,000 persons in that population per year.

Results In patients age 0-19 years from 2021 to 2022, traumatic crude death rate dropped from 20 to 19.4, and the firearm deaths also decreased, with a rate from 5.8 to 5.6. Of note, rates of MVC death also dropped from 5.1 to 4.6. Looking more closely at firearm deaths, the crude rates for American Indian and Alaskan Native (AIAN) increased from 4.1 to 5.4, while rates for African Americans decreased from 18.9 to 18.6, remaining far higher than other races. Crude rate for firearm death in Hispanics increased from 4 to 4.44. Despite the overall decrease in firearm deaths, the rate of homicides continued to increase in 2022, to 3.9 from 3.7, with this effect notable for an increase in rates of white homicide deaths (1.5 to 1.7) and increase in rates of Hispanic homicide (2.8 to 3.3). Homicides continue to be predominantly seen in large and medium metropolitan areas, with rates increasing in large and large fringe metropolitan areas.

Conclusion: Firearms continue to be the leading cause of death in the pediatric population in the US, despite rates beginning to decrease in 2022. The racial and ethnic disparities remain prominent. Rates of firearm deaths in Hispanics and AIAN populations increased, and the rate of firearm deaths in African American children continues to be disproportionately high. Rates of homicides continue to rise, indicating prevention strategies must be aimed at this mechanism and toward vulnerable populations.

Abbreviations: CDC WONDER: Center for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research
AIAN: American Indian and Alaskan Native

Scientific Session XI - Colorectal

2:00 PM – 3:15 PM

APSA 72

2-STAGE VERSUS 3-STAGE COLECTOMY AND POUCH CREATION FOR ULCERATIVE COLITIS IN CHILDREN: A PROPENSITY SCORE MATCHED ANALYSIS OF NSQIP-PEDIATRIC OUTCOMES

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Abstract: Background: Total colectomy with restorative procedures for children with intractable Ulcerative Colitis (UC) are typically performed in three vs two stages. Three stage procedures are considered preferable in clinically unstable patients with the pretext that the restorative procedure can then be performed after optimization and correction of physiological deterioration and nutritional status, thus making it potentially safer. However, there is limited empirical data to support this trend. We aimed to compare rates of adverse outcomes for patients undergoing 2- and 3-stage procedures for UC in the National Surgical Quality Improvement Program – Pediatric (NSQIP-P) database.

Methods: We queried NSQIP-P for children < 18 years old with UC. CPT codes were used to divide patients into two groups based on whether they had concomitant colectomy and pouch creation (2-stage group: CPT 44157-44158, 44211) or pouch creation alone (3-stage group: CPT 45113). A binary composite outcome variable was created as an indicator of anastomotic leak (AL) for further analysis using the following postoperative outcomes: death, organ space infection, sepsis, septic shock, and intra-abdominal reoperation.

Results: 411 children fulfilled selection criteria, out of which 262 (63.7%) underwent 2-stage and 149 (36.2%) underwent 3-stage procedures. 37 (14.1%) and 13 patients (8.7%) had a composite adverse outcome (signifying AL) in the 2-stage and 3-stage groups respectively, although this difference was not statistically significant (p=0.108). Preoperative nutritional status (albumin), WBC count, steroids and ASA class were identified as confounders a priori. On adjusted multivariable regression, 2- versus 3-stage procedures were not statistically associated with adverse outcomes (aOR=0.495, 95% C.I.=0.100-2.453).

Conclusion: Contrary to established belief, we were unable to identify evidence that 3-stage procedures have a lower rate of negative outcomes, including organ space infection, sepsis, septic shock and abdominal reoperation, following pouch creation in patients with UC, irrespective of preoperative disease severity. Emphasis on achieving disease remission and correcting nutritional status rather than procedure staging would likely be helpful for limiting adverse outcomes such as anastomotic leak. Surgeons may opt for 2-stage procedures, even in the setting of more advanced disease, without a significant increase in rates of postoperative adverse events following restorative pouch creation.

Abbreviations: NSQIP-P: National Surgical Quality Improvement Program - Pediatric
CPT: Current Procedural Terminology
AL: Anastomotic Leak

APSA 73

GANGLIONIC INTESTINE IN HIRSCHSPRUNG'S DISEASE IS STIFF AND FIBROTIC

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Abstract: Purpose: Hirschsprung disease (HSCR) is characterized by the lack of ganglia in the distal bowel. Proximal ganglionic bowel was once thought to be normal, but many patients inexplicably experience bowel dysfunction even after surgery. We aim to characterize properties of the proximal ganglionic bowel in HSCR that may contribute to bowel dysfunction after surgery.

Methods: First, proximal colon segments from HSCR mice (Ednrb-/-; n=4) and WT littermates (n=4) were flash frozen in liquid nitrogen, cryosectioned, and the stiffness of the muscularis propria was measured by atomic force microscopy. Next, RNA was extracted from the distal ileum of HSCR (n=3) and WT (n=3) mice and the differential expression of fibrosis-related genes was assayed using quantitative PCR. Finally, trichrome staining was performed on formalin-fixed, paraffin-embedded proximal colon sections from HSCR (n=3) and WT (n=3) mice and the degree of fibrosis was quantified. Trichrome staining was also used to compare the degree of fibrosis in proximal ganglionic intestine from HSCR patients (n=6; 20 months-14 years) to site and aged-matched controls (n=3; 2-13 years). To determine if fibrosis is an effect of distention alone, dilated upstream intestine was compared to decompressed downstream intestine from neonates with intestinal atresia (n=3). Results were normalized to control when applicable and statistical analysis was performed using a paired t-test.

Results: The proximal colon of HSCR mice was significantly stiffer than WT (1.0 vs. 1.41□0.11, $p < 0.05$). The proximal bowel of HSCR mice also exhibited upregulation of profibrotic genes, MMP-8 (+2.01 fold change) and TIMP-1 (+3.78), and downregulation of anti-fibrotic genes, MMP-9 (-2.50) and TIMP-4 (-5.83), when compared to WT. Proximal HSCR bowel was significantly more fibrotic than control in mice (1.0 vs. 1.3□0.1, $p < 0.05$) and humans (1.0 vs. 1.4□0.2, $p < 0.05$). In contrast, the degree of fibrosis didn't differ significantly in intestinal atresia (1.0 vs. 0.96□0.08, p=NS).

Conclusion: Proximal ganglionic bowel in HSCR is stiffer, more fibrotic, and exhibits differential expression of fibrosis-related genes when compared to normal bowel. This appears to be unique to HSCR as increased fibrosis is not observed in the dilated proximal bowel in intestinal atresia. These factors may contribute to postoperative bowel dysfunction in HSCR.

