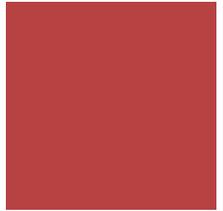
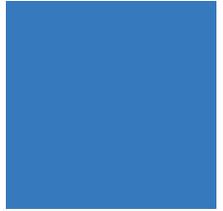


APSA 2020 Annual Meeting

Abstracts



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Educational Objectives

The APSA Annual Meeting is designed to provide comprehensive continuing education in the field of pediatric surgery. APSA strives to bring together the world's leading pediatric surgery authorities to present and discuss the most recent clinical and basic science research efforts. This meeting covers the breadth of pediatric surgery and is intended to acquaint attendees with the latest research findings, clinical discoveries and trends that influence the day-to-day practice of pediatric surgery.

The topics at these sessions have been selected by the Program and Professional Development Committees and approved by the APSA Board of Governors. Additional sessions overseen by other APSA Committees (Cancer, Fetal Diagnosis and Treatment, New Technology, Practice, Informatics and Telemedicine, Surgical Critical Care, Research, Trauma, Surgical Quality and Safety, and Outcomes and Evidence-based Practice) address topics unique to specific areas of interest within the specialty and include both educational topics as well as novel clinical and basic science research. Topic selection is based on previous meeting attendee surveys, committee feedback regarding learning needs and member requests from surveys and journal articles about what is relevant to their practices. Plenary and scientific sessions consist of basic science research and practical clinical presentations selected from a blind review from the Program Committee. Sessions presented in an oral format with the ability for audience participation in the form of commentary and questions. Poster sessions provide young investigators an opportunity to share preliminary research or to inform the membership about additional topics that may be of interest.

Learning Objectives

As a result of attending the sessions, attendees will be able to:

- Discuss the current level of evidence supporting current approaches to common pediatric surgical clinical problems.
- Explain the basic science foundations of pediatric surgical diseases.
- Identify and discuss the challenges facing pediatric surgical patients, their families and surgical providers as the result of information technology, socioeconomic pressures, insurance regulations and governmental policies.

Disclosures

Disclaimer: These materials and all other materials provided in conjunction with educational activities are intended solely for purposes of supplementing educational programs for qualified health care professionals. Anyone using the materials assumes full responsibility and all risk for their appropriate use. APSA makes no warranties or representations whatsoever regarding the accuracy, completeness, currentness, noninfringement, merchantability or fitness for a particular purpose of the materials. In no event will APSA be liable to anyone for



any decision made or action taken in reliance on the materials. In no event should the information in the materials be used as a substitute for professional care.

Policy on Faculty Disclosure

It is the policy of APSA that the planning committee and faculty disclose and resolve real or apparent conflicts of interest relating to the content of the educational activity, and also disclose discussions of unlabeled/unapproved uses of drugs or devices during their presentations.

Faculty Disclosures

In the case of faculty presentations the following faculty members have disclosed a financial relationship with an industry partner. The relationship was proven not to have an impact on the science presented at this annual meeting. All other faculty indicated that they have no financial relationships to disclose.

Posters

P66, Sarah Jane Commander - The Hidden Mortality of Congenital Anomalies in Uganda

American Association of Surgeon's Global Surgery Research Fellowship Award (Self): Research Grant (Status: Ongoing); Eunice Kennedy Shriver National Institute of Child Health & Human Development Pediatric Clinical Pharmacology Fellowship (Self): Salary (Status: Ongoing); National Institute of General Medical Sciences of the National Institutes of Health under Award Number T32GM086330 (Self): Salary (Status: Ongoing)

P40, Charlene Dekonenko - Outcomes in Gastroschisis: Expectations in the Post-natal Period

Avery's Angels Foundation (Self): Funds for travel expenses to conferences where presenting gastroschisis research on behalf of Midwest Pediatric Surgery Consortium (Status: Ongoing)



P87, Robert Obermeyer - 20 Years of Selective Use of Sternal Elevation During the Nuss Procedure at a Single Institution

Zimmer Biomet LLC (Self : Consultant/Advisory Board (Status: Ongoing), Consulting Fees (e.g., advisory boards) (Status: Ongoing), Product development for the Nuss Procedure. (Status: Ongoing) Vacuum Bell (Manufacturer: Eckart Klobe, Germany, Off-label use: Intraoperative Sternal Elevation)

P84, Christina Theodorou - Prescription Drug Monitoring Program Mandate Associated with Decreased Post-Operative Opioid Prescriptions in Pediatric Surgical Patients

Alpha Clinic Grant from the California Institute for Regenerative Medicine (Grant/Research Support) National Center for Advancing Translational Sciences, National Institutes of Health (Grant/Research Support)

Scientific Sessions

33, Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors, Sarah Jane Commander Hepatic Angiosarcoma in Children Is Associated with Increased Rates of Surgical Resection and Improved Overall Survival Compared with Adults

Eunice Kennedy Shriver National Institute of Child Health & Human Development Pediatric Clinical Pharmacology Fellowship (Self): NIH T32 training grant (Status: Ongoing), Salary (Status: Ongoing); National Institute of General Medical Sciences of the National Institutes of Health Award Number T32GM086330 (Self) : NIH T32 training grant (Status: Ongoing), Salary (Status: Ongoing); Thrasher Research Fund's Early Career Award (Self): Research Grant (Status: Ongoing), This is supporting a different research project (Status: Ongoing)

85, Scientific Session 11: Colorectal Surgery – Christina Theodorou Surgical Management of an Obstructive Müllerian Anomaly in a Patient with Anorectal Malformation

Alpha Clinic Grant from the California Institute for Regenerative Medicine (Grant/Research Support) National Center for Advancing Translational Sciences, National Institutes of Health (Grant/Research Support)



Committee Disclosures

Disclosures were collected from all committee members with influence over the educational content of the annual meeting program. These committee members have reported the following financial relationships and it has been determined that no conflict of interest exists with any of these relationships. All other committee members indicated that they have no financial relationships to disclose.

Joseph Vacanti

3 - Biolabs (Self) : Board Member/Advisory Panel (Status: Ongoing), Consultant (Status: Ongoing), Consultant/Advisory Board (Status: Ongoing), Consulting Fees (e.g., advisory boards) (Status: Ongoing), Ownership Interest (Status: Ongoing), Ownership Interest (stocks, stock options, or other ownership interest excluding diversified mutual funds) (Status: Ongoing); Biostage (Self): Board Member/Advisory Panel (Status: Ongoing), Consultant (Status: Ongoing), Consultant/Advisory Board (Status: Ongoing), Consulting Fees (e.g., advisory boards) (Status: Ongoing), Ownership Interest (Status: Ongoing), Ownership Interest (stocks, stock options, or other ownership interest excluding diversified mutual funds) (Status: Ongoing)

Clifton, Matthew - Industry and Institutional Advisory Committee
JustRight/Bolder Surgical, Physician Advisory Board, fee for consulting

Danielson, Paul - Education Committee
Clozex, Medical Advisory Board

Diesen, Diana - Education Committee
American Board of Surgery – Consultant, reimbursed for travel; ACGME – Consultant, reimbursed for travel

Geiger, James - Industry and Institutional Advisory Committee
FlexDex Inc. - Founder, stockholder

Hackam, David - Program Committee
Abbott - Research Grant; Noveome - Reserach Grant; Gen1e Life Sciences - Research Grant

Henry, Marion - Benjy Brooks Committee, Health Policy and Advocacy Committee
Foreign: M3, Straumann Holding, Lonza Group, Ipsen SA, Eurofins Scientific - Stock Holder
US Companies: Emergent Biosolutions, Cantel Medical, PRA health sciences, Supernus Pharmaceuticals, Integral Lifesciences Holdings, Corcept Therapeutics, Centene, Illumina, Vertex, Regeneron, Biomarin, Celgene, Alexion, Incyte – Stock Holder

Inge, Thomas - Industry and Institutional Advisory Committee
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Notrica, David - Education Committee, Trauma Committee
Zimmer – Consultant; KLS Martin – Consultant

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Perez, Numa - New Technology, Childhood Obesity, Diversity, Equity and
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Daytoday Health Inc., consultant

Saltzman, Daniel - Wellness Task Force
Salspera LLC - Microbial Based Immunotherapy - Chief Medical Officer,
shareholder, patent ownership

Siddiqui, Sabina - Surgical Critical Care Committee
Brio Device, Founder, Chief Medical Officer

Slater, Bethany - New Technology Committee, Program Committee
Bolder Surgical

Wakeman, Derek - Surgical Quality and Safety Committee
Patent pending for magnetically coupled medical devices

Plenary Session 1

1

LONG-TERM OUTCOMES OF PEDIATRIC LAPAROSCOPIC NEEDLE-ASSISTED INGUINAL HERNIA REPAIR: A TEN YEAR EXPERIENCE

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Purpose: Laparoscopic inguinal hernia repair has gained acceptance over the past decade, although studies with longitudinal follow-up are lacking. We present the largest cohort of children undergoing laparoscopic inguinal hernia repair with long-term follow-up.

Methods: This is a single-center retrospective analysis including children < 14 years (n=1023) that underwent laparoscopic needle-assisted repair (LNAR) between 2009 and 2017 with review of outcomes through August 2019. Patient demographics and surgery details were captured. Mean follow-up time was calculated on patients with longitudinal care (continued institutional care post-operatively) observed by chart review of last physical exam by physician. A de-identified database generated captured early and late complications (> 30 days) including recurrence, wound infection, and hydrocele. A subset of pre-term patients was analyzed for comparison with pre-term patients. Results with p-value <0.05 were deemed statistically significant.

Results: A total of 1,023 patients with 1,457 hernia repairs were included during the 10-year study period. Bilateral repair occurred in 42.8% of patients, right in 37.5%, and left in 19.8%. Mean patient age at surgery was 2.56 years (0.005 to 14 years) with 29% pre-term patients. The overall hernia recurrence rate was 0.75% (11/1457) with two occurring early and nine occurring late. Postoperative hydrocele occurred in 4.1% however only 4/61 required intervention. Wound infection occurred in 0.6%. 297 pre-term patients underwent 477 LNAR repairs with a recurrence of 0.62% (3/477) that was significantly less compared to term patients (p<0.01) (Table 1). Longitudinal follow-up over the 10-year period occurred with 64.2% of patients with mean follow-up time of 5.97 years since surgery.

Conclusion: This large cohort study supports that LNAR is a safe and effective procedure for term and pre-term patients. On long-term follow-up, LNAR has low complication and recurrence rates similar to reports on open repair. Finally, the results suggest that pre-term infants may benefit from this method of hernia repair.



Plenary Session 1 (continued)

2

SAME-DAY DISCHARGE FOR PEDIATRIC LAPAROSCOPIC GASTROSTOMY

Charlene Dekonenko, MD¹, Wendy Jo Svetanoff, MD, MPH¹, Obiyo Osuchukwu¹, Kartik Depala², Shubhika Jain², Rebecca M. Rentea¹, Pablo Aguayo¹, Jason D. Fraser, MD¹, David Juang¹, Richard J. Hendrickson¹, Charles L. Snyder, MD¹, Walter S. Andrews¹, Shawn D. St. Peter, MD¹, Tolulope A. Oyetunji¹

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Tweet it! Same-day discharge for pediatric laparoscopic gastrostomy successful in 82% of patients eligible for outpatient surgery (LOS=9hr) Possible for select children who undergo pre-op education. @ChildrensMercy @ToluOyetunji @bexoncall @clsnyder @WJSvetanoff @obiyoosuchukwu #APSA2020

Purpose: Laparoscopic gastrostomy is a common procedure in children. Patients are admitted post-operatively to initiate feeds and perform teaching with family members. We developed a same-day discharge (SDD) protocol for children undergoing laparoscopic button gastrostomy.

Methods: A prospective observational study of children undergoing laparoscopic gastrostomy button placement and were eligible for SDD from August 2017 to September 2019 was performed. Patients were eligible for SDD if they were not undergoing additional procedures requiring admission or did not have a planned overnight admission due to medical complexity, and received gastrostomy button education pre-operatively. Data analysis was performed in STATA with a $p < 0.05$ considered significant.

Results: Of the 150 patients who underwent elective laparoscopic gastrostomy during the study period, 62 children were eligible for SDD. The median age was 2.1 years [IQR 0.9, 4.1] and the median weight was 10.5 kg [IQR 7.6, 15.5]. Forty-one (66%) were previously nasogastric fed. The median operative time was 22 min [IQR 16, 29]. The median time to initiation of feeds was 4.4 hours [IQR 3.4, 5.5]. Fifty-one (82%) were discharged the same day with a median length of stay (LOS) of 9 hours [7, 10], while 11 (18%) were admitted with a median LOS of 28 hours [IQR 25, 29]. The most common reason for admission was for further teaching. Eleven SDD patients (22%) were seen in the emergency room within 30 days of surgery compared to 3 patients (27%) who were admitted post-operatively on the day of surgery, $p=0.68$. The most common reason for emergency room visits was gastrostomy button dislodgement.

Conclusion: Same day discharge following laparoscopic gastrostomy is safe and feasible for select pediatric patients who undergo pre-operative education, with no increase in post-operative emergency room visits compared to overnight hospital stay.



Plenary Session 1 (continued)

3

GIANT OMPHALOCELE MANAGEMENT WITH A NON-SURGICAL SILO: A NEW PROPOSAL

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Introduction: Giant Omphaloceles (GO) always represent a great challenge for pediatric surgeons. The use of non-operative management and, at the same time, proceeding with reduction and closure of the defect provides a powerful alternative that reduces the associated morbidity and mortality.

Objectives: Review of a new medical-surgical management of minimum invasion conducting a definitive closure in patients with GO.

Type of Study: With IRB approval, a retrospective and multi-center cohort study was carried out between 1996 and 2019. Demographic data, gestational age, associated malformations, anatomic closure, intra and post silo complications, mortality and follow-up were collected.