Abbreviations: Hirschsprung disease (HSCR)
Endothelin receptor b (Ednrb)
Wildtype (WT)
Matrix metalloproteinase-8 (MMP-8)
Matrix metalloproteinase-9 (MMP-9)
Tissue metallopeptidase inhibitor 1(TIMP-1)
Tissue metallopeptidase inhibitor 4 (TIMP-4)
Non-significant (NS)

APSA 74

RISK FACTORS FOR RECURRENCE OF CROHN'S DISEASE AFTER ILEOCECAL RESECTION AND MANAGEMENT STRATEGIES

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Abstract: Introduction: The terminal ileum is the most common anatomic location affected by Crohn's Disease (CD) and pediatric patients refractory to medical management frequently require ileocecectomy. However, risk factors for post-operative anastomotic recurrence and appropriate management strategies are poorly defined in the literature.

Purpose: To identify risk factors for anastomotic recurrence after ileocecal resection for CD and determine appropriate management strategies.

Methods: We queried our internal institutional database from 2012-2022 for patients < 21 who underwent ileocecectomy for CD. We analyzed baseline characteristics, recurrence patterns, and management of recurrent disease. We used student's t-test for continuous variables and chi-squared test for dichotomous variables with $p < 0.05$ used to define significance.

Results: We identified 208 patients who underwent ileocecal resection, of which 43 (21%) demonstrated anastomotic recurrence at a mean time of 2.1 +/- 0.5 years on colonoscopy. Average follow-up was 3.1 +/- 0.3 years. Compared to those who did not recur, patients with anastomotic recurrence demonstrated no differences in age, sex, BMI, time from initial CD diagnosis to surgery, or the presence of gastrointestinal disease outside the ileocecal region. However, patients with recurrence were more likely to require a second line biologic, require more biologic medications overall, and were more likely to require an examination under anesthesia for perianal disease [table 1]. Of the 43 patients with anastomotic recurrence, the majority 39/43 (90%) were managed with medical optimization. Four patients (10%) required procedural intervention with two being managed successfully with endoscopic balloon dilation and two requiring resection and re-anastomosis.

Conclusion: Recurrence at the prior surgical anastomosis is common after ileocecal resection for CD. While it is difficult to predict which patients will recur, those whose disease is difficult to medically control and those with contaminant perianal disease should be counselled they may be at higher risk. However, anastomotic recurrence can typically be managed medically with few patients requiring endoscopic stricture dilation or repeat resection.

Abbreviations: CD: Crohn's Disease; BMI: Body Mass Index

APSA 75

EXPRESSION OF EPITHELIAL TIGHT JUNCTION PROTEINS AND LEUKOTRIENE B4 RECEPTOR 2 IN NORMOGANGLIONIC HIRSCHSPRUNG DISEASE COLON. IMPLICATIONS FOR POST PULL-THROUGH ENTEROCOLITIS

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Abstract: Purpose
Expression of intestinal tight junction proteins (TJP) and leukotriene B4 receptor 2 (BLT-2; an upstream regulator of the TJP Claudin-4) in normoganglionic Hirschsprung disease (HD) colon were investigated for possible etiologic correlation with post-pull-through (PT) Hirschsprung-associated enterocolitis (post-PT-HAEC).

Methods
Specimens of normoganglionic HD colon (HD-N) and aganglionic HD rectum (HD-A) from rectal/rectosigmoid (R/RS) and descending/transverse (D/T) from a prospective cohort (p-cohort; n=15; R/RS=13 and D/T=2; 2021-2023) and a retrospective cohort (r-cohort; n=24; R/RS=17 and D/T¬=7; 2011-2020) of HD patients were assessed for Occludin, TJP-1, TJP-2, Junctional adhesion molecule (JAM)-1, JAM-2, Claudin-1, Claudin-3, Claudin-4, and BLT-2 using quantitative polymerase chain reaction (qPCR).
Post-PT-HAEC was defined by Gosain et al., Pediatr Surg Int, 2017, developing within 2 years of PT in the absence of technical surgical issues and transitional zone PT. Claudin-4 was compared between post-PT-HAEC(+) cases (n=9) and post-PT-HAEC(-) cases (n=30) in p-cohort by immunoblotting and in both cohorts by immunohistochemistry, quantified by ImageJ software to determine if Claudin-4 and BLT-2 are associated with post-PT-HAEC. Specimens of colon collected during colostomy closure in anorectal malformation patients (n=29) were used as controls.

Results
Mean ages at surgery (years) were R/RS: 2.6±2.8, D/T: 1.8±2.3, and controls: 1.1±0.4. On qPCR, TJP-1, TJP-2, JAM-1, JAM-2, and Claudin-4 were significantly lower in both HD-N and HD-A compared with controls and a strong significant decrease in BLT-2 was identified in both HD-N and HD-A compared with controls ($p < .01$ and $p < .001$, respectively; Figure 1: A, B). Claudin-4 was significantly lower in both HD-N and HD-A compared with controls on immunoblotting and immunohistochemistry (Figure 1: C, D, E), and significantly lower in HD-N from D/T compared with R/RS (Figure 1: F). Post-PT-HAEC(+) was grade I (n=4) and grade II (n=5); Claudin-4 was lower in HD-N from post-PT-HAEC(+) compared with post-PT-HAEC(-), but not significantly (Figure 1: G).

Conclusions
From TJP results, there would appear to be some degree of epithelial barrier derangement in HD-N especially from D/T cases supported by significantly decreased BTL-2 resulting in lower Claudin-4 in post-PT-HAEC(+) that may have etiologic implications.

Abbreviations: TJP: Tight junction protein
BLT-2: leukotriene B4 receptor 2
HD: Hirschsprung disease
PT: pull-through
post-PT-HAEC: post-pull-through Hirschsprung-associated enterocolitis
HD-N: normoganglionic HD colon
HD-A: aganglionic HD rectum
R/RS: rectal/rectosigmoid
D/T: descending/transverse
p-cohort: prospective cohort
r-cohort: retrospective cohort
JAM: Junctional adhesion molecule
qPCR: quantitative polymerase chain reaction

Figure 1

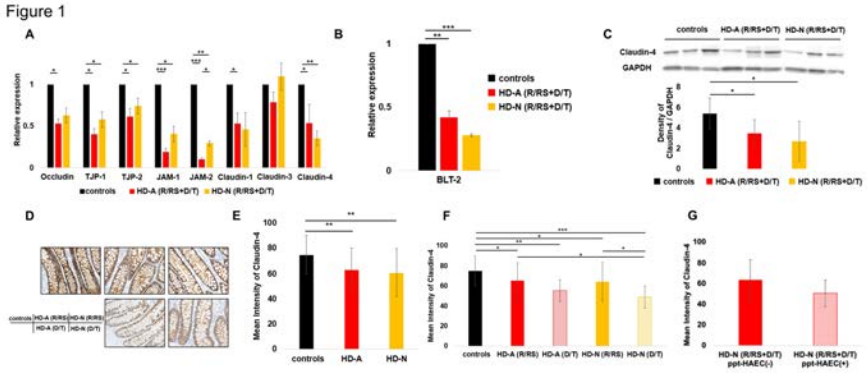

Figure legends
A: Significantly lower expression of Occludin, TJP-1, TJP-2, JAM-1, JAM-2, and Claudin-4 in HD-A (R/RS+D/T), and of TJP-1, TJP-2, JAM-1, JAM-2, and Claudin-4 in HD-N (R/RS+D/T) than controls on qPCR (*p<.05, **p<.01, and ***p<.001).
B: Significantly lower expression of BLT-2 in HD-A (R/RS+D/T) and HD-N (R/RS+D/T) than controls on qPCR (**p<.01, ***p<.001).
C: Significantly lower expression of Claudin-4 in HD-A (R/RS+D/T) and -HD-N (R/RS+D/T) than controls on immunoblotting (*p<.05).
D: Representative images of Claudin-4 expression in controls, HD-A (R/RS), HD-A (D/T), HD-N (R/RS), and HD-N (D/T).
E: Claudin-4 was significantly lower in both HD-N and HD-A compared with controls on immunohistochemistry (**p<.01).
F: Claudin-4 was significantly lower in HD-A (R/RS), HD-A (D/T), HD-N (R/RS), and HD-N (D/T) than controls and significantly lower in HD-N (D/T) than HD-A (R/RS) and HD-N (R/RS) (*p<.05, **p<.01, and ***p<.001).
G: Relatively lower Claudin-4 in HD-N from post-PT-HAEC(+), but not significantly (p=.07).

APSA 76

A REVIEW OF THE ECONOMIC IMPACT OF DAILY BOWEL MANAGEMENT REGIMENS

Vatche J. Melkonian, DO[1], Luis de La Torre, MD[2], Jill Ketzer[3], Victor Rodriguez[1], Hannah Martin[1], Lauren Schneider[1], Anne Merritt[1], Alberto Pena[1], Andrea Bischoff, MD[2], Maura Wickham[4]

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[2]*International Center for Colorectal and Urogenital Care, Children's Hospital Colorado, Aurora, CO, USA,*
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Abstract: Purpose:

Chronic constipation and fecal incontinence are devastating problems for patients with anorectal malformations, Hirschsprung disease, idiopathic constipation, and spina bifida. Finding the proper regimen allows our patients to be out of diapers and free of stool accidents. A typical bowel management regimen consists of daily laxatives or enemas; because these products are sold over the counter, insurance companies do not cover them. The purpose of this study was to review the cost of bowel regimens and to analyze their economic impact juxtaposed against the median annual income of the families we treat.

Methods:
A retrospective review of patients undergoing bowel management between January 2016 and September 2023 was done. The mean annual income of families was calculated using their zip codes.

Results:
Upon review, 592 patients met inclusion criteria; 232 were on laxatives, and 360 were on enemas. There was significant variation in the cost of medications based on the stores/companies they were bought from and the amount of the medication in their regimen. A 15 mg chocolate senna square for a patient taking 5 squares nightly could range from $328.50 to $857.75 annually, depending on where it was purchased. For a patient using 30 ml of glycerin on a daily enema, the price could range from $87.60 to $1,095 annually. The dose based cost for these bowel regimens can range from $6.28 to $8,701.31 annually. The median annual income of our treated families spanning 39 states ranged from $27,479 to $135,449. The cost of diapers/incontinence briefs was also evaluated as these would be required for patients without a successful bowel management regimen. For 5 diapers per day, prices ranged from $657/year in infants to $2,171/year in larger children/adult patients.

Conclusions:
Our findings emphasize the importance of proper counseling families about the difference of medication cost in the market, with the intent to promote long-term treatment adherence. This study can also serve as a data source to advocate for improved insurance coverage of these essential medications required to manage these chronic conditions successfully, with the knowledge that it has a decreased cost to families when compared to diapers.

Abbreviations:

APSA 77

UPFRONT BOTOX INJECTIONS AND THEIR IMPACT ON HIRSCHSPRUNG-ASSOCIATED ENTEROCOLITIS INCIDENCE

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Abstract: Background

Hirschsprung-associated enterocolitis (HAEC) is an important cause of morbidity and mortality in Hirschsprung Disease (HD) patients. Botulinum toxin (Botox) has previously been associated with decreased episodes of HAEC and increased interval between HAEC episodes. We aimed to evaluate the efficacy of upfront anal Botox injections for reducing postoperative HAEC occurrence.

Methods

Two arms were used in this study; first, HD patients who had undergone a pull-through procedure and were seen at our institution between 2005 and 2019 were reviewed retrospectively. Second, HD patients undergoing pull-through procedure and/or ostomy takedown at our institution between 2020 and 2023 were included in a prospective study and treated with upfront Botox (at the time of pull-through or establishment of intestinal continuity). Patients with intestinal discontinuity at time of analysis were excluded. Frequencies of HAEC, defined by treatment for presumed HAEC, and Botox injections were tallied. Associations between initial Botox treatment and HAEC incidence were evaluated with chi-square analysis.

Results

Two hundred and twenty-nine patients meeting criteria were reviewed; 29 were in the prospective cohort. Median age at diagnosis was 9 days (IQR 3-127). One hundred and thirty-two (57.9%) patients underwent primary pull-through at a median age of 26 days (IQR 10-121). Ninety-six (42.1%) patients with initial ostomy had intestinal continuity reestablished at a median of 370 days (IQR 191-858). One hundred and five (47.7%) of all patients experienced at least one episode of HAEC and 68 (64.8%) experienced multiple episodes. Thirty-five (16.4%) patients received Botox injections at the time of pull-through or establishment of intestinal continuity, including all prospectively studied patients. There was no difference in the overall occurrence of enterocolitis between patients who received upfront Botox and those who did not (34.3% vs 50.6%, p = 0.078). Fewer patients who received upfront Botox had multiple episodes of enterocolitis compared to those who did not receive upfront Botox (17.1% vs 34.7%, p = 0.042).

Conclusions

Upfront Botox injections at the time of pull-through procedure or establishment of intestinal continuity may reduce the number of episodes of postoperative Hirschsprung-associated enterocolitis.

Abbreviations: HAEC, Hirschsprung-associated enterocolitis
HD, Hirschsprung disease
Botox, Botulinum toxin
IQR, interquartile range

APSA 78

HISTOPATHOLOGICAL FINDINGS AFTER TRANSANAL PROXIMAL RECTOSIGMOID RESECTION FOR SEVERE CHRONIC IDIOPATHIC CONSTIPATION IN CHILDREN WITH MEGA-RECTOSIGMOID

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Abstract: Purpose
To describe the histopathological findings in the mega-rectosigmoid of pediatric patients suffering from severe chronic idiopathic constipation (SCIC) who underwent a transanal proximal rectosigmoid resection.

Methods
All children suffering from SCIC in the setting of a mega-rectosigmoid who underwent a transanal proximal rectosigmoidectomy from July 2017 to May 2018 were included. The resected specimens were sectioned and analyzed circumferentially at the proximal and the distal margin. In addition, longitudinal sections along the total specimen's length were evaluated. The thickness of the muscle as well as identified nerve fibers were compared to age-matched controls. Statistical analysis was performed with SPSS 21.0.