Material and Methods: Management consisted of a silo with adhesive hydrocolloid dressing to achieve the reduction of the omphalocele in stages until the bowel and liver were completely reduced. The amniotic sac was not removed until final closure. The neonates were managed in the neonatal intensive care unit with muscle relaxation, ventilator support, and intra-abdominal pressure monitoring.

Results: 40 patients with GO were managed. The average weight was 2.766 grams (890 – 3.700 grams), and the average gestational age was 37 weeks. Forty percent presented with an associated co-morbidity. The average time to complete reduction and abdominal closure was 14 days. Closure without mesh was achieved in 35 patients and 4 required mesh closure. Thirteen patients had complications not related to the closure technique. The average length of stay was 26 days. There were no morbidities or mortality associated with this management. Four patients died not related to the GO or management. The average follow up has been 60 months (6 – 288 months)

Conclusion: This new non-operative silo management of GO is effective and safe, reducing morbidity and mortality in comparison with the traditional surgical or non-operative management.

Plenary Session 1 (continued)



Plenary Session 1 (continued)

4

DELAYED DELIVERY OF ENTERIC NEURAL CREST CELLS INTO TISSUE-ENGINEERED AGANGLIONIC INTESTINE RESULTS IN FUNCTIONAL ENTERIC NERVOUS SYSTEM RESCUE

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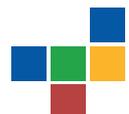
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Purpose: We previously reported that co-implantation of human intestinal organoids (HIOs) and enteric neural crest cells (ENCC), both from induced pluripotent stem cells (iPSC), will form innervated Tissue-Engineered Small Intestine (TESI). However, the appropriate clinical scenario is delivery of cell therapy to fully formed aganglionic intestine rather than a cellular mixture forming contemporaneously. We therefore performed repeated survival surgeries to first form aganglionic TESI followed by subsequent delivery of ENCC 10 weeks later to assess rescue of enteric nervous system (ENS) function.

Methods: H9 HIOs were loaded on biodegradable scaffolds and implanted into the omentum of NOD-SCID mice (n=15). At repeat laparotomy 10 weeks later, developed TESI received either an ENCC injection at a dose of 1e5 cells in 30 μ l (n=7) or 30 μ l of saline (n=3). Any mice without sufficient TESI growth were humanely euthanized. After an additional 4 weeks, TESI were explanted and recorded under a live imaging scope for baseline contractility. All contractile TESI were treated with methylene blue to immobilize interstitial cells of Cajal and imaged again for contractility. Any remaining contractile TESI were treated with tetrodotoxin to poison the ENS. Imaging was repeated after incubation in tetrodotoxin. All experiments were conducted with institutional IACUC approval.

Results: Of the initial 10 TESI with baseline contractility (n=3, saline; n=7, ENCC), the implanted cells that formed an ENS demonstrated continued contractions after methylene blue treatment (n=7) and none of the saline (n=3). After treatment with tetrodotoxin, 6 ENCC-injected TESI ceased contractions. One ENCC-injected TESI continued contraction after both treatments.

Conclusion: Aganglionic tissue-engineered intestine can be injected with iPSC-derived ENCC during a second survival surgery in a technically challenging but achievable model of cellular therapy for enteric neuropathies. ENCC-injected TESI explants demonstrate rescue of contractile function through the formation of enteric neurons and ganglia.



Plenary Session 1 (continued)

5

2019 Jay Grosfeld, MD, Scholar Grant

The Role of Adjuvant Induced Myeloid-Derived Suppressor Cells in Allograft Tolerance

Alex G. Cuenca, MD, PhD

Boston Children's Hospital, Boston, MA USA

Plenary Session 2

6

EXTRACELLULAR CIRP CONTRIBUTES TO CARDIAC DYSFUNCTION IN NEONATAL SEPSIS

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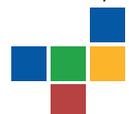
Tweet it! Extracellular CIRP is elevated in infants with sepsis. eCIRP promotes inflammation and mitochondrial dysfunction resulting in cardiac dysfunction. Inhibition of eCIRP is cardioprotective and improves survival in neonatal sepsis. #APSA2020

Purpose: Neonatal sepsis and associated myocardial dysfunction remain leading causes of infant mortality. Extracellular cold-inducible RNA-binding protein (eCIRP) is an inflammatory mediator whose effect on cardiac function has never been investigated. We hypothesize that eCIRP causes cardiac dysfunction, and thus its inhibition with a novel small peptide, M3, will improve cardiac parameters and outcomes in neonatal sepsis.

Methods: Serum samples were obtained from human neonates. Primary murine neonatal cardiomyocytes were isolated and stimulated with recombinant murine (rm)CIRP with or without M3. Cytokine levels in the supernatants were assayed and mitochondrial membrane potential was quantified using TMRM fluorescence. 5-7-day old C57BL/6 mouse pups were injected with rmCIRP (5 mg/kg; i.p.) and speckle-tracking echocardiography was conducted to measure cardiac strain. Sepsis was induced in pups by cecal slurry (CS, 0.525 mg/kg; i.p.). Pups received M3 (10 mg/kg) or vehicle (0.9% NS) and echocardiography was performed. A less severe model of sepsis (0.175 mg/kg CS; i.p.) was used for 7-day survival study.

Results: Serum levels of eCIRP were elevated in septic neonates compared to controls ($p < 0.001$). Stimulation of cardiomyocytes with rmCIRP increased TNF- α and IL-6 levels in the supernatants; these were inhibited by M3 ($p < 0.001$, Table). Stimulation of cardiomyocytes with rmCIRP for 4 h resulted in a 20% reduction in mitochondrial membrane potential ($p = 0.02$). In vivo, rmCIRP injection impaired longitudinal and radial cardiac strain by 34.2% and 26.2%, respectively ($p < 0.05$), and strain rates by 15.3% and 35.0% ($p < 0.01$). Sepsis resulted in cardiac dysfunction; this was improved by eCIRP inhibition via M3 treatment ($p < 0.05$, Table). M3 improved survival in neonatal sepsis, from 7.7% in the vehicle group to 53.8% in the M3 cohort ($p < 0.05$).

Conclusions: eCIRP is elevated in infants with sepsis. eCIRP promotes inflammation and mitochondrial dysfunction resulting in cardiac dysfunction. Inhibition of eCIRP is cardioprotective and improves survival in neonatal sepsis.



Plenary Session 2 (continued)

7

REDUCING COST AND WASTE IN PEDIATRIC LAPAROSCOPIC PROCEDURES

Keon Young Park, MD, PhD¹, James I. Russell, RN-BC², Nathan P. Wilke, MBA², Nicholas A. Marka, MS³, Peter F. Nichol, MD, PhD⁴

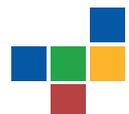
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Purpose: In 2017, the cost of health care in the United States accounted for 17.9% of the Gross Domestic Product (GDP). Furthermore, healthcare facilities produce more than 4 billion pounds of waste annually. Inter-hospital and inter-surgeon variability in surgical procedures has been cited as one of the drivers of high healthcare cost and waste. The goal of this quality improvement intervention was to determine the effect of a monthly surgeon report card detailing the utilization and cost of disposable and reusable surgical supplies on cost and waste reduction on pediatric laparoscopic procedures without increasing complications.

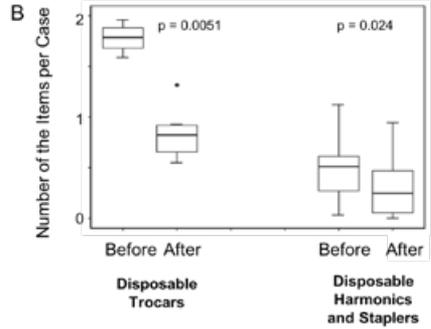
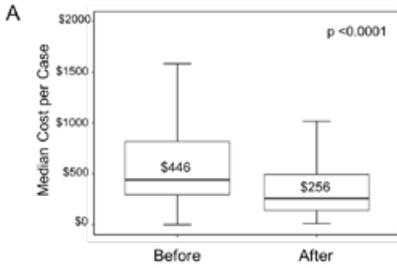
Methods: Starting in July 2017, surgeons were provided with an individual report with supply cost per case, supply utilization and clinical outcomes for themselves, and in comparison to their colleagues. Supply cost per case, utilization of high-cost item and disposable item per case, number of complications, procedure time and length of stay 6 quarters before the intervention (January 2016 – June 2017) and 6 quarters after the intervention (October 2017 – March 2019) were compared.

Results: Total of 1133 pediatric laparoscopic procedures were included in the analysis. We reduced the median supply cost per case by 42% after the intervention (\$446 per case to \$259 per case) (Figure A) with total cost savings of \$89,392 for the first four quarters and total cost avoidance of \$55,167 for the subsequent two quarters. We also reduced the use of disposable trocars by 56% and the use of disposable harmonics and laparoscopic staplers by 33% (Figure B). There was no significant difference in the number of complications, length of procedure or stay.

Conclusion: By using a monthly surgeon report card detailing the utilization and cost of disposable and reusable surgical supplies, we were able to reduce supply cost per case and utilization of disposable items for all pediatric laparoscopic procedures without increasing complications.



Plenary Session 2 (continued)



Plenary Session 2 (continued)

8

IMPROVING CARE THROUGH STANDARDIZED TREATMENT OF SPONTANEOUS PNEUMOTHORAX

Amy E. Lawrence, MD¹, Justin T. Huntington², Kate Savoie, MD, MS¹, Michael Dykes³, Jennifer H. Aldrink⁴, Holden Richards, BA⁵, Gail E. Besner, MD⁶, Brian D. Kenney, MD¹, Jeremy Fisher, MD⁷, Peter C. Minneci, MD, MHSc⁸, Marc Michalsky¹

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Purpose: Significant variability in the management of patients with primary spontaneous pneumothorax (PSP) existed within our institution. The objective of this quality improvement (QI) initiative was to implement a standardized treatment pathway for patients admitted with PSP in order to decrease hospital length of stay (LOS), diagnostic radiation exposure, and cost.

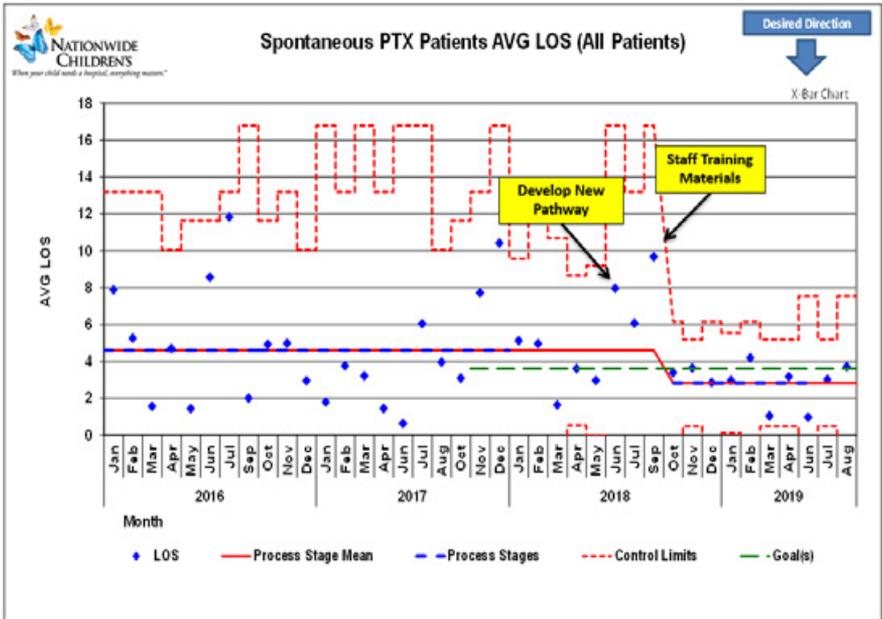
Methods: Historical control data were obtained retrospectively for all patients (11-21 years of age) admitted with PSP from January 2016 to December 2017. An evidence-based treatment pathway was developed and subsequently initiated among surgical faculty in September 2018. Components of the pathway included standardized criteria for chest tube placement, removal, and clinical failure, warranting transition to operative intervention; postoperative chest tube management guidelines; and recommendations for timing and type of imaging both pre- and post-operatively. Standard QI methodology was used to create key drivers and interventions, and to track pathway compliance and results. Patient outcomes were then compared pre- and post-pathway adoption.

Results: There were 49 episodes of PSP in 35 patients during the baseline (control) period, and 30 episodes of PSP among 20 patients after adoption of the pathway. The average LOS decreased from 4.6 days to 3.1 days, a 32% decrease ($p < .05$) (Figure). Patients underwent an average of 8.5 X-rays per admission pre-intervention and 6.4 X-rays after implementation (24% decrease, $p < 0.05$). Additionally, the number of CT scans fell from 65% to 18% of patients. There were 5 episodes of recurrence within 30 days (10% of all episodes) pre-intervention and 4 episodes of recurrence (13% of all

Plenary Session 2 (continued)

episodes) post-intervention ($p=.91$). Based on improvements in LOS and imaging charges, costs were estimated to have decreased by an average of \$2,561 per admission after adoption of the pathway.

Conclusions: The adoption of a standardized treatment pathway for PSP led to decreased LOS, X-rays, CT scans and cost, without increasing recurrence.



Plenary Session 2 (continued)

9

THE TIMEOUT PROCEDURE IN PEDIATRIC SURGERY - EFFECTIVE TOOL OR LIP SERVICE?

Oliver J. Muensterer, MD, PhD, Hendrik Kreutz, Jan Goedeke

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Tweet it! This undercover study evaluated the detection rate of purposefully-introduced errors in the surgical checklist timeout procedure. Almost half of errors were missed. Anesthesiologists were more likely to pick up errors than scrub nurses, surgical trainees, or students. The timeout routine needs to be optimized. #APSA2020

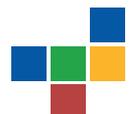
Background: For over a decade, the preoperative timeout procedure has been implemented in most pediatric surgery units. In our hospital, a standardized team-timeout is performed before every operation. However, the impact of this intervention has not been systematically studied.