Results
Twelve patients met our inclusion criteria. The median age at the time of surgery was 8.6 years, and most patients were male. The median duration of constipation was 5.5 years. Compared to the controls, all patients showed significant hypertrophy of the inner and outer layers of the muscularis propria, thickened nerve fibers, and increased width of the lamina propria (Table 1). In addition, the increased thickness of the lamina propria was primarily caused by fibrosis.
When comparing the distal (rectal border) to the proximal (sigmoid border) limit of the specimen, a significant difference in thickness of the outer muscularis propria, size of the nerve fibers, and the lamina propria was found ($p < 0.05$).
Fibrosis was increased in all cases compared to age-matched controls, predominantly in the lamina propria. No morphometric analysis was used in this assessment, but the distal end of the specimen was also more fibrotic than the proximal portion.

Conclusion
Histopathologic findings in patients with SCIC in the setting of mega-rectosigmoid anatomy showed significant muscular hypertrophy, thickened nerve fibers, and fibrosis within the lamina propria. These findings were more pronounced in the resected rectal part, suggesting an advanced disease process in this location. This is the first report of fibrosis in children with SCIC, raising concerns for an irreversible process that can only be corrected surgically.

Abbreviations: SCIC: Severe chronic idiopathic constipation

APSA 79

UROLOGICAL OUTCOMES IN ADULT FEMALES BORN WITH ANORECTAL MALFORMATION OR HIRSCHSPRUNG DISEASE

Lea A. Wehrli, MD[1], Elisha McGuire, APP, MSN, RN, CPNP-AC[2], Emily H. Cooper, Jared M. Rieck, Kelly Harris, MD[3], Dan Wood, MBBS, PhD[4], Duncan T. Wilcox, MD[4], Jill Ketzer[5], Luis de La Torre, MD[6], Alberto Peña, MD[3], Andrea Bischoff, MD[6]

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Abstract: Introduction
Women born with anorectal malformation (ARM) or Hirschsprung disease (HD) may have impaired urologic function resulting in sequelae in adulthood. This study assessed and compared self-reported urinary outcomes in adult females born with ARM or HD to a reference population.

Methods
This was an IRB approved, cross-sectional study of female born patients in the Adult Colorectal Research Registry who completed surveys between November 2021 and August 2022. Female patients between the ages of 18 and 80 years with ARM or HD were included. Lower Urinary Tract Symptom questionnaires were administered through REDCap and the responses were compared to a reference population. A p-value of < 0.05 was considered significant.

Results
Sixty-six born female patients answered the questionnaires, two of them identified as non-binary. The response rate was 76%. Median age was 31.7 years. The majority were born with Cloaca (57.6%, 38 patients), followed by other type of ARMs (27.3%, 18 patients), Complex Malformation (9.1%, 6 patients), and HD (6.1%, 4 patients). A history of bladder reconstruction was present for 27.3%. Catheterization through a channel or native urethra was present in 13.6%. Three patients had a history of a kidney transplantation and two had ureterostomies, all were born with a cloaca.
Patients with cloaca had significantly higher rates of urinary incontinence, urinary tract infection, and social problems due to impaired urological functioning when compared to an age-matched reference population (Table1).

Conclusion
This study emphasizes the necessity of a multi-disciplinary team that includes urology and follows patients with ARM for long-term, especially within the subgroup of cloaca.

Abbreviations: ARM: Anorectal Malformation
HD: Hirschsprung Disease
IRB: Institutional Review Board

APSA 80

DECISIONS IN DIVERSION: OSTOMY VS. PRIMARY ANASTOMOSIS FOR COLONIC ATRESIA

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Abstract: Purpose
Colonic atresia (CA) is associated with a low, but poorly defined, incidence of Hirschsprung disease (HD). Due to concerns about constructing an anastomosis proximal to aganglionic bowel or dysmotility due to distended colon associated with the atresia, some surgeons elect to perform ileal or colonic diversion with a staged anastomosis. We sought to better define the incidence of concurrent HD and to evaluate contemporary practice regarding diversion in infants with CA.
Methods
The Pediatric Health Information System (PHIS) database was used to identify patients with CA from 2013-2022. Exclusions included concurrent small bowel atresia, anorectal malformation, gastroschisis, prematurity, and first operation after 14 days of age. Index operation (diversion or primary anastomosis), the anatomy of stomas and anastomoses, and the details of subsequent operations were determined. Surgical complications, duration of parenteral nutrition, time to ostomy closure, and unplanned operations were evaluated.
Results
Infants who underwent diversion were demographically similar to those managed with a primary anastomosis. In the 58 (69%) patients who were initially diverted, an ileostomy was performed in 19(33%) and a colostomy in 39(67%). Continuity was restored with an ileo-colic anastomosis in 63% of diverted and 27% of primarily anastomosed patients. Of those managed with an initial colostomy, 53% ultimately received a colo-colic anastomosis at the time of ostomy reversal, allowing for retention of proximal colon. Those who underwent a primary anastomosis had a longer duration of TPN and fewer total operations. There was no difference in any other outcome (Table). HD was diagnosed in 8 (9.5%) patients and 7 of these were diverted.
Conclusion
In a large and geographically diverse population of infants with CA, we found that 9.5% had concurrent HD. Almost 70% of CA patients underwent initial intestinal diversion and only one with HD had a primary anastomosis. Patients managed with a primary anastomosis were substantially more likely to retain the segment of colon proximal to the atresia, but had a similar incidence of operative complications compared to those who were initially diverted. When intraoperative frozen section can be obtained, we conclude that primary anastomosis is a safe and effective strategy for colonic atresia.

Abbreviations: HD: Hirschsprung disease
CA: Colonic atresia
TPN: Total parenteral nutrition
SD: Standard deviation
IQR: Interquartile range

Scientific Session XII - Education

2:00 PM – 3:15 PM

APSA 81

VALIDATION OF AN ANORECTAL MALFORMATION TRAINER - CAN A HIGH-FIDELITY MODEL SIMULATE REAL LIFE?

Claire A. Ostertag-Hill, MD[1], Prathima Nandivada, MD[1], Aaron P. Garrison, MD[2], Richard J. Wood, MD[3], Michael G. Silver[1], Gregory Loan[1], Stephen F. Wilson[1], Belinda H. Dickie, MD, PhD[1]

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Abstract: Purpose

The average number of anorectal malformation (ARM) repairs performed by U.S. pediatric surgery trainees is 15.5 (5-27) with recertifying American pediatric surgeons performing an average of only 2.2 ARM repairs annually. The reconstruction is composed of a series of reproducible maneuvers that can be replicated on a simulator. We have previously demonstrated face and content validity of a newly developed, high-fidelity ARM simulator. The aim of this study was to investigate the discriminant construct validity of this simulator.