Purpose: This study evaluates whether purposefully-introduced errors during the timeout routine are picked up by the operating team.

Methods: After ethics board approval and informed consent, deliberate errors were randomly and clandestinely introduced into the timeout routine for elective surgical procedures by a pediatric surgery attending. Errors were randomly selected among critical (wrong name, site, side, allergy) or minor (wrong birthdate, gender) items. The main outcome measure was how frequent an error was picked up by the team, and by whom.

Results: Over the course of 16 months, 1800 operations and timeouts were performed. Errors were randomly introduced in 120 cases. Overall, 54% of the errors were picked up, the remainder went unnoticed. Errors were picked up most frequently by an anesthesiologists (64%), followed by nursing staff (28%), residents-in-training (6%) and medical students (1%). The detection rate was 33 out of 60 for critical errors, 32 out of 60 for minor errors.

Conclusions: Errors in the timeout routine are not picked up by the team in almost half of the cases. Therefore, even if preoperative timeout routines are strictly implemented, mistakes may occur. The reason for missing important information ranges from inattentiveness to situational stress. Hence, the timeout procedure in its current form is not reliable. Future developments such as computer-assisted timeout protocols, automatic patient identification and the use of artificial intelligence may be useful to improve the quality of the surgical timeout.



Plenary Session 2 (continued)

10

LEVERAGING ARTIFICIAL INTELLIGENCE IN THE APSA EDITORIAL PROCESS

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Purpose: Although the conventional editorial process is recognized as a burdensome pathway to determine quality in academic writing, it is accepted as the status quo for lack of better alternatives. Advances in machine learning (ML) and natural language processing (NLP) have enabled content, concept, and even sentiment analysis in a wide variety of texts. We sought to utilize these artificial intelligence (AI) approaches to replicate the APSA 2019 editorial board decisions.

Methods: Submission data for all 2019 abstracts was obtained. Differences between accepted and rejected abstracts were evaluated with chi square. NLP was used to analyze text and extract key features. A set of ML classifiers was then used to predict peer review decisions. Model performance was assessed using nested ten-fold cross-validation.

Results: 520 submissions were analyzed (41% acceptance rate). Significant differences ($p < 0.05$) between accepted and rejected abstracts included number of authors and acceptance rates for clinical fellow submissions and for the topics of advocacy, basic science, oncology/vascular, and trauma. There were no differences by first author gender, time of submission, or United States origin. Our best AI model was able to predict acceptance with an accuracy of 74% and an AUC of 81% (sensitivity=80%, specificity=70%, PPV=65%, NPV=84%). Concepts like integration to practice, diagnosis, comparisons between groups, sex/gender differences, negative findings, specification of data collection and analyses, significance levels with p-values, focus on children, and explicit description of sample size had higher OR of acceptance. Submissions missing a clear conclusion, presented as retrospective reviews, having more medical than surgical focus, and those presenting early results were less likely to be accepted.

Conclusions: In conclusion, AI technologies showed promise in predicting editorial board decisions. The generalizability of these findings would likely be impacted by the year-to-year trends in research interest; however, this represents a developing area of opportunity for quality improvement, process optimization, and bias reduction.

Plenary Session 2 (continued)

2019 Jay Grosfeld, MD, Scholar Grant

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Improving Reperfusion Injury in Pediatric Respiratory Arrest Using a Porcine Model of ECPR

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Scientific Session 1: Quality and Safety

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IMPLEMENTING A SAME DAY DISCHARGE GUIDELINE FOR ACUTE APPENDICITIS IMPROVES QUALITY OF CARE AND VALUE AT A TERTIARY CARE CHILDREN'S HOSPITAL

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Purpose: Several single-institution studies have demonstrated feasibility of Same Day Discharge (SDD) for simple appendicitis. We share the process of implementation of a SDD clinical care guideline (CCG) within a large, urban, tertiary center.

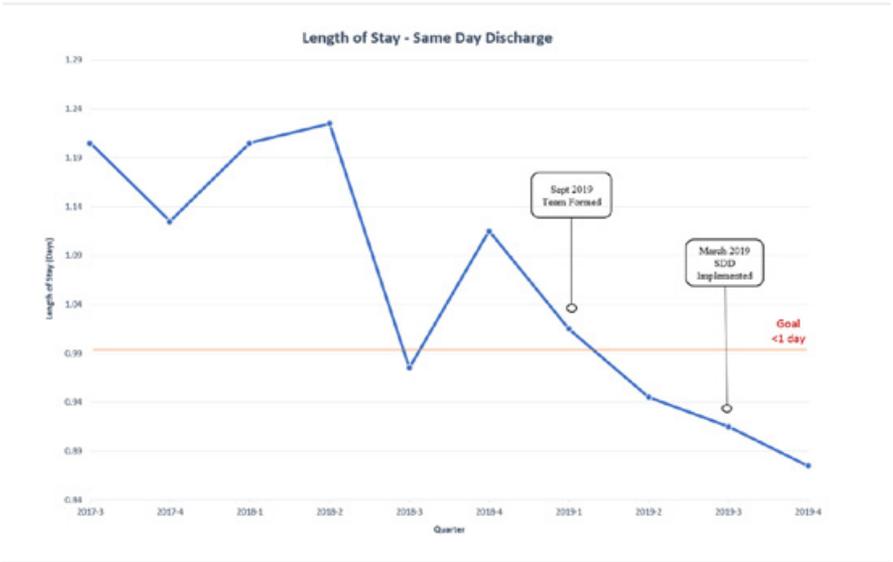
Methods: An evidence-based CCG for simple appendicitis was developed by a multi-disciplinary committee of pediatric general surgeons, anesthesiologists, emergency medicine providers, advanced-practice practitioners, quality improvement (QI) personnel and clinical informatics specialists. The CCG was implemented using plan/do/study/act (PDSA) methodology to reduce unwarranted variation in care and allow for safe discharge within 24 hours of admission. Similar protocols from the APSA toolkit were reviewed and modified for local implementation. Adjuncts included incorporation of guideline-specific ordersets into the electronic medical record system and providing parents with pre-operative expectations for SDD. Outcomes measured included post-operative complications, length of stay (LOS), readmissions, and hospital costs. Run charts tracked outcomes before and after implementation. Descriptive statistics, Chi-square regression and student's t-test of comparison were used when appropriate.

Results: Six months of post-implementation data representing 88 patients was compared to pre-implementation performance. Average LOS dropped to 0.87 days (IQR 0.87-0.94 days) from an average of 1.2 days (IQR 0.97-1.42 days, Figure). This equates to an average cost-savings of \$2479/patient, assuming observation status. Thirty-day readmission rates have remained unchanged at 2.3%. To-date, no readmissions have been secondary to infectious complications. Mean utilization of standardized operative notes and postop ordersets increased from 40% to 75% and 34% to 84%, respectively. Mean Time to Operation (TTO) has trended from 7.6 to 6.52 hours. In two months of aiming for "under 2 hour" TTO, mean TTO has been 2.92 hours.



Scientific Session 1: Quality and Safety (continued)

Conclusion: Successful implementation of CCG for simple appendicitis is possible within a large tertiary center among a practice of 16 general surgeons. These efforts demonstrate early improvements in patient outcome and hospital resource utilization.



Scientific Session 1: Quality and Safety (continued)

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INSTITUTION-INITIATED TEXT MESSAGING CAN REDUCE UNPLANNED EMERGENCY DEPARTMENT VISITS AFTER APPENDECTOMY

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Purpose: To reduce unplanned Emergency Department (ED) visits for minor complaints in children after appendectomy through proactive institution-driven communication and utilization of telehealth resources.

Methods: Appendectomy was found to be the general surgical procedure most commonly associated with post-operative ED revisits in our multi-institution healthcare system (8%). Many of these ED encounters were for superficial wound complaints or conditions unrelated to surgery, such as a viral URI, and likely could have been avoided with a phone call or non-emergent clinic visit. We developed a text messaging system to initiate communication with parents of appendectomy patients and connect them with a telehealth visit or surgeon office phone call as needed (Figure 1). An opt-out option was provided. Using descriptive statistics and chi square, we compared ED visits for the four months pre and post implementation of the messaging system, and summarized the feedback we received from patients. This quality improvement project was exempt from IRB review.

Results: A total of 396 appendectomies were performed in two institutions (pre N = 197, post N = 199). Post-operative ED visit rate decreased from 6.6% pre-implementation to 2.5% post-implementation ($p=0.046$). Over a quarter of the families messaged (56) had questions regarding their child's postoperative course, with many (31) expressing interest in a video chat with a telemedicine physician and some (11) wanting to speak directly with the surgeon. A simple "yes" or "no" question on whether the system was helpful revealed that 95.5% of respondents found it helpful, and only 4.9% chose to opt out.

Conclusion: We conclude that implementation of a hospital-initiated text messaging system has the potential to reduce ED visits in the immediate postoperative period after appendectomy. This system has the potential to be scaled to include different surgeries across multiple disciplines.

Scientific Session 1: Quality and Safety (continued)

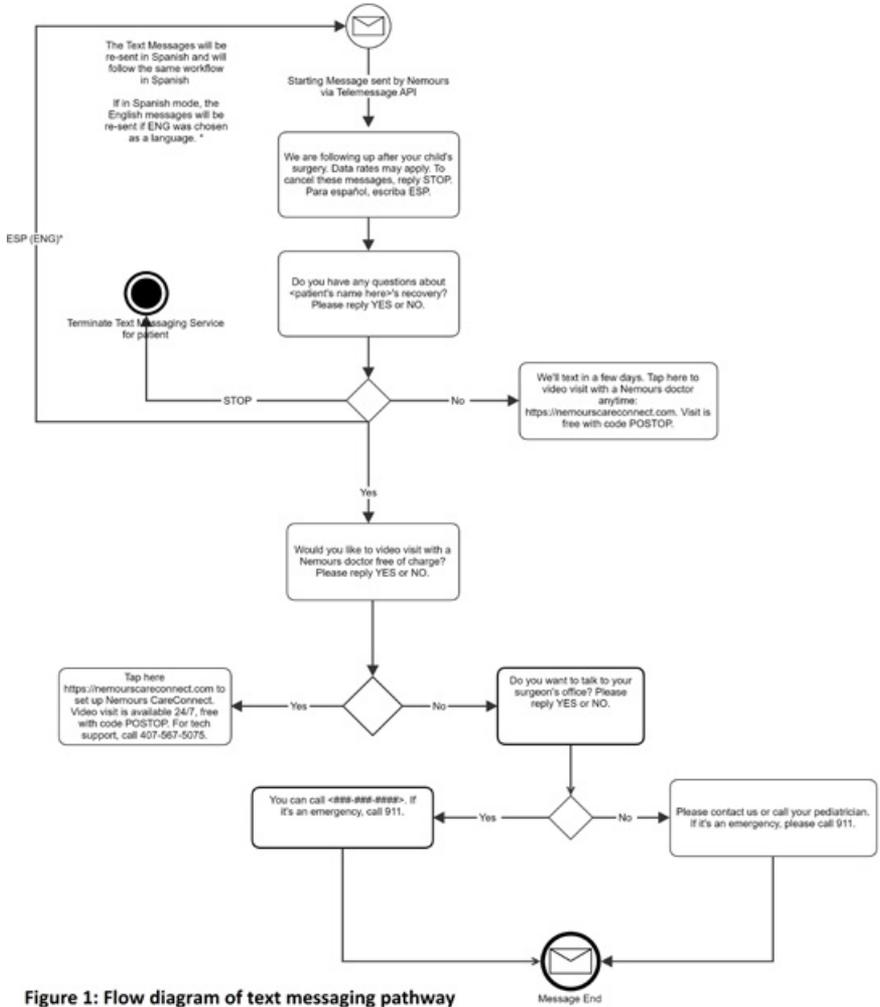


Figure 1: Flow diagram of text messaging pathway

Scientific Session 1: Quality and Safety (continued)

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PROTOCOLIZED MANAGEMENT OF ABSCESS DRAINS SAFELY REDUCED RESOURCE UTILIZATION IN COMPLICATED PEDIATRIC APPENDICITIS

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Purpose: Clinical pathways and protocols for diagnosis and treatment have improved multiple process measures and outcomes in pediatric appendicitis. To date, however, there is a paucity of data on the clinical outcomes associated with a standardized management strategy for percutaneous drains placed for appendiceal abscesses in children. We hypothesized that a drain management protocol relying upon drain output and clinical factors instead of routine drain interrogation: 1) would reduce the need for interventional radiologic (IR) procedures, decreasing anesthetic and radiation exposure; 2) would not adversely impact clinical outcomes.