Methods

A high-fidelity ARM simulator was designed using digital modeling software packages and fabricated using 3D-printing, hand-sculpting, and multi-stage silicone injection molding techniques. A cross-sectional observational study was performed at an international surgical meeting in May 2022, recruiting 27 surgeons with varying levels of experience in performing a posterior sagittal anorectoplasty (PSARP) (n=11 experts, n=16 novice). Each participant performed a PSARP after viewing a short demonstration video on the model and receiving an instructional guide based on Delphi consensus methods for PSARP steps. Each session of the simulation was recorded and independently assessed by 3 experienced pediatric colorectal surgeons (raters). They were blinded to operator identity and experience level and utilized standardized general skills (OSATS) and PSARP step-specific (based on Delphi consensus) assessment tools.

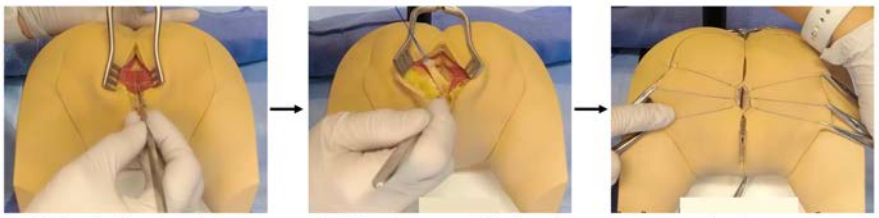
Results

Significant differences between the groups were observed for multiple items in the OSATS checklist, including respect for tissue (p=0.017), instrument handling (p=0.012), flow of operation (p=0.004), and knowledge of specific procedure (0.014), with interrater reliability scores indicating moderate reliability (ICC 0.52 to 0.75). Additionally, pediatric colorectal raters indicated that the model could distinguish between experts and novices on all steps of the PSARP procedure (p-values 0.005 to 0.046), with interrater reliability scores indicating good to moderate reliability (ICC 0.51 to 0.79). There was no significant difference in the time taken to complete a PSARP (62.2±18.5 versus 60.7±15.1 minutes for experts, p=0.84).

Conclusion

Evaluation of a newly developed high-fidelity, 3D-printed anorectal malformation surgical simulator demonstrated face, content, and discriminant construct validity. Given the low number of PSARPs performed annually by surgical fellows and attendings, this simulator can offer a high-fidelity training tool.

Abbreviations: ARM: anorectal malformation; PSARP: posterior sagittal anorectoplasty; OSATS: objective structured assessment of technical skill



Midline incision through skin, muscles, and fat

Defining planes around fistula and separating anterior rectal wall from posterior vaginal wall

Anoplasty

APSA 82

IMPROVING DIVERSITY, EQUITY, AND INCLUSION IN PEDIATRIC SURGERY: AN INNOVATIVE MENTORSHIP PROGRAM

Amelia E. Gavulic, BS[1], Insiyah Campwala, MD[2], Natalie Moreno, MD[3], Grace M. Mallampalli, BSN[4], Yousef Ibrahim, MD[5], Anthony Stallion, MD[6], Sabina Siddiqui, MD[7], Marjorie J. Arca, MD[8], Samir K. Gadepalli, MSc, MD, MBA[5], Erika A. Newman, MD[9]

[1]University of Cincinnati College of Medicine, Cincinnati, OH, USA, [2]University of Pittsburgh, Pittsburgh, PA, USA, [3]University of Pennsylvania, Philadelphia, PA, USA, [4]The Ohio State University, Columbus, OH, USA, [5]University of Michigan, Ann Arbor, MI, USA, [6]Beaumont Children's Hospital, Royal Oak, MI, USA, [7]Arkansas Children's Hospital, Springdale, AR, USA, [8]University of Rochester | Golisano Children's Hospital, Rochester, NY, USA, [9]C. S Mott Children's Hospital, University of Michigan, Ann Arbor, MI, USA

Abstract: Purpose:
Representation among pediatric surgeons does not reflect the pediatric patient population. In line with the Association of Pediatric Surgery Training Program Directors (APSTPD)'s mission to broaden cognitive diversity and representation in the workforce via leadership development and longitudinal mentorship, the Alliance of Pediatric Surgeons Growing and Advancing Representation (APGAR) was created with national collaboration. One year later, we report on the composition of APGAR and the perspectives of its members.

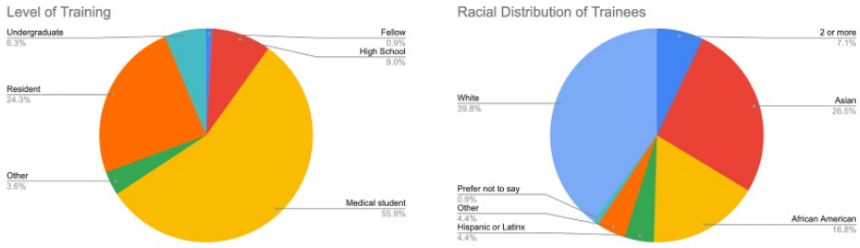
Methods:
Seventeen mentorship groups ("pods") were formally established with representatives from each premedical learner level from high school students to pediatric surgery fellows and attendings. Pods were led by faculty surgeons and met quarterly. Programming was facilitated via video conferencing in large and small-group settings. A survey was administered prior to pod formation and at the one-year checkpoint.

Results:
A total of 126 trainees and 29 faculty pediatric surgeons participated in national APGAR programming, representing 54 institutions. Ninety-seven trainees completed the pre-survey and 46 completed the post-surveys (111 unique trainees), with a response rate of 88%. Survey participants were primarily women (74%) and exhibited diversity in race and training level. [Figure 1] Median age was 26 years [IQR 24-28, range 13-42]. Many had prior clinical (60%) or research (49%) experiences in pediatric surgery. Trainee perspectives regarding the ranked importance of factors affecting specialty selection (e.g., compensation, job market) and their perceptions of pediatric surgeons (e.g., work-life balance, team environment) were not significantly different before the creation of pods and one year later. Majority of participants believed APGAR increased their interest in pursuing pediatric surgery specialty training (60%), highly valued the mentorship provided by APGAR (76%), and believed that APGAR membership helps them prepare for a career in pediatric surgery (52%).

Conclusion:
One-year qualitative assessment illustrates how APGAR, a longitudinal small-group inter-institutional networking and longitudinal mentorship program, may improve trainee perspectives and career preparation. This platform encourages participation of minoritized groups early during their education toward an eventual pathway to pediatric surgery. Long-term implementation and follow-up are required to determine sustainable impact.

Abbreviations: Association of Pediatric Surgery Training Program Directors (APSTPD)
Alliance of Pediatric Surgeons Growing and Advancing Representation (APGAR)

Figure 1: Demographic Composition of APGAR Participants



APSA 83

VIRTUAL REALITY FOR PEDIATRIC TRAUMA TRAINING - A FACE AND CONTENT VALIDATION STUDY

Fabio Botelho, MD MSc[1], Said Ashkar, B.Sc[2], Shreenik Kundu, MD, MSc[3], TJ Matthews, n/a[4], Elena Guadagno, MS[5], Dan Poenaru, MD, Ph.D[6], Jason M. Harley, PhD[7]

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Abstract: Purpose: We aim to evaluate the face and content validity of a virtual reality (VR) platform designed to enhance pediatric trauma skills. Specifically, we seek to determine whether the platform effectively presents pediatric trauma scenarios and comprehensively covers the range of essential knowledge and skills in the pediatric trauma domain.