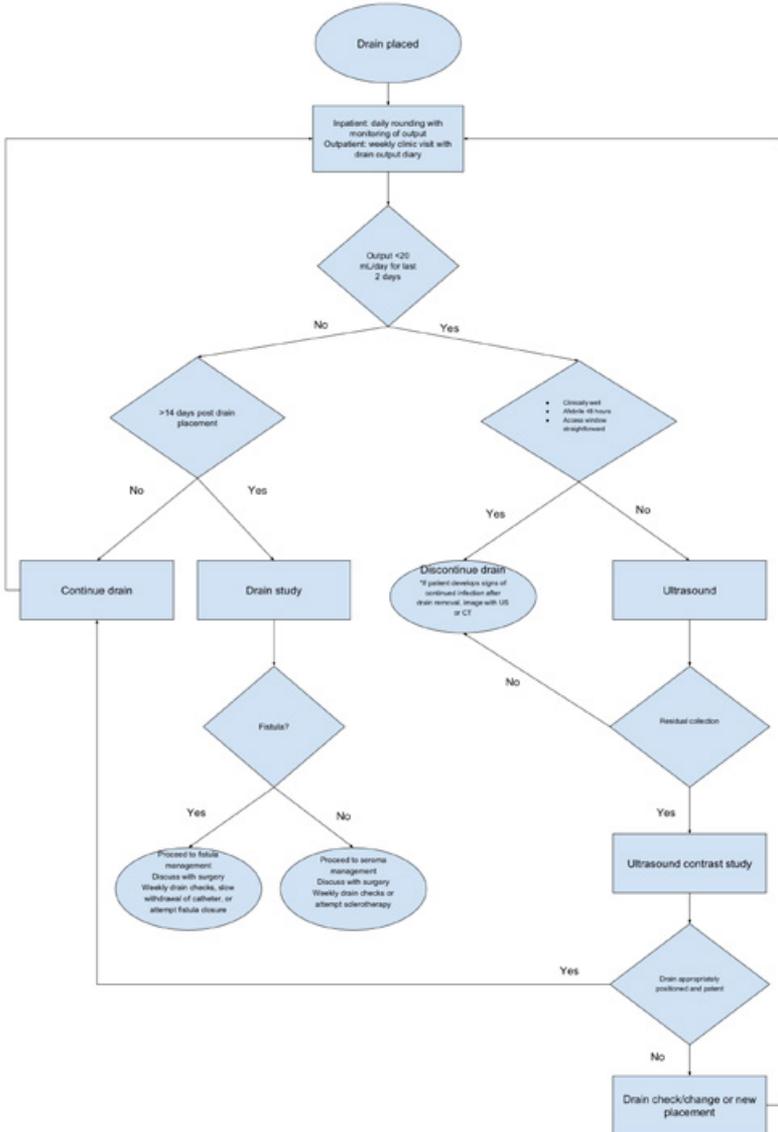
Methods: A standardized drain management protocol that advocated for appendiceal abscess drain removal if the patient was afebrile and clinically well following 48-hours of <20cc/day drain output was uniformly adopted by the division of pediatric surgery at a tertiary-care children's hospital in April, 2016 (Figure 1). A retrospective chart review was conducted for all patients who had an appendectomy requiring abscess drainage by IR for 3-years preceding and 3-years following the protocol's adoption (2013-2019).

Results: Fifty-nine patients (pre-protocol=40, post-protocol=19) underwent abscess drainage by IR, of whom 52 (pre-protocol=34, post-protocol=18) had a drain placed. Baseline demographics, initial presentation (e.g. WBC count, perforation on imaging), and management strategy (upfront versus interval appendectomy) were similar across groups. Following protocol implementation, the total number of IR procedures decreased from 2.33 to 1.26/patient ($p=0.0047$). CT-guided interventions decreased from 0.7 to 0.21/patient ($p=0.009$) and fluoroscopic interventions decreased from 1.5 to 0.7/patient ($p=0.09$). There was no statistically significant difference in number of diagnostic imaging studies, readmissions, or length of stay.

Conclusion: Implementation of a standardized protocol for management of abscess drains for complicated appendicitis reduced the number of IR procedures without a negative impact on clinical outcomes or increase in alternative imaging studies. This treatment approach decreased radiation

Scientific Session 1: Quality and Safety (continued)

exposure, anesthetic administration, and resource utilization in the treatment of complicated appendicitis.



Scientific Session 1: Quality and Safety (continued)

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IDENTIFYING PATTERNS OF NON-COMPLIANCE WITH ANTIBIOTIC PROPHYLAXIS IN PEDIATRIC GENERAL SURGERY AND UROLOGY

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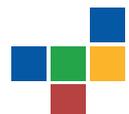
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Purpose: Antibiotic stewardship programs highlight the negative impacts of antibiotic overuse. Recent national guidelines generally recommend 24 hours or less of perioperative antibiotic prophylaxis. These guidelines, based on adult literature, leave room for interpretation by pediatric surgeons. In a regional, free standing children's hospital with an active antibiotic stewardship program, we evaluated compliance with peri-operative antibiotic guidelines.

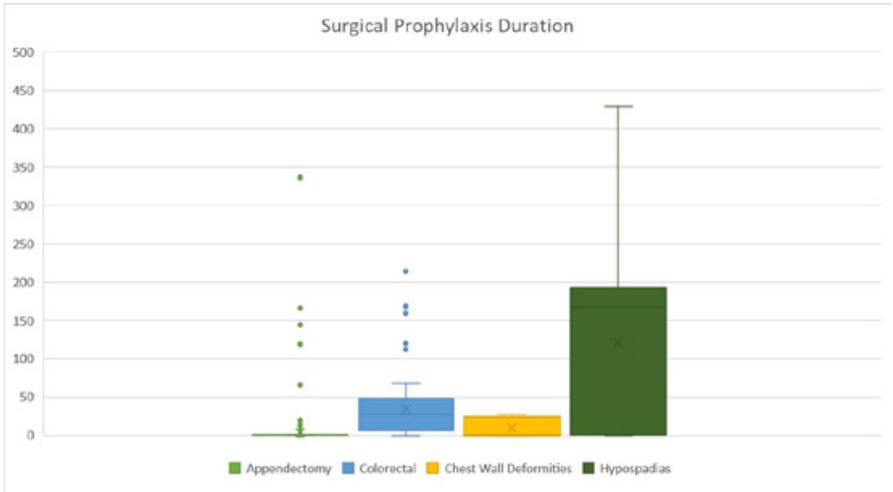
Methods: All anti-infectives associated with procedures in the 2017 calendar year were extracted from the EPIC database and imported to REDCap. Exclusion criteria included: procedures that did not break the mucosa, procedures done for active infection, use of an instrument smaller than a needle, anti-infectives not associated with surgical prophylaxis, and gross contamination of the surgical site. The included procedures were categorized by surgeon specialty and procedure type, then further separated into four groups based on the amount of prophylaxis received: none, single dose, multiple doses in 24 hours, and greater than 24 hours. Excess duration of prophylaxis was defined as over 24 hours. Distribution plots were used to find patterns of non-compliance.

Results: General Surgery performed 2,426 procedures in 2017. Of those, 28% received no prophylaxis, 53% received a single dose, 10% received multiple doses in 24 hours, and 9% received doses over 24 hrs. Those given over 24 hours resulted in 10717 hours of excess antibiotic administration. Distribution plots of individual procedure types revealed specific patterns of failure (Figure 1). Uniform overuse was considered secondary to knowledge gaps or systems issues. Lack of standardization resulted from provider variability and lack of institutional guidelines. The multimodal distributions were attributed to perceived changes in recommendations associated with different populations.

Conclusions: Analysis of peri-operative antibiotic usage revealed significant overuse and patterns of noncompliance. These guide targeted education, structural system improvement, and implementation of standardized institutional guidelines to improve antibiotic stewardship.



Scientific Session 1: Quality and Safety (continued)



Scientific Session 1: Quality and Safety (continued)

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REDUCING HOSPITALIZATION AND COST FOR SKIN AND SOFT TISSUE ABSCESSSES

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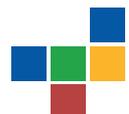
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Purpose: Simple abscesses are a common reason for emergency department (ED) visits. Many of these can be drained in the ED, however, over one fourth of our patients were admitted to the hospital for drainage in the operating room (OR). Our aim was to decrease the number of patients hospitalized for incision and drainage (I&Ds) procedures for skin and soft tissue abscesses.

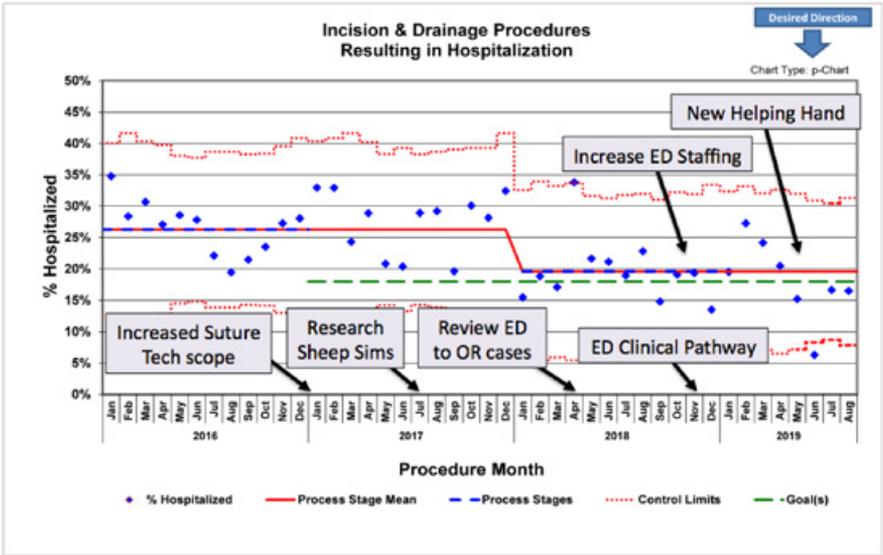
Methods: A multidisciplinary team was developed and included surgeons, ED physicians, infectious disease physicians, anesthesiologists and perioperative nurses. A clinical pathway was implemented. We performed multiple "Plan-Do-Study-Act" cycles including specialized procedural training of suture technicians and credentialing of ED nurse practitioners to perform conscious sedation. Surgeons were encouraged to drain abscesses in the ED for patients receiving surgery consultation. Individual follow up with ED providers and surgeons was performed to determine rationale for patients that went to the OR for drainage. The number of suture technician-drained abscesses and the number of abscesses drained in the OR were analyzed with control charts. Charges were assessed before and after implementation.

Results: Within one year we were able to decrease the number of hospitalized patients by 26%. The number of I&Ds performed by suture technicians increased from 62% to 70%. An unexpected benefit: the number of repeat I&Ds within 30 days decreased from 4.3% to 1.7%, and within 60 days decreased from 5.6% to 2%. The average charge of an admission for OR I&D was 1167% more expensive than one performed in the ED. After implementation of the clinical pathway, the average charge for all abscesses undergoing I&D (OR and ED) decreased by 17%.

Conclusions: The number of hospitalizations for simple I&Ds can effectively be decreased by improved training and staffing of suture technicians and through increased sedation credentialing of ED providers. These changes are associated with an average 17% cost saving.



Scientific Session 1: Quality and Safety (continued)



Hospitalized I&D Cases	Total Cases
32	92
32	92
21	74
27	88
26	96
36	126
37	133
25	113
22	113
36	124
29	119
27	99
23	82
27	82
18	74
26	90
21	120
35	103
33	113
21	107
31	103
29	103
24	74
24	74
13	84
13	69
13	36
24	71
21	37
18	104
21	92
16	108
17	89
18	93
10	74
17	87
21	77
22	91
17	83
14	82
7	111
20	130
17	103

Scientific Session 1: Quality and Safety (continued)

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IMPLEMENTATION OF A GASTROSTOMY CARE BUNDLE REDUCES EARLY DISLODGEMENTS

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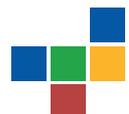
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Purpose: Pediatric gastrostomy (G) tube insertion is common, though associated with significant healthcare utilization. Early tube dislodgement can result in tract disruption and abdominal sepsis. We aimed to reduce early G tube dislodgements by 25% within 12 months.

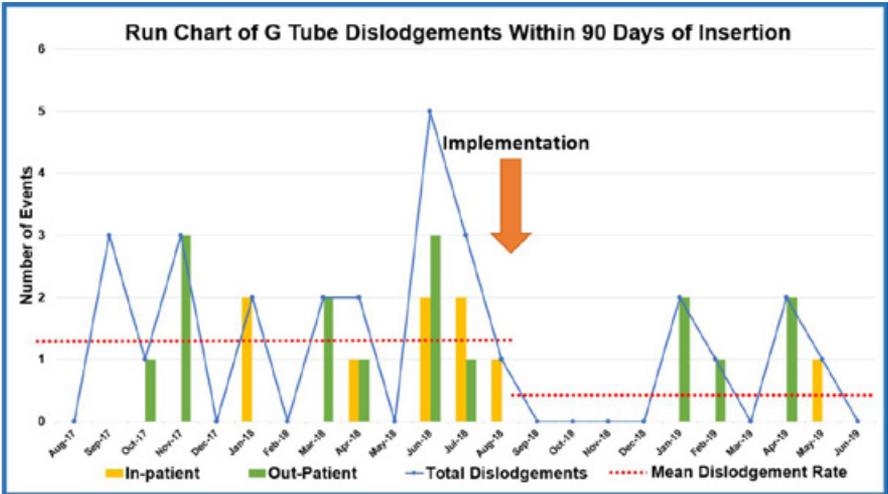
Methods: An interdisciplinary quality improvement team of physicians, advanced practice providers, nurses, and care coordinators convened to identify key drivers of G tube dislodgement. We implemented 1) a comprehensive care bundle to institute mechanical deterrents to dislodgement 2) G tube best-practice education to in-patient nursing staff and 3) a standardized discharge pathway for care coordinators focusing on family engagement. We abstracted the rate of early G tube dislodgement (dislodgements within 90 days of insertion / cases performed; outcome measure). Ten months of cases after bundle implementation were compared to a 12 month period before implementation. Length of stay (LOS; balancing measure) and bundle compliance (process measure) were tracked. Mean G tube dislodgement rates and LOS were compared with Mann-Whitney U tests with significance set at 0.05.

Results: After care bundle implementation, a 65% reduction in dislodgements per month compared to the year prior was observed (mean dislodgement rate 30% vs. 10%, $p=0.04$; (Figure). This finding was driven by a statistically significant reduction in early dislodgements occurring in the in-patient setting (mean dislodgement rate 12% vs. 2%, $P=0.032$). In the out-patient setting, we observed no significant change in the rate of early dislodgments (mean dislodgment rate 19% vs. 11%, $P=0.35$). Mean length of stay decreased from 11.6 days to 6.4, though this did not reach statistical significance ($p=0.076$).

Conclusion: An interdisciplinary team using quality improvement methodology can significantly improve value (reduced harm, reduced costs) after pediatric gastrostomy tube insertion. Fewer in-patient dislodgements is an encouraging outcome; in the future we will focus on reducing out-patient dislodgements through educational interventions in at-risk populations.



Scientific Session 1: Quality and Safety (continued)



Scientific Session 1: Quality and Safety (continued)

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CLINICAL OUTCOMES FOLLOWING IMPLEMENTATION OF A MANAGEMENT BUNDLE FOR ESOPHAGEAL ATRESIA WITH DISTAL TRACHEOESOPHAGEAL FISTULA: A MIDWEST PEDIATRIC SURGERY CONSORTIUM QUALITY IMPROVEMENT STUDY

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Scientific Session 1: Quality and Safety (continued)

Background: Prior evaluation of treatment strategies employed in the management of Type-C esophageal atresia (EA) with distal tracheoesophageal fistula (TEF) by the Midwest Pediatric Surgery Consortium (MWPSC) revealed significant variation between institutions. This study sought to compare clinical outcomes following implementation of a quality improvement management protocol for EA/TEF.

Methods: A prospective review of protocol compliance and outcomes in patients with Type-C EA/TEF was performed by 11 institutions of the MWPSC before and after implementation of a management protocol bundle from 1/2016-1/2019. Bundle components included elimination of prosthetic material between tracheal and esophageal suture lines at definitive repair (NO-PROS), not leaving a trans-anastomotic (TA) tube in the esophagus at conclusion of repair (NO-TUBE), obtaining an esophagram at postoperative-day-5 (EGRAM=5), and discontinuing prophylactic antibiotics 24hrs postoperatively (ABX<24). Outcomes were primarily stratified by treatment pre- or post-protocol implementation, and secondarily by compliance with all bundle components after controlling for institution as random effect.

Results: One-hundred-seventy patients were included, 40% pre-protocol and 60% post-protocol. Overall bundle compliance significantly increased pre- to post-protocol, from 17.6% to 44.1% ($p<0.001$). After stratifying by institutional compliance with all four bundle components, 43% of patients were treated at low-compliance centers (< 20%), 43% at medium compliance centers (20-80%), and 14% at high-compliance centers (> 80%) (Table 1). Patients in high-compliance centers had significantly higher rates of long gap length ($p=0.006$), postoperative vasopressors ($p=0.015$), and thoracoscopic repairs ($p<0.001$). Despite these differences, rates of esophageal leak and anastomotic stricture did not increase with high NO-TUBE compliance, and time to full enteral feeds was equivalent between groups when combined compliance with NO-TUBE and EGRAM=5 was high.

Conclusion: This prospective, multi-institutional study demonstrates that eliminating TA-tubes during EA/TEF repair does not increase leak or stricture rates. Further, the combination of no TA-tube and earlier esophagram allows for equivalent time to goal enteral feeds following repair.

Scientific Session 1: Quality and Safety (continued)

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A COLLABORATIVE HYBRID OPERATING ROOM APPROACH TO PULMONARY NODULE LOCALIZATION AND RESECTION AS A TOOL FOR QUALITY IMPROVEMENT IN PEDIATRIC SURGERY

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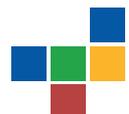
¹Cincinnati Children's Hospital Medical Center, University of Texas Health Science Center at San Antonio, Cincinnati, OH, USA, ²Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Purpose: CT-guided localization is an accepted method of pulmonary nodule identification that allows for VATS resection, avoiding thoracotomy. Traditionally, this involves marking in the radiology suite with transfer to the operating room (CT+OR) – requiring patient transportation under general anesthesia and re-positioning for thoracoscopy. Since February 2018, we have performed these procedures in a collaborative hybrid operating room (HOR) in an attempt to improve efficiency and patient safety. We sought to characterize the differences between these approaches.

Methods: All cases performed in our HOR from February 2018 to August 2019 were retrospectively identified. Cases performed with CT+OR were selected in consecutive reverse chronological order for a 1:1 sampling. Descriptive statistics were obtained, and comparisons were made with t-tests.

Results: A total of 26 cases were reviewed, 13 for each approach. Patients had similar age, diagnoses, and number of additional procedures performed. Time from localization to case start was shorter for HOR (17±12min vs 31±23min, p=0.04), representing the effect of patient transport time in CT+OR. Surgery time was shorter for HOR (103±35min vs 148±72min, p=0.05), signaling the burden of patient re-positioning in CT+OR. OR time was longer for HOR (272±72min vs 198±82min, p=0.02), an expected finding given that all portions of the intervention take place in this room. Anesthesia time was shorter for HOR (285±74min vs 318±94min, 0.17), a desired effect given the potential neurodevelopmental risks of anesthetic exposure in the pediatric population. There was no significant difference in patient charges.

Conclusion: HOR is a promising alternative to the conventional CT+OR approach to pulmonary nodule localization and resection that minimizes surgery and anesthesia times while avoiding complications associated to patient transport (including potential marker dislodgment) without increasing patient charges. These differences are expected to become more pronounced as our HOR experience grows and we overcome the learning curve associated to the use of this new resource.



Scientific Session 2: ECLS and CDH

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PHYSICIAN'S CURRENT PROCEDURAL TERMINOLOGY CHANGES AND DIMINISHING RETURNS IN PEDIATRIC ECMO

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Purpose: After a surge in ECMO utilization in adults with respiratory failure, CPT codes were modified in 2015 to differentiate the wide range of procedures associated with this life-sustaining therapy. The purpose of this study was to evaluate the impact of those changes in professional billing for pediatric surgeons.

Methods: A retrospective review of ECMO charges in CDH patients was performed for therapy provided between 2008-2012 and 2015-2017. ECMO-specific CPT codes and RVUs were obtained. A sample 10-day ECMO run with peripheral cannulation and open peripheral decannulation was designed for calculations.

Results: With the previous CPT codes, the sample ECMO run accounted for 174.8+ RVUs, for a total of \$32,237 average charges. With the new CPT codes, the sample ECMO run collected a total of 61.4 RVUs, with \$17,755 in charges. This represented a 65% reduction in RVUs and a 46% reduction in charges. The Medicare reimbursement rate in our population has remained stable at 9%, with private insurance reimbursement falling from 70% to 59% between these study periods. This represents diminishing payments from a total reimbursement of \$2,910 to \$1,598 for all services provided in Medicaid patients, and \$22,636 to \$10,475 in the commercially insured since the introduction of the new procedural terminology.

Conclusions: Modern CPT codes for pediatric ECMO have depreciated professional RVUs by 65% and average professional charges by 46%, significantly diminishing the revenues for pediatric surgery departments offering this therapy. As the infrastructure required to provide this service is costly, some centers may be impacted by diminishing returns, ultimately limiting access to this service for a greater portion of the population.



Scientific Session 2: ECLS and CDH (continued)

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BEYOND SURVIVAL: READMISSIONS AND LATE MORTALITY IN PEDIATRIC ECMO SURVIVORS

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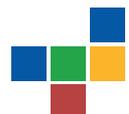
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Introduction: Beyond mortality, little is known about longer-term outcomes of pediatric ECMO survivors. The objective of our study was to identify rates of readmission and late mortality in pediatric ECMO patients after discharge from their ECMO hospitalization.

Methods: We conducted a population-based retrospective cohort study of children who were discharged after ECMO. Data were obtained from the State Inpatient Databases for 10 states. Pediatric ECMO admissions in 2005-2015 were identified using International Classification of Disease, 9th edition (ICD-9) procedure codes. Readmission was defined as unplanned readmissions, and late mortality was defined as any death that occurred during any readmission (planned or unplanned). Time-to-event analyses were used to estimate the risk of readmission and to identify factors predictive of readmission and late mortality, including characteristics of initial hospital course and ECMO center volume.

Results: A total of 1603 pediatric ECMO patients were included and 42.4% of these patients died prior to discharge. Of the 924 ECMO survivors, 44.6% had at least 1 unplanned readmission throughout the study period (35.6% within 1 year after discharge from ECMO). Median number of readmissions per patient was 2 during a median follow-up of 20 months. Overall, 4.9% of initial ECMO survivors died during a subsequent readmission. On multivariable modeling, the likelihood of readmission was significantly related to the indication for ECMO, number of complex chronic conditions, transfer status, and discharge destination (all $p < 0.05$). The likelihood of late mortality was significantly related to health insurance, transfer status, number of complex chronic conditions, and indication for ECMO (all $p < 0.05$).

Conclusions: Pediatric ECMO survivors have a high chance of hospital readmission with approximately 5% mortality during readmissions. The risks for readmission are related to patient and hospital characteristics from the ECMO hospitalization. These results can be used to help set expectations and counsel families of children who survive ECMO.



Scientific Session 2: ECLS and CDH (continued)

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FETOSCOPIC INSUFFLATION MODELED IN EXTEND: WARM HUMIDIFIED CARBON DIOXIDE INSUFFLATION IS SAFER FOR THE FETUS

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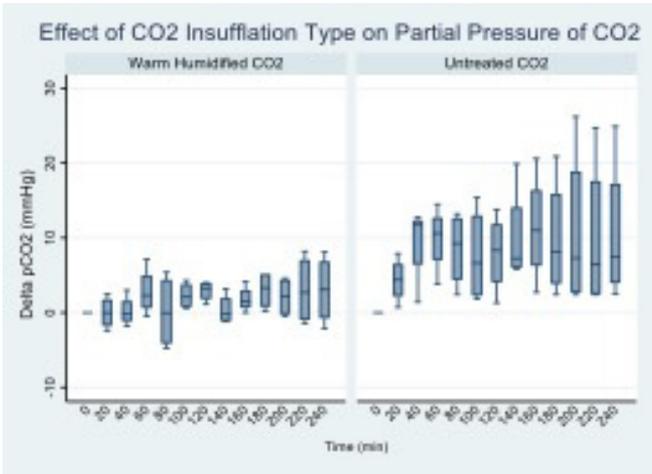
Purpose: Minimally invasive fetal surgery, or fetoscopy, is an alternative to open fetal surgery to repair common birth defects like myelomeningocele. Though fetoscopy may appear feasible and safer for the mother, the effects on the fetus are poorly understood. We sought to use the accessibility of the fetus in the EXTEND (EXTrauterine Environment for Neonatal Development) system to study the effects of insufflation on the fetus.

Methods: Fetal sheep at gestational age 104 to 107 days were cannulated onto the EXTEND system using dual umbilical artery/umbilical vein cannulation. The fetuses were allowed to recover for twenty-four hours, and their arterial blood gases normalized. Fetuses were exposed to two different insufflation conditions at a pressure of 7mmHg for four hours each: warm, humidified carbon dioxide using an Insufflow Gas Conditioning Device (n=4) and untreated carbon dioxide (n=4). Animals were allowed to sufficiently recover between each exposure, as determined by normalization of hemodynamic status and laboratory values. Blood gases were assessed from the umbilical vein every twenty minutes. Statistical analysis was performed using Stata/IC 15.1.

Results: Fetal pCO₂ levels increased more rapidly in the Untreated CO₂ group than in the Warm Humidified CO₂ group (p=0.01) (Figure 1). Umbilical blood flow decreased more slowly in the Warm Humidified CO₂ group than in the Untreated Group (p=0.006). Oxygen delivery dropped acutely in the Untreated CO₂ group (p=0.0266) (Figure 2).

Conclusions: Using the EXTEND system, we demonstrate that insufflation with Warm, Humidified CO₂ is safer for the fetus than Untreated CO₂ Insufflation. Fetoscopic interventions should therefore be performed with warm humidified CO₂ Insufflation.

Scientific Session 2: ECLS and CDH (continued)



Scientific Session 2: ECLS and CDH (continued)

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GEOGRAPHIC DISTANCE TO ECLS CENTERS FOR PEDIATRIC PATIENTS WITHIN THE CONTINENTAL UNITED STATES

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Purpose: Distance to subspecialty surgical care is a known impediment to quality health care. In 2010, more than 10 million children lived greater than 60 miles from a pediatric surgeon, and disparities in distance-to-care were demonstrated across race, ethnicity, and state. Extracorporeal Life Support has been shown to benefit pediatric patients with specific medical conditions. Geographic proximity to ECLS centers for pediatric patients has not been evaluated to date nor have racial, ethnic, gender or urbanization variations been reported.

Methods: A publicly available listing of current voluntarily reporting ECLS centers in 2019 and the 2010 Decennial Census were used to calculate straight-line distances between ECLS zip code centroids and census block centroids.

Results: There were 136 centers providing pediatric ECLS in 2019. The distribution varied by state with Texas, California and Florida having the most centers. Over 16 million children (23% of the pediatric population) were found to live greater than 60 miles from an ECLS center. Significant disparity with regard to access to care for ECLS centers was found based upon urban versus rural locations with over 47% of children in a rural setting living greater than 60 miles from an ECLS Center compared with 17% of children living in an urban setting.

Conclusions: Disparities in proximity to ECLS centers were present and persistent across states. Significant variation exists in the number of ECLS centers available in each state. Children in a rural setting were found to have a higher likelihood of living greater than 60 miles from an ECLS center. These findings may affect practice patterns and treatment decisions. This data is important to development of regionalization strategies to ensure all children have subspecialty surgical care available including ECLS.



Scientific Session 2: ECLS and CDH (continued)

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Growth, Cognition and Cardiopulmonary Health Among 8-13 Year Olds with Pulmonary Hypoplasia: A Prospective Cohort

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Purpose: As advances in fetal imaging, neonatal intensive care and pediatric surgery improve survival for neonates with pulmonary hypoplasia (PH), evaluation of long-term outcomes is critical. The purpose of this study was to evaluate growth, cognition and cardiopulmonary health of 8 - 13 year olds diagnosed with PH within the first 28-days of life.