Methods: We have developed PetitVR, a multiplayer VR platform for enhancing trainees' skills in pediatric trauma care. It allows up to five simultaneous users (including the instructor) to immerse themselves in realistic 3D scenarios designed with input from pediatric trauma experts to optimize educational value (Figure 1). Scenarios unfold dynamically based on trainee actions, and quantitative performance analytics are generated to support debriefing and feedback. Physicians involved in pediatric trauma care were invited to evaluate the platform. They completed a questionnaire based on the modified Technology Acceptance Model (TAM) and a cybersickness assessment using a 6-point Likert scale. Additionally, participant demographics were collected, including age, country of medical education, and current position. Descriptive analysis was employed to examine perceived usefulness, intention to use (derived from standard TAM formulas), and cybersickness. We compared the effectiveness of the VR platform to improve technical vs. non-technical skills, as assessed through participants' feedback, using chi square tests.

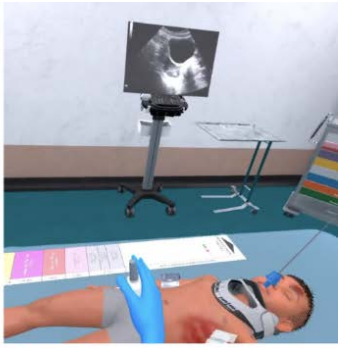
Results: Eleven physicians who completed medical training in eight different countries evaluated the platform. Most (87%) perceived the VR simulator as useful and 93% intended to use it. The majority (81%), preferred the VR experience over high-fidelity mannequins, agreeing or strongly agreeing that VR was superior. The VR platform was rated more favorably for training non-technical (score 4.7/5) than for technical skills (score 3.5/5, $p < 0.01$). Only 9% of the participants reported experiencing any cybersickness symptoms, none resulting in requests to terminate the simulation.

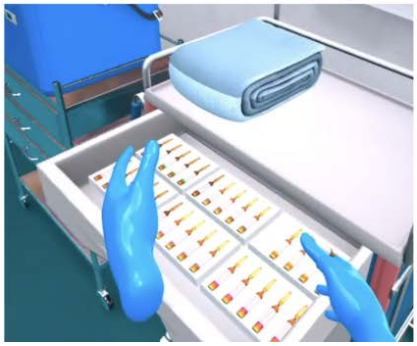
Conclusion: We have performed a preliminary validation of a novel VR simulator for pediatric trauma education. These positive results will lead to a phase 2 clinical trial comparing the effectiveness of VR technology to high-fidelity mannequins for pediatric trauma education.

Figure 1. PetitVR platform for pediatric trauma education

Abbreviations: Virtual Reality: (VR)
Technology Acceptance Model (TAM).


PeTIT
Petit






Dr Tom
Team Leader

APSA 84

THE IMPACT OF LONGITUDINAL COACHING ON WELL-BEING AND BURNOUT IN PEDIATRIC SURGERY TRAINEES: 2021-2023 COHORT

Eunice Huang, MD, MS[1], **Azalia Avila, MD**[2], Rebecca A. Saberi, MD[3], Kerri Palamara, MD[4], Danielle Katz, MPH[5], Heidi Chen, PhD[6], Holly Neville, MD[7]

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Abstract: Purpose:
This study aims to explore the influence of a longitudinal coaching relationship on the well-being and burnout of pediatric surgery residents coached by practicing surgeons trained in professional development and positive psychology coaching.

Methods:
A prospective quality improvement study was conducted from August 2021 to July 2023 evaluating pediatric surgery resident well-being before and after coaching by surgeons trained in positive psychology coaching. Residents completed pre- and post-coaching surveys, which employed validated measures of well-being, including Professional Fulfillment Index, Burnout, Self-Valuation, Positive Emotion, Engagement, Relationships, Meaning, and Accomplishments score (PERMA), Gratitude, Intolerance of Uncertainty, Dispositional Resilience Scale, and measurement of coping skills. Wilcoxon Signed Rank Test was used for paired comparisons between pre- and post-coaching survey results.

Results:
20 (34%) participants completed both pre- and post- coaching surveys. 70% were female; 50% were junior residents. Residents exhibited improvement in PERMA (measurement of well-being) and self-valuation. Residents rated improved ability to cope in the areas of work-life balance and self-confidence. Residents also had higher scores in experiences with receiving feedback and opportunities to reflect post-coaching. (Table 1) Additionally, a greater percentage of residents showed a reduction in burnout, even though absolute value of change may have been small (65% beneficial direction, 5% unchanged, 30% non-beneficial direction, $p = 0.004$). Interestingly, junior residents demonstrated greater improvement in Dispositional Resilience Scale post-coaching compared to senior residents (median change junior=3.0 {IQR:0.3,5.3}), median change senior=-1.0 {-3.0,0.8}, $p = 0.054$).

Conclusion:
Coaching is helpful for pediatric surgery residents, as it helps to reduce burnout and improve well-being. It also supports activities that promote well-being, such as reflection and goal setting. These results are consistent with previous findings that positive psychology coaching supports resident well-being, coping skills, self-compassion, and self-valuation.

Abbreviations:

APSA 85

DETERMINANTS OF ACADEMIC SUCCESS IN PEDIATRIC SURGEON-SCIENTISTS

Oluyinka O. Olutoye, MD, MPH[1], Michael Gyimah, MD[1], Taylor Lee[2], Anjali Degala[2], Ekene Onwuka, MD, MS[3], Kristy Rialon, MD[1], Alice King, MD[2], Sundeep G. Keswani, MD[4], Lily Cheng[5]

[1]Baylor College of Medicine, Houston, TX, USA, [2]Texas Children's Hospital, Houston, TX, USA, [3]Texas Children's Hospital & Baylor College of Medicine, Houston, TX, USA, [4]Baylor College of Medicine and Texas Children's Hospital , Bellaire, TX, USA, [5]University of Virginia, Charlottesville, VA, USA

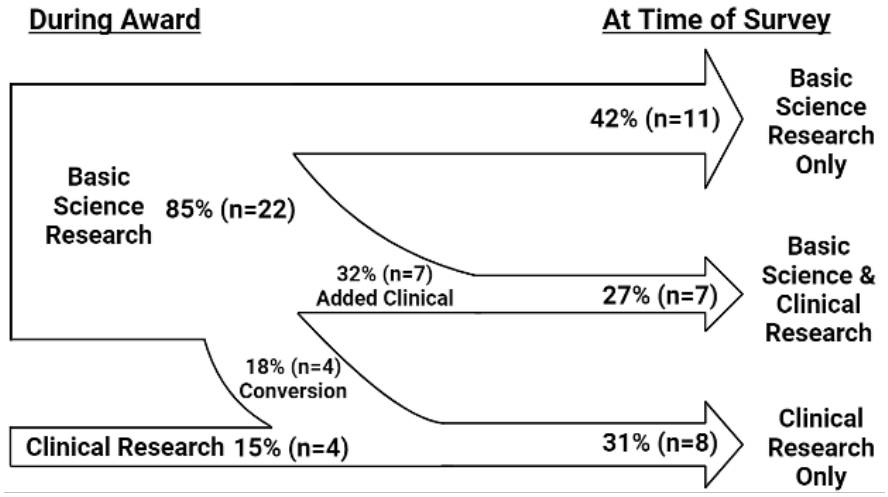
Abstract: Purpose: The American Pediatric Surgical Association Foundation's Jay Grosfeld, MD Scholar Grant supports early-career pediatric surgeon-scientists. We have previously demonstrated that these Scholars experience high degrees of success in their future academic careers. In this study, we sought to elucidate other determinants of academic success in this cohort.