Methods: This is a single-institution prospective cohort study of children with PH enrolled in an interdisciplinary follow-up program started in 2004. The study visit included a history and physical as well as evaluation of cognitive functioning and cardiopulmonary health. Outcomes included age- and sex-standardized anthropometry (CDC growth curves), composite general cognitive ability Intelligence Quotient (Wechsler Abbreviated Scale of Intelligence - WASI-II 4) and reconciliation of current respiratory and pulmonary hypertension medications as an indicator of chronic cardiopulmonary disease.

Results: Of 626 participants, 100 met inclusion criteria (mean = 10.5 years) and participated in the study visit. 55 were male, 59 had isolated congenital diaphragmatic hernia (CDH), 14 had isolated giant omphalocele, 20 had isolated lung lesions; 7 children had mixed/other diagnoses. 86% (n = 55) of children with CDH had left-sided lesions. The median weight was 27.4 %ile (IQR = 9.3 - 59.2) and height was 29.4 %ile (IQR = 11.5 - 62.4). Cognitive assessments were completed on 96 participants with mean WASI-II 4 IQ score 102.2 (sd = 17.3); 4 children had WASI-II 4 IQ < 70. 40 participants were taking a bronchodilator and 3 children required medication to manage pulmonary hypertension.

Conclusions: On average, infants with PH cared for by an interdisciplinary clinical program have normal growth and general cognition in late childhood. A minority have evidence of pulmonary hypertension, though many have chronic respiratory disease. Long-term follow-up is necessary to understand the impact of early interventions on neuropsychological functioning and cardiopulmonary health in children with PH.

Scientific Session 2: ECLS and CDH (continued)

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LOW-VOLUME CENTERS ARE MORE COST-EFFECTIVE THAN HIGH-VOLUME CENTERS IN THE TREATMENT OF CONGENITAL DIAPHRAGMATIC HERNIAS (CDH)

Ruth A. Lewit, MD, MPH, Tim Jancelewicz, MD, MA, MS

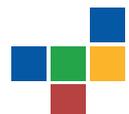
Le Bonheur Children's Hospital, University of Tennessee Health Sciences Center, Memphis, TN, USA

Purpose: The purpose of this study was to examine the cost-effectiveness of CDH treatment, comparing high- versus low-volume centers.

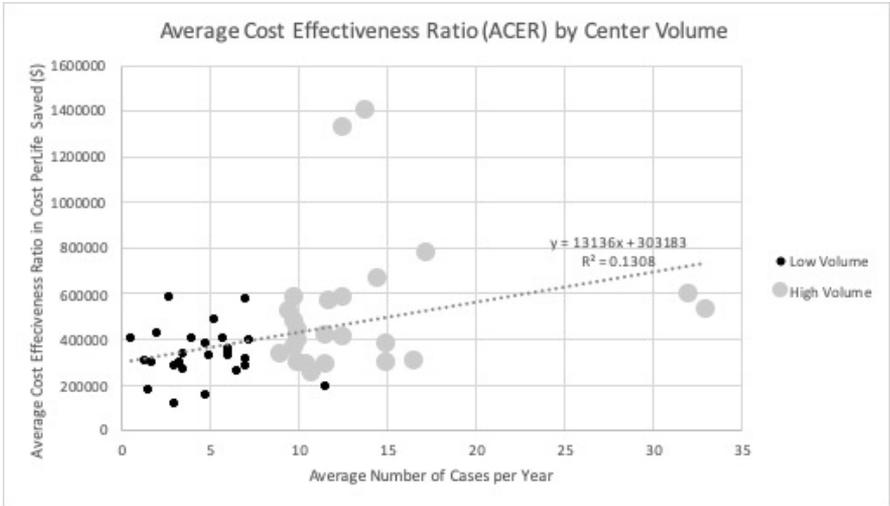
Methods: This is a retrospective study of neonatal CDH patients at U.S. hospitals using data from the Pediatric Health Information System (PHIS) database (2015-2018). Centers were considered high volume if they had more than 10 patients with CDH for at least two years. CDH severity was estimated using CDH Study Group predicted survival. Statistical analysis was done using R Software; p-values <0.05 were considered significant. The adjusted average cost per patient per center was calculated, as well as the average number of patients per year and average center mortality, and linear regression analysis was conducted. Cost-effectiveness analysis was performed using TreeAge Software with cost per survivor as the outcome measure, and probabilistic sensitivity analysis was performed.

Results: Fifty-one hospitals provided data on 1,689 CDH patients to the PHIS database. Of those, 24 were considered high volume (N=1,269) and 27 were low volume (N=428). No statistical difference in severity of disease or survival was found between high- and low-volume centers. When the Average Cost Effectiveness Ratio (ACER) was compared with average patient volume using linear regression analysis, it was found that ACER increased with increasing volume (p=0.009). The average cost of care per patient at high-volume centers was \$371,451 +/- \$70,847 with an average effectiveness of 0.74; average cost of care at low-volume centers was \$233,984 +/- \$42,755, with an effectiveness of 0.70. Low-volume centers were therefore more cost-effective at treating CDH than high-volume centers and sensitivity analysis with Monte Carlo simulation confirmed this in 95.8% out of 1,000 trials.

Conclusions: While there is substantial variability in cost-effectiveness amongst high-volume centers, they are overall less cost-effective at treating patients with CDH than low-volume centers. High volume centers have substantially higher costs without an associated survival benefit.



Scientific Session 2: ECLS and CDH (continued)



Scientific Session 2: ECLS and CDH (continued)

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SOURCES OF REGIONAL AND CENTER-LEVEL VARIABILITY IN SURVIVAL AND COST OF CARE FOR CONGENITAL DIAPHRAGMATIC HERNIAS (CDH)

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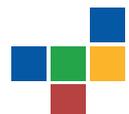
Le Bonheur Children's Hospital, University of Tennessee Health Sciences Center, Memphis, TN, USA

Purpose: Enormous variability occurs in CDH care. The purpose of this study was to identify patterns and underlying sources of this variability.

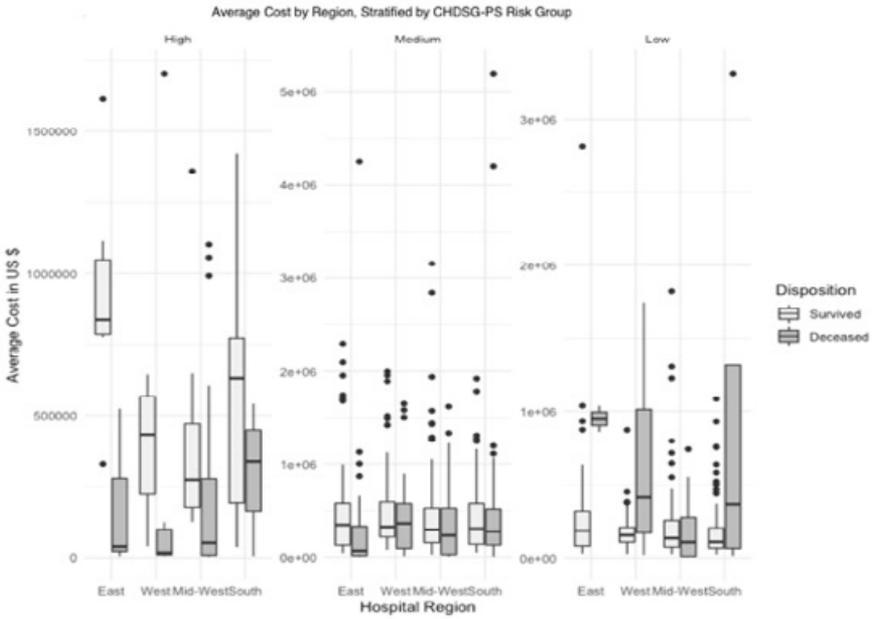
Methods: A retrospective study of neonatal CDH patients at U.S. hospitals using data from the Pediatric Health Information System (PHIS) database (2015-2018). Centers were considered high volume if they had more than 10 patients with CDH for at least two years. Patients were risk-stratified using CDH Study Group predicted survival (CDHSG-PS), and mortality and costs were assessed by region (East, West, Mid-West, and South) and by center. Statistical analysis was conducted using R Software; p-values <0.05 were considered significant. Student's t-test, Kruskal-Wallis, Chi-Squared, univariate and multivariable regression analyses were performed when appropriate.

Results: Of 1,687 patients at 51 centers, 412 (24.4%) died. Higher mortality and extracorporeal life support (ECLS) rates were found in the Mid-West and South ($p < 0.0001$). Higher mortality was seen with ECLS amongst low-volume centers in the South compared to other regions ($p = 0.007$). When broken down by CHDSG-PS, higher risk patients had higher mortality in the Mid-West and South ($p = 0.038$). Blacks had higher overall mortality and associated costs, particularly higher mortality in the East compared to other races, but there was no difference in mortality when comparing black populations across regions (Table). Caucasians in the East had significantly lower mortality rates compared to other regions ($p = 0.0045$). Cost was significantly lower for high-risk non-survivors than survivors (\$244,005 vs \$565,487, $p = 0.0008$). The East spent significantly more on high-risk patients with lower mortality compared to high-risk patients in other regions, but also spent 3.5x more on low-risk non-survivors than survivors (Figure). Costs were higher at high-volume centers for low- and medium-risk patients, but all centers spent the same on high-risk patients.

Conclusion: Race, center volume, region, and severity all contribute to the complex survival and cost disparities that exist in caring for CDH patients.



Scientific Session 2: ECLS and CDH (continued)



Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors

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SMALL MOLECULE INHIBITORS TARGETING DNA LIGATION IMPAIRS XENOGRAFT GROWTH IN HIGH-RISK NEUROBLASTOMA

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Objective: The majority of children diagnosed with advanced-stage neuroblastoma succumb to refractory disease that relapses despite aggressive surgery and cytotoxic therapy. Over the last five decades there has been little progress in improving outcomes for patients with relapsed neuroblastoma and overall 3-year survival remains low. Thus, there is an immediate need to develop improved treatment for neuroblastoma refractory to current therapy. DNA ligase III (LIG3) is an enzyme with overlapping function in the ultimate steps of DNA replication and repair. Our overarching hypothesis is that LIG3 is a new therapeutic target for neuroblastoma, and that refractory tumors rely on LIG3 ligation activity for fitness. We have identified promising small molecule inhibitors of LIG3 by high-throughput screening. The current investigation is to establish compound 283 as a novel targeted inhibitor of DNA ligation activity for preclinical studies.

Methods: Through multidisciplinary collaboration, we screened ~132,000 unique small molecules and discovered potent and selective inhibitors of LIG3 ligation activity with promising cytotoxicity in neuroblastoma cell lines and in a clinically relevant xenograft model. The cellular thermal shift assay was utilized for studies of target engagement of drug candidates in an intracellular context. MTS cellular proliferation and colony formation in vitro and orthotopic/subcutaneous tumor formation in SCID mice for in vivo studies were performed to evaluate the compound's target effects in neuroblastoma.

Results: Compound 283 had the most potent and consistent DNA ligation inhibition activity. Cellular thermal shift assay indicated that compound 283 binds intracellular LIG3 and impairs cell growth in high-risk neuroblastoma cell lines. Compound 283 specifically binds LIG3a, efficiently inhibits cellular growth and is synergistic with cisplatin in vitro. I.P. injection (5mg/kg) of compound 283 in mice inhibits orthotopic tumor growth in SCID mice.

Conclusion: Small molecule compound 283 targets LIG3 DNA ligation activity and inhibits neuroblastoma growth.

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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INHIBITION OF HUMAN NEUROBLASTOMA PROGRESSION BY PROBENECID AND CARBENOXOLONE

Marie-Eve St-Pierre, Stephen Holland, **Stephanie Langlois, PhD**, Hisham Mohamed, Ahmed Hammad, Cem Dural, Kyle N. Cowan, MD, PhD

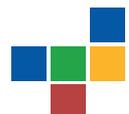
CHEO Research Institute, Ottawa, ON, Canada

Purpose: Despite aggressive surgery and chemotherapy, the survival rate of high-risk neuroblastoma (NB) patients remains below 50%, thus highlighting the urgent need for improved NB treatments. Interestingly, it was recently shown that pannexin 1 (Panx1) channels are expressed in the mouse NB-derived cell line N2a and that the Panx1 channels blocker probenecid reduces N2a cell proliferation. Here we assessed whether inhibition of human PANX1 channels constitute a potential novel NB therapeutic approach.

Methods: Institutional Research Ethics Board and Animal Care And Use Committee approvals have been obtained. PANX1 protein levels were examined by western blotting in six NB patient specimens and seven high-risk NB patient-derived cell lines. To assess whether inhibition of PANX1 channels reduces NB growth, cell proliferation and apoptosis assays were performed in the presence of probenecid, carbenoxolone, or vehicle control. Furthermore, the effect of these drugs on 3D spheroid growth was measured using our Incucyte live imaging system. Finally, the effect of probenecid and carbenoxolone was tested on NB tumor growth in vivo. Statistical significance was analyzed using two-tailed Student's t-Test ($n \geq 3$; $*P < 0.05$).

Results: Our results indicate that PANX1 is expressed in high-risk patient derived NB cell lines as well as in NB tumor specimens and may be upregulated in undifferentiated/poorly differentiated human NB. Probenecid and carbenoxolone reduced NB growth by inhibiting cell proliferation and triggering apoptosis. Treatment with probenecid and carbenoxolone significantly reduced 3D spheroid growth and in some cases induced tumor regression in vitro. Importantly, both drugs significantly reduced NB xenograft growth in vivo.

Conclusions: Altogether our findings indicate that PANX1 is expressed in human NB and that treatment with probenecid or carbenoxolone reduced NB malignant properties in vitro and in in vivo pre-clinical assays. Given that probenecid and carbenoxolone are already clinically-approved, translation into clinical trials for NB treatment could be expedited.



Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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A NOVEL METHOD TO INCREASE DOXORUBICIN UPTAKE IN A NEUROBLASTOMA MOUSE MODEL USING FOCUSED ULTRASOUND AND MICROBUBBLES

Rebecca C. Kirschner, MD¹, Aditi Bellari², Bianca Lec¹, Ann Marie Defnet¹, Naina Bagrodia³, Shashank Sirsi², Jessica Kandel¹, Sonia Hernandez¹

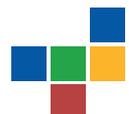
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Purpose: Neuroblastoma (NB) causes for 15% of cancer-related childhood deaths. Chemotherapy with doxorubicin imposes long-term toxicities, and therefore identification of reduced-toxicity strategies is urgent. Liposomal doxorubicin formulation increases circulation time but uptake depends on tumor vascular permeability (VP). Microbubbles (MB), acoustically reactive molecules, can be targeted to enhance VP when coupled with Focused Ultrasound (FUS), called sonoporation. We hypothesized that sonoporation could enhance VP in NB, increasing local liposomal doxorubicin (LDOX) delivery to NB xenografts, and reducing systemic exposure.

Method: All experiments were approved by UChicago and UT Dallas IACUC. 1×10^6 Neuroblastoma NGP-Luciferase cells were intrarenally implanted into NCR nude mice, forming tumors of 1-2 grams after 5 weeks. FUS (2W/cm²) was applied to tumors in cycles (5 minutes in 60 seconds on, 60 seconds off), while mice received intravenous LDOX and 1×10^9 MB labeled with fluorescent dye DiD. Controls received no treatment or no FUS. 24 hours after treatment, intratumoral LDOX and DiD were visualized by fluorescent confocal microscopy. Slides were interrogated with H&E and immunostaining for the vascular pericyte marker alpha-smooth muscle actin (alphaSMA).

Results: H&E analysis of MB+FUS-treated tumors indicate an increase in red blood cell extravasation versus untreated controls. AlphaSMA immunostaining of treated tumors revealed discontinuous pericyte coverage of endothelial cells, consistent with increased VP. Tumors that received LDOX+DiD only had minimal LDOX and DiD signal visible in blood vessels and extracellular spaces. In contrast, LDOX+DiD+MB+FUS tumors revealed much higher LDOX and DiD fluorescence, in both extracellular and nuclear compartments of the treated tumors, particularly in areas located near blood vessels.

Conclusion: The combination of MB and FUS can increase LDOX tumor uptake, likely by promoting tumor VP. These findings could be applied to other solid tumors, both primary and metastatic. Decreasing the amount of systemic drug required for effective treatment could reduce long-term toxicity of cancer chemotherapy.



Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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SUSTAINED RELEASE INTERFERON-GAMMA INCREASES M1 TUMOR-ASSOCIATED MACROPHAGES AND SUPPRESSES TUMOR GROWTH IN AN ORTHOTOPIC NEUROBLASTOMA MOUSE MODEL

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Introduction: Neuroblastoma is a deadly disease, especially for high-risk patients. Recent efforts in utilizing immune therapy in treating neuroblastoma showed inadequate response, highlighting the immune-suppressive tumor microenvironment. Tumor-associated macrophages are present within the tumor, but they have been ineffective in tumor suppression. Different stimuli can polarize macrophages into cancer-inhibiting M1 or cancer-promoting M2 types. We hypothesize that treating neuroblastoma tumor with interferon-gamma (IFN- γ) can increase M1 macrophage population and suppress tumor growth. Since systemic administration of IFN- γ leads to significant toxicity, we further hypothesize that we can directly deliver IFN- γ to the tumor by implanting a sustained release silk film loaded with IFN- γ .

Methods: Different IFN- γ doses were loaded onto silk film, and the amounts of IFN- γ released from the film in vitro over time was recorded. Orthotopic, syngeneic neuroblastoma xenografts were generated by injecting 9464D cells into left adrenal gland of immunocompetent C57BL/6 mice, and IFN- γ -loaded silk films were implanted into the tumor once tumor size reaches 100mm³. Tumor volume was measured with ultrasound. Formalin preserved paraffin-embedded tumor sections were stained with hematoxylin and eosin (H&E). Tumor was homogenized for quantitative-PCR (qPCR).

Results: 0.5, 1, 2 μ g of IFN- γ were loaded onto silk films. In vitro release study showed 1-2% of IFN- γ was released by the fifth day. Neuroblastoma tumor implanted with silk film loaded with 0.5 μ g, 1 μ g, or 2 μ g IFN- γ reached 500mm³ in 6.72 \pm 1.13, 6.85 \pm 1.06, and 7.92 \pm 1.2 days, respectively, which are significantly longer than 4.94 \pm 1.21 days for control film ($p=0.02$, 0.02, 0.006 respectively). H&E staining of tumor sections demonstrated tumor necrosis adjacent to the silk film. q-PCR showed increased expression of M1 macrophage markers (TNF, CCR7) for IFN- γ -treated tumor compared to that of control ($p<0.05$).

Conclusions: Local delivery of sustained release IFN- γ can increase M1 macrophage populations and suppress neuroblastoma tumor growth.

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

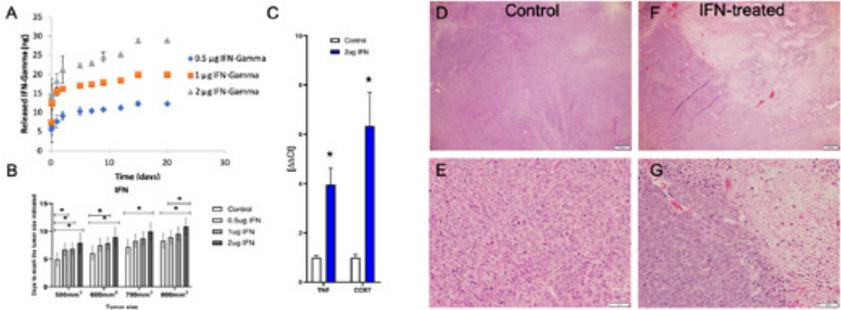


Figure 1. (A) In vitro release study of IFN-γ-loaded silk film. (B) Days to estimated tumor size by implant, demonstrating significantly longer time to reach a given size as compared to control. (C) Quantitative-PCR showed increased TNF and CCR7 expression (M1 markers) in treated tumors as compared to control. (D, E) H&E staining of neuroblastoma tumor section treated with control silk film, showing small round blue cells at 40x, 200x respectively. (F, G) Tumor section adjacent to IFN-γ film demonstrating tumor necrosis at 40x, 200x respectively. (*p<0.05)

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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CHARACTERIZATION OF METASTATIC VARIANTS FROM HUMAN HEPATOBLASTOMA CELL LINE

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Purpose: Outcomes for children with metastatic hepatoblastoma (HB) remain poor. Cell lines and preclinical models that depict the progression of disease and metastasis-related biology are much needed. We aimed to generate and characterize metastatic HB cell line variants to better investigate the molecular mechanism associated with metastasis.

Methods: Human HB cells (HuH6) were injected into the tail vein of athymic nude mice. Lung metastases were detected using bioluminescence imaging and confirmed using hematoxylin and eosin staining. Two separate metastatic pulmonary lesions were dissociated and plated into cell culture to derive the two cell lines, HLM_2878 and HLM_2936. Cell proliferation, growth curves, migration and invasion, and anchorage-independent growth were assessed using CellTiter 96®, Trypan Blue, modified Boyden chamber assays, and a colony formation assay, respectively. Cells were treated with cisplatin at increasing concentrations for 72 hours and viability was assessed using an alamarBlue® assay. Protein expression for PIM3 kinase and CXCR4 was evaluated by immunoblotting. Student's t-test was used with mean ± standard error of the mean reported and $p \leq 0.05$ significant.

Results: HLM_2878 and HLM_2936 successfully propagated in culture. These two cell lines showed enhanced tumorigenicity as measured by increased proliferation and rapid growth compared with the parent HuH6 cell line (Figure 1 A-B). Moreover, the two cell lines exhibited significantly increased migration, invasion, and anchorage-independent growth indicating a more invasive phenotype (Figure 1 C-E), which was associated with higher expression of PIM3 kinase as well as increased expression of epithelial-to-mesenchymal marker, CXCR4. Finally, the two metastatic variants were more resistant to cisplatin compared to the parent cell line, mirroring the clinical development of chemoresistance (Figure 1 F).

Conclusion: We have successfully established and characterized two metastatic hepatoblastoma cell lines with enhanced tumorigenicity and invasiveness, offering a novel tool and an opportunity to evaluate new therapeutic strategies for invasive hepatoblastoma.

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

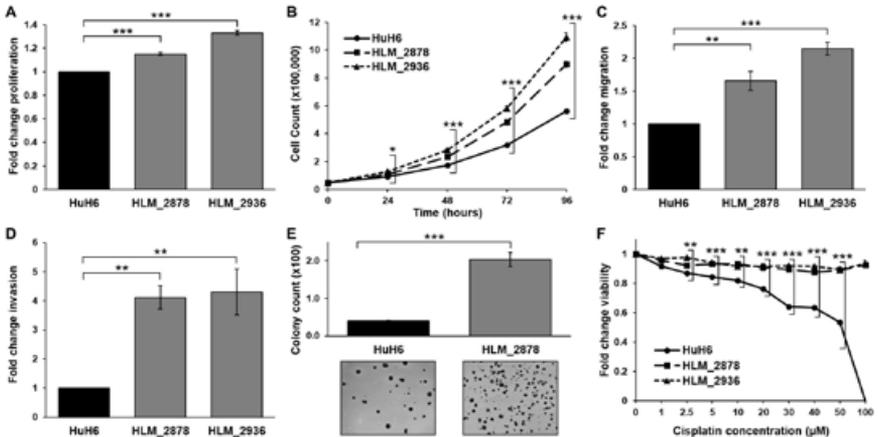


Figure 1. Characterization of Metastatic Human Hepatoblastoma Cell Line Variants. HLM_2878 and HLM_2936 showed increased (A) cell proliferation, (B) growth, (C) migration, (D) invasion, and (E) anchorage-independent growth compared to the parent HuH6 cell line. (F) The two metastatic variants were more resistant to cisplatin with significantly increased viability at the same dose of cisplatin compared to the parent cell line. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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THE USE OF REAL-TIME INDOCYANINE GREEN-GUIDED NEAR-INFRARED IMAGING DURING PARTIAL HEPATECTOMY FOR THE TREATMENT OF PEDIATRIC LIVER CANCER

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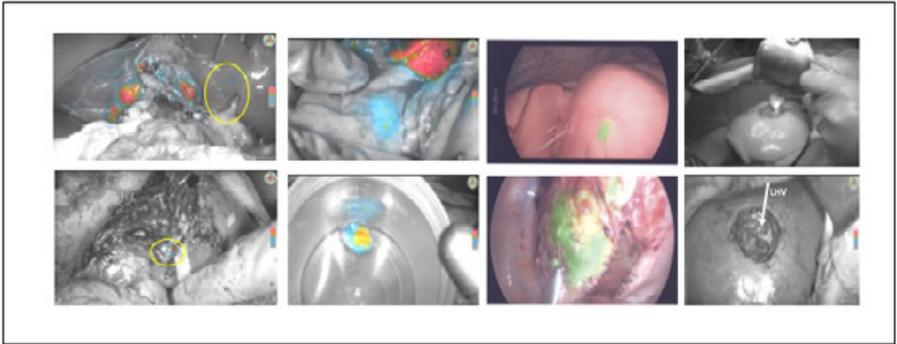
Purpose: Hepatoblastoma (HB) and hepatocellular carcinoma (HCC) are the most common primary malignant tumors of childhood. Intraoperative indocyanine green (ICG) administration with near-infrared imaging (NIR-ICG) has emerged as a surgical technology that can be used to assist with localization of pulmonary metastases secondary to HB; however, there has been limited application to the real-time intraoperative use for extrahepatic disease, multifocal tumors, and margin assessment during partial hepatectomy.

Methods: We present five patients treated for HB and HCC at our institution with the use of intraoperative NIR-ICG imaging. All patients were treated with 0.5-0.75 mg/kg IV ICG, 48-72 hours prior to surgery.

Results: NIR-ICG allowed pulmonary metastasectomy in two patients using thoracoscopy or thoracotomy allowing for visualization of 20 nodules not seen on preoperative imaging of which 14 were positive for malignancy. NIR-ICG imaging allowed for identification of extrahepatic extension in two patients; an HCC patient with extrahepatic lymph nodes positive for malignancy, and a recurrent HB patient with diaphragm thickening demonstrating NIR-ICG fluorescence and disease on resection pathology. This technique was used to guide partial hepatectomy in four patients. Three patients underwent right trisectionectomy, and NIR-ICG was used for real time resection of satellite HB lesions in two multifocal patients and detected caudate extension that was subsequently resected. The fourth patient had preoperative biliary obstruction and NIR-ICG imaging revealed fluorescence throughout the liver. All 4 patients were resected with negative margins.

Conclusions: Intraoperative use of NIR-ICG imaging during partial hepatectomy enabled identification and guidance for surgical resection of extrahepatic extension and multifocal liver tumors for the treatment of children with HB and HCC.