Methods: A 31-question survey was emailed to Grosfeld Scholars, which elicited demographics, research areas during and after the award, amount of departmental support, and extramural funding obtained following the award among other metrics. Survey results were compared to National Institutes of Health (NIH) RePORTER data on award recipient funding. Data were analyzed with Fisher's exact and Wilcoxson rank sum tests.

Results: Twenty-six of 47 (55%) awardees responded to the survey. Twenty-two (85%) awards were given for basic/translational science research, but only half of those awardees continued to conduct primarily basic/translational research at the time of the survey. Seven awardees (27%) conducted a mix of clinical and basic/translational research, and eight (31%) conducted clinical research only at the time of the survey (Figure 1). Awardees who converted to clinical research only were all female (n=4) and reported a median of 15% research time compared to a median of 30% research time across all awardees. Men were more likely to obtain extramural funding ($p < 0.05$) in those surveyed. A similar trend exists in the larger group of all 47 awardees (24% women vs. 37% men with extramural funding), but was not statistically significant. Intent to apply for an NIH mentored career development award correlated with obtention of extramural funding ($p < 0.05$). Research area, departmental research support, primary mentor's background, and Blue Ridge ranking of the awardee's home institution did not correlate with extramural funding.

Conclusion: The academic success of Grosfeld Scholars appears to be independent of institutional support and research area, but may be tied to gender, amount of protected research time, and intent to apply for NIH awards. Additionally, women appear more likely to convert from basic/translational research to clinical research and less likely to obtain extramural funding. Results from this small sample of academic pediatric surgeons highlight important issues in need of further study.

Abbreviations: NIH: National Institutes of Health


During Award
At Time of Survey
Basic Science Research
85% (n=22)
42% (n=11)
Basic Science Research Only
32% (n=7) Added Clinical
27% (n=7)
Basic Science & Clinical Research
18% (n=4) Conversion
Clinical Research 15% (n=4)
31% (n=8)
Clinical Research Only

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READINESS OF GRADUATING GENERAL SURGERY RESIDENTS TO PERFORM COMMON PEDIATRIC SURGERY PROCEDURES

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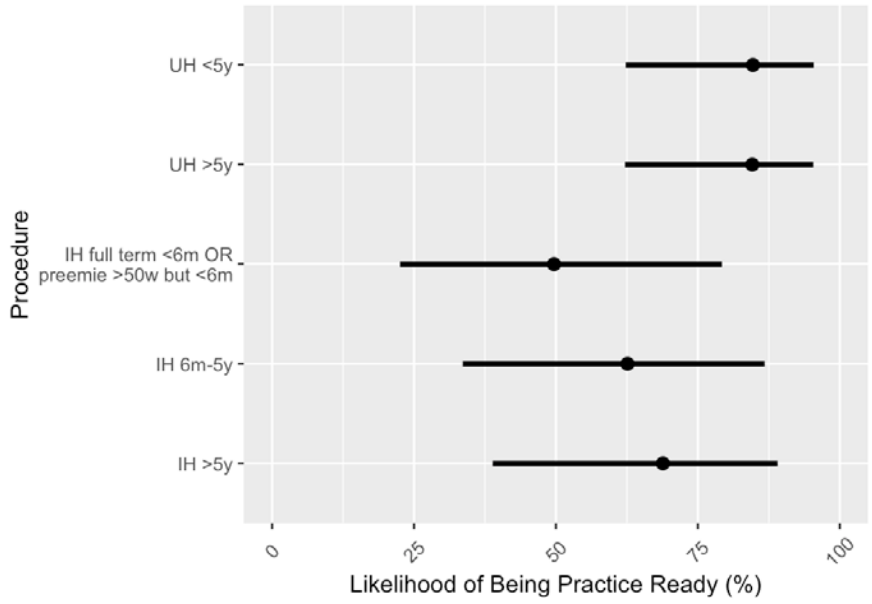
Abstract: Purpose
Pediatric surgery exposure for general surgery trainees has been declining since the 1990s, yet 40% of pediatric surgery procedures are performed at adult hospitals. Some of these pediatric procedures are performed by non-fellowship trained general surgeons. However, only 20 pediatric surgery cases are required for general surgery graduation, and the most commonly logged cases are inguinal (IH) and umbilical hernia (UH) repairs. In this study, we aim to evaluate how prepared general surgery residents are to perform the most common pediatric surgery procedures upon completion of residency.

Methods
Pediatric IH and UH operative performance ratings were collected from all general surgery trainees in the United States between 2015-2023 using the Society for Improving Medical and Professional Learning (SIMPL) assessment system. Ratings were analyzed using Bayesian generalized linear mixed models. The primary outcome was graduating residents' adjusted probability of being competent to perform an IH or UH repair, defined as 'practice-ready' or 'exceptional' performance ratings, controlling for case complexity, procedure, post-graduate year (PGY), and academic month as fixed effects and faculty, trainee, program as random effects.

Results
A total of 1,601 evaluations (878 UH, 723 IH) from 57 general surgery residency programs were analyzed. Graduating residents had an adjusted probability of being deemed competent to perform an IH of 49.7% (Interquartile range [IQR] 23%-79%) for a full term < 6 month old or preemie >50 week old, 62.6% (IQR 34%-87%) for a 6 month to 5 year old, and 68.8% (IQR 39-89%) for a >5 year old. For UH, adjusted probability of competence was 84.7% for a < 5 year old (IQR 62%-95%) and 84.6% for a >5 year old (IQR 62%-95%).

Conclusions
General surgery residents are not universally competent to perform the most common pediatric surgery procedures at the completion of residency. These results call for examination of the current graduation case requirements and pediatric surgery experience provided for general surgery trainees.

Abbreviations: IH = inguinal hernia
UH = umbilical hernia
SIMPL = Society for improving medical and professional learning
PGY = postgraduate year
IQR = interquartile range


UH <5y
UH >5y
IH full term <6m OR preemie >50w but <6m
IH 6m-5y
IH >5y
Procedure
0
25
50
75
100
Likelihood of Being Practice Ready (%)

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THE INFLUENCE OF A PEDIATRIC SURGERY RESIDENT ORIENTATION PROGRAM ON DOCUMENTATION OF APPROPRIATE SPECIFIC ACUTE APPENDICITIS BILLING CODES AND HOSPITAL REIMBURSEMENT

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Abstract: Purpose:
Residents may be unfamiliar with the impact of ICD 10 diagnosis code specificity on hospital billing for appendicitis. Usage of unspecified codes such as the k35.80 code “Unspecified acute appendicitis” versus the specified k35.30 code “Acute appendicitis with localized peritonitis” for simple acute appendicitis may lead to decreased hospital reimbursement. We hypothesized that the use of a formal resident orientation program would improve resident selection of appropriate billing codes, leading to increased reimbursement.
Methods:
Beginning at the end of 2020, residents received a formal orientation to the pediatric surgery service, including choosing specified ICD 10 diagnosis codes. A retrospective billing data review was performed for all pediatric patients that underwent laparoscopic appendectomy for appendicitis. The pre-orientation period was 2020 and the post orientation period was 2022. Patients for whom there was no payment were excluded. Our primary outcome measure was the number of times each code was used. Secondary outcome data was the rate of payment for each year, adjusted to account for inflation/billing changes. Reimbursement for patients not requiring inpatient stay was analyzed using Microsoft Excel and GraphPad Prism. Two-tailed p-value ≤ 0.05 was considered significant.
Results:
There were 267 patients with hospital charges for the analyzed codes during the years analyzed, with 139 in 2020, and 128 in 2022. There was a significant increase in specific diagnosis code utilization (K35.30 as opposed to K35.80) from 3.6% in 2020 to 87.5% in 2022, p< 0.0001. When adjusted for inflation and billing changes by normalizing 2020 data to 2022 data, mean reimbursement increased from $4,414 per case to $5,075 per case for a difference of $661 per case, p=0.027. This resulted in $84,616 greater hospital reimbursement for 2022 simply by improving coding for one subset of appendicitis patients.
Conclusions:
A resident orientation program for pediatric surgery can lead to a significant increase in specified billing code usage and hospital reimbursement for patients undergoing ambulatory laparoscopic appendectomy for uncomplicated acute appendicitis.

Abbreviations: ICD-10: International Classification of Diseases, Tenth Revision,

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GATHER (GENERATE AND TEACH HEALTH EQUITY ROUTINELY): CHANGING SURGEON DEI BEHAVIORS THROUGH A NOVEL QI FRAMEWORK

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Abstract: Purpose: Clinicians are critical to addressing health inequities. However, minimal published data exists supporting the effectiveness of educational interventions to improve clinician diversity, equity, and inclusion (DEI) behaviors. We studied a 3-session, peer-driven quality improvement (QI) educational intervention (GATHER) for clinicians at a quaternary pediatric medical center, and its impact on equity-focused behaviors for surgical service clinicians. We hypothesized improvements in equity-focused behaviors as compared to a participant's baseline through completion of the program.

Methods: Participants enrolled in Generate and Teach Health Equity Routinely (GATHER) reported frequency of 7 DEI behaviors using self-assessments. All surgical service clinicians (surgeons, anesthesiologists, certified nurse anesthetists, ophthalmologists, gastroenterologists, dentists) who enrolled in the intervention and completed at least 1 self-assessment between September 2021-August 2023 were included in the analysis (n=52). Participants completed assessments monthly for 3 months pre-intervention, weekly during the intervention, and at 1, 2, 3 and 6 months post-intervention. Behavior frequency was measured as always, often, sometimes, seldom, or never. Mixed effects logistic regression models with fixed effects of time period and a random effect of participant were used to model the binomial probability of 'often' or 'always' engaging in measured DEI behaviors. Time was assessed categorically based on model fit and timing of responses. Population averaged predictive probabilities and odds ratios for each time period were calculated with 95% confidence intervals. Statistical significance was defined as $p < 0.05$.

Results: 52 surgical service clinicians completed at least 1 self-assessment during their participation in GATHER over the 23-month time period (median:11 surveys, range 2-15). Predicted probability and odds ratios for reporting 'often' or 'always' engaging in a behavior increased over time for all 7 behaviors. Compared to baseline, there were increased probabilities and odds of engaging in DEI behaviors after participation in each session. Compared to baseline, the increased odds were statistically significant after 1 session of GATHER for the first 6 behaviors, and after 2 sessions for the 7th behavior (Table 1).

Conclusion: A novel diversity, equity, inclusion quality improvement educational intervention was associated with significant and sustained improvements in self-assessed frequency of equity-focused behaviors for surgical service providers at our institution.

Abbreviations: DEI: Diversity, Equity, Inclusion; QI: Quality Improvement; Gather: Generate and Teach Health Equity Routinely

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IMPACT OF A PEDIATRIC AMBULATORY SURGICAL CENTER ON SURGERY RESIDENT EDUCATION

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Abstract: Purpose: Most operative education for surgery residents occurs in primary academic hospitals. While ambulatory surgical centers (ASCs) can benefit patients and health systems, the impact on resident operative experience with adult procedures has been mixed. Moreover, the impact of an ASC on resident operative experience regarding index ACGME pediatric cases has not been reported. We hypothesized that the introduction of a pediatric ASC in our health system led to decreased opportunities for surgery residents to participate in required cases. In this novel study we investigate the impact of a pediatric ASC on surgery learner education at a quaternary care, academic children's hospital (CH).

Method: We examined operative data from the electronic health record for procedures performed at an academic CH and its pediatric ASC from January 1, 2018 to June 30, 2023. Pediatric Surgery first performed operations at the ASC in May 2020. Case CPTs were filtered to the overlapping subset performed at both the ASC and the CH and grouped in 6-month blocks. The presence of trainees (i.e., categorical, preliminary, and pediatric surgery residents) in overlapping cases was analyzed, and descriptive statistics were performed.

Results: Overlapping subset (OS) cases included inguinal, umbilical, and epigastric herniorrhaphies, as well as subcutaneous lesion excisions. Before May 2020, a median of 338 OS cases were performed every half year (IQR: 314, 340) at the CH with a surgery resident present in 82.6% of cases on average. Since May 2020, a median of 365 OS cases (IQR: 341, 387) were performed semiannually at the CH with an average of 84.2% resident participation. A median of 64 OS cases (IQR: 42, 76) were performed semiannually at the ASC with near-zero resident coverage (n=9). While the number of cases performed at the ASC increased over time, the number of cases performed at the Ch and resident participation remained relatively constant (Figure 1).

Conclusion: The introduction of a pediatric ASC to offload outpatient cases and to accommodate increasing higher-acuity inpatient operative volumes did not deleteriously reduce resident operative experience. ASC cases nevertheless represent a missed educational opportunity for pediatric surgery trainees in the ambulatory setting.

Abbreviations: ASC = ambulatory surgical center
CH = children's hospital
OS = overlapping subset

Figure 1: Surgical case counts of procedures performed at both the CH and ASC over 6-month periods. Trainee presence at ASC cases was zero or near-zero for all periods.