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)



Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

32

PATHOLOGICAL EVALUATION OF ICG NAVIGATION SURGERY FOR HEPATOBLASTOMA RESECTION AND PULMONARY METASECTOMY: JCCG EXPERIENCES

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We have used indocyanine green (ICG) fluorescence navigation imaging surgery to achieve precise and sensitive detection of tumor invasion and pulmonary metastases of hepatoblastoma. This study clarified the feasibility of intraoperative ICG fluorescent imaging for the resection of primary tumor and pulmonary metastases using histological examination in JCCG (Japanese Children's Cancer Group) cases. Lung metastasectomies under this method were performed in 41 patients aged from 0 to 12 years (Table 1). ICG (0.5 mg/kg) was injected intravenously 24-72 hours before surgery. After thoracotomy, a 760-nm infrared ray was applied to the lung using a generator and the 830-nm evoked fluorescence was collected on a real-time display. In total, 374 fluorescence-positive and 39 fluorescence-negative lesions were extirpated in 67 operations. Among them, 264 lesions (72%) had been detectable by preoperative CT. Among 374 ICG-positive lesions, 341 (sensitivity: 91%) contained variable tumor cells and the diameter of the smallest was 0.06 mm (Fig. 2). On the other hand, 25 of 39 ICG negative lesions were non-malignant (specificity: 64%). To analyze false positive and false negative cases, the pathological slides of these cases were closely examined using fluorescent microscopy using long-wavelength laser. Most false-positive lesions were stroma or inflammation with sickly ICG positive cells (Fig. 3). In addition, we tried to use ICG methods for detecting positive margin at 39 primary tumor resection without enough margin. Among these primary tumor resection, 12 were ICG positive and 6 of 12 contained variable tumor cells. The 6 false negative lesions were bile leakage or stroma lesions. Therefore, intraoperative ICG fluorescence imaging for patients with hepatoblastoma is feasible and useful for identifying small viable lesions in lung as well as margin of primary tumor resection.



Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

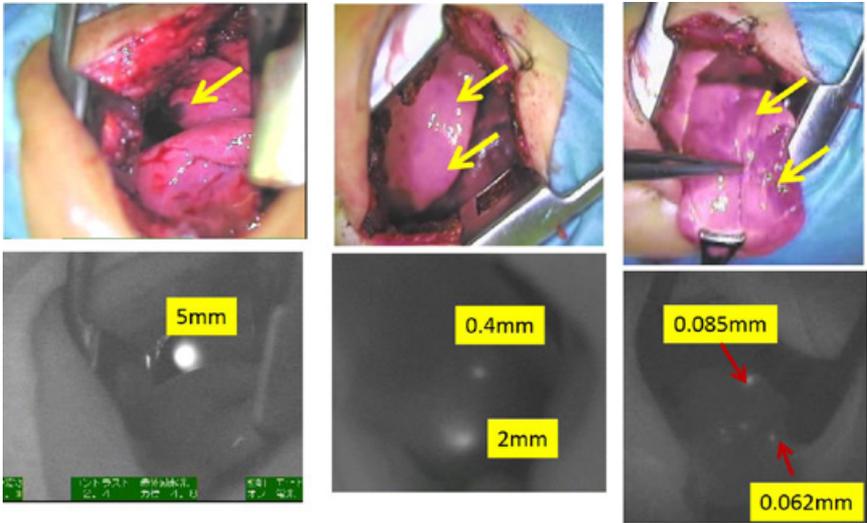


Fig. 3 Detection of lung micro-metastases in hepatoblastoma

Scientific Session 3: Oncology I - Neuroblastoma and Hepatic Tumors (continued)

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HEPATIC ANGIOSARCOMA IN CHILDREN IS ASSOCIATED WITH INCREASED RATES OF SURGICAL RESECTION AND IMPROVED OVERALL SURVIVAL COMPARED WITH ADULTS

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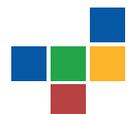
Duke University Medical Center, Durham, NC, USA

Purpose: This project aims to compare the disease characteristics of hepatic angiosarcoma, a rare and aggressive malignancy with fewer than 50 reports in the literature, between the pediatric and adult populations.

Methods: The 2017 National Cancer Database was queried for patients with histologically confirmed hepatic angiosarcoma using ICD-O-4 codes and found 669 patients. Patients were stratified by age: pediatric < 21 years (n=19) and adults ³ 21 (n=650). Descriptive statistics and Pearsons chi square analysis were performed, and significance was defined as p<0.05.

Results: The mean age at diagnosis was 12 years (standard deviation 8) in the pediatric group as compared to 60 (16) in the adult group. There were no significant differences in distributions of gender or race. The 1, 3, and 5-year overall survival for pediatric patients was 88%, 72%, 72%, respectively, vs 37%, 28%, 26% in adults. There was no significant difference between the pediatric and adult groups in median (Q1,Q3) tumor size [5.5cm (3.0, 19.0) vs 5.9cm (3.1, 10.0)] or presence of metastasis (32% vs 29%). Although the rate of surgery in the pediatric group was significantly higher (42% vs 23%, p=0.03), there was no difference in the extent of surgery performed (Table 1), number of lymph nodes examined (38% vs 24%), or number of positive lymph nodes identified (33% vs 52%). There was also no significant difference in the use of radiation (5% vs 5%), chemotherapy (8% vs 7%), or palliative care (0% vs 6%).

Conclusion: In the largest study of hepatic angiosarcoma to date, we found that although tumor size and rate of metastases are similar between children and adults, children had higher rates of surgical resection and improved overall survival. Further multicenter collaborative studies are needed to understand the ontogeny of angiosarcoma and develop management strategies for this rare but aggressive malignancy.



Scientific Session 4: Oncology II - Sarcoma and Renal Tumors

35

CLINICAL AND FUNCTIONAL OUTCOMES OF CHILDREN TREATED FOR CHEST WALL SARCOMA: A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

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Purpose: We sought to characterize the factors associated with clinical and functional outcomes of children following surgery and/or radiation for chest wall sarcomas.

Methods: A multi-institutional review of children with chest wall sarcomas treated at ten Pediatric Surgical Oncology Research Collaborative institutions between 2008-2017 was performed. Factors associated with scoliosis development and need for surgical correction were analyzed in a

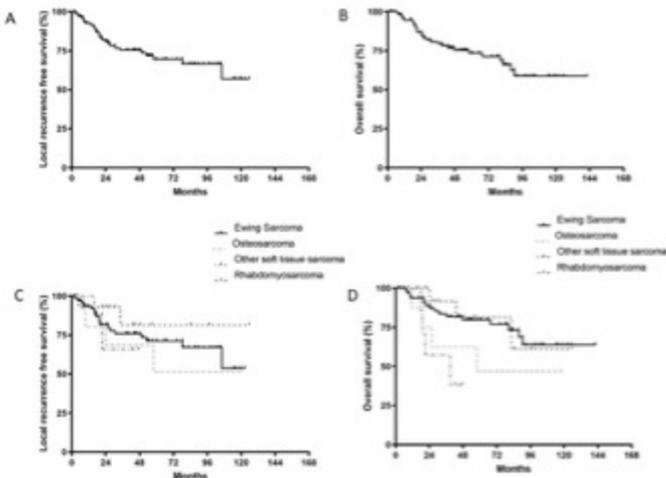


Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

multivariable regression and survival by Kaplan-Meier analysis.

Results: 106 patients with a median age of 14 years were included. The most common diagnoses were Ewing sarcoma (71/106, 67%) and osteosarcoma (11/106, 10%). 40% of the tumors were located anteriorly (42/106) and 43% posteriorly (46/106). Treatments included surgery alone (7/106, 7%); surgery plus chemotherapy (36/106, 34%); surgery, chemotherapy and radiation (49/106, 46%); and radiation plus chemotherapy (13/106, 12%). A median of 2 ribs were totally or partially resected (IQR=1-3) and 24% (22/92) had at least one rib completely resected. Sixty-three (68%) patients had reconstruction: synthetic mesh (28/63, 44%), methyl methacrylate cement ± mesh (20/63, 32%) or biologic mesh (13/63, 21%). With a median follow-up of four years (IQR=1.7-6.5), 17 (16%) patients developed scoliosis (median Cobb angle 26, IQR=15-33.5) and 7 (41%) of these patients required corrective spine surgery. Scoliosis was associated with posterior rib resection (HR 8.43; $p=0.003$) and increasing number of ribs resected (HR 1.78; $p=0.002$). Three-year local failure-free survival (FFS) and overall survival (OS) were 75% and 81%, respectively, with improved OS ($p=0.03$) in Ewing sarcoma compared to other diagnoses (Figure).

Conclusion: Chest wall sarcomas present unique challenges and are most often treated with multimodal therapy. Scoliosis occurs in a significant minority of patients undergoing chest wall resection and is associated with posterior location and increased number of ribs resected. Further work is ongoing to better understand functional outcomes and quality of life after treatment for chest wall tumors.



Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

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GEFITINIB TREATMENT REVERSES POST-SURGICAL PRO-METASTATIC IMMUNE CHANGES AND IMPROVES SURVIVAL IN A MOUSE MODEL OF OSTEOSARCOMA

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Tweet it! Utilizing gefitinib as an adjunct to primary tumor resection in osteosarcoma mitigates surgery-accelerated metastasis and improves survival in a mouse model. @michelle_kallis #APSA2020

Purpose: Although primary tumor excision can improve survival in osteosarcoma (OS), surgery itself may promote metastatic development. We have found that surgery increases pulmonary metastasis in an OS mouse model, and is associated with pro-metastatic changes in tumor-associated macrophages in the lung. We have also demonstrated that gefitinib, via inhibition of receptor-interacting protein kinase 2 (RIPK2), reduces metastatic burden. In this murine survival study, we examine gefitinib's ability to reverse pro-metastatic immune changes and enhance survival.

Methods: Murine K7M2 OS cells were implanted into the tibia of BALB/c mice. One week following tumor inoculation mice were assigned to 3 groups: 1) tumor-bearing control; 2) amputation of tumor only; 3) amputation with gefitinib. Mice used for immunophenotypic studies (n=10-17/group) were sacrificed 3 weeks following surgery and lungs were isolated for flow cytometric analysis of immune cell populations. Mice used for survival studies (n=15/group) were sacrificed when euthanasia criteria were met.

Results: Comparing the ratio of CD206+ pro-tumor macrophages to MHCII+ anti-tumor macrophages, surgery increased this ratio from 1.6 in tumor-bearing mice to 2.3. Gefitinib treatment was able to reduce this ratio to 1.1 (p<0.05). Gefitinib also reduced the presence of the myeloid-derived suppressor cells (MDSCs) within the lung compared to both tumor-bearing and amputated mice (15.0% vs. 23.5% and 24.1%, respectively; p<0.05). Median survival of tumor-bearing mice was 39 days compared to 38 days for amputated mice, and amputated mice had greater metastatic burden compared to tumor-bearing mice (54.5% vs 36.6%; p=0.05). Gefitinib treatment with primary resection extended median survival to 61 days (p<0.05).



Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

Conclusions: Gefitinib impairs the pro-metastatic immune changes following surgical resection creating a pulmonary microenvironment that is less amenable to metastatic development. Gefitinib treatment increases survival in our murine model.

Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

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HDAC-4 AND HDAC-6 REGULATION OF HIF-1 α PLAYS A ROLE IN MEDIATING BOTH DRUG RESISTANCE AND INVASIVENESS IN OSTEOSARCOMA

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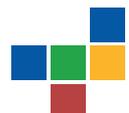
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Purpose: Osteosarcoma is common childhood cancer with a poor prognosis when recurrent or metastatic (5-year survival <30%). Prior studies suggest that multi-drug resistant tumors are more metastatic relative to their parental wild-type (WT) cells but the mechanism remains unknown. In other cancers, studies show that histone deacetylases (HDACs) regulate activity of HIF-1 α which controls gene expression associated with drug resistance and metastasis. We hypothesize that this same mechanism functions as a link between chemoresistance and invasiveness in osteosarcoma.

Methods: We used Human WT osteosarcoma (SJSA-1) cell line and created a doxorubicin resistant (DoxR) cell line via incubating WT cells with incremental concentrations of doxorubicin. Matrigel in vitro invasion assays were used to compare invasiveness of WT to DoxR cells and DoxR cells treated with vorinostat (an HDAC inhibitor). Western blot assays were used to compare HDAC expression in WT and DoxR cells as well as HIF-1 α expression with and without vorinostat and HDAC4 and HDAC6 knockdowns. Immunoprecipitation of HDAC and HIF-1 α in DoxR cell lines was also performed.

Results: DoxR cells were more invasive than WT cells, but had decreased invasion when treated with vorinostat or with HIF-1 α knockdown via shRNA (Figure 1). Expression of HDAC4, HDAC6, and HIF-1 α was increased in DoxR cells compared to WT and both inhibition and knockdown of HDAC4 and HDAC6 decreased HIF-1 α expression based on Western blot assays. Immunoprecipitation of HDAC with HIF-1 α was confirmed and increased in DoxR cells compared to WT.

Conclusion: We conclude that HDAC is involved in the regulation of HIF-1 α in Osteosarcoma and could connect drug resistance to cancer invasiveness.



Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

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DIFFERENTIAL EXPRESSION OF HUMAN ENDOGENOUS RETROVIRUS-K IN WILMS TUMOR

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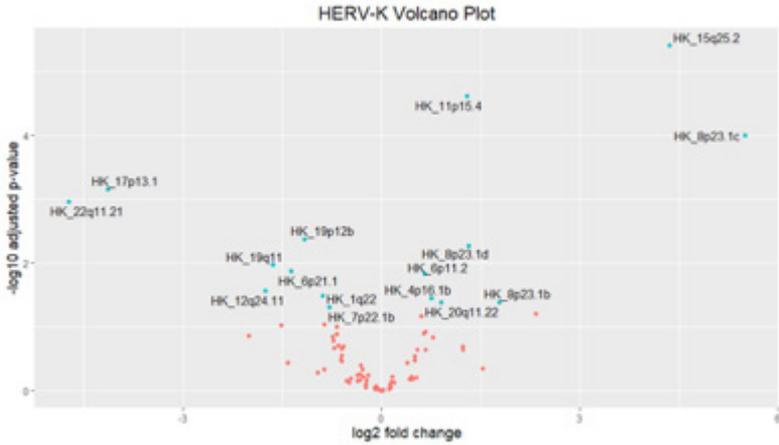
Purpose: Wilms' tumor (WT) is the most common kidney malignancy in children. Human endogenous retroviruses (HERVs) are genomic elements which resulted from ancient retroviral infection. HERV-K transcription is upregulated in cancers and during embryogenesis. The activity of HERV-K during fetal development could impact the development of certain pediatric malignancies and represent important tumor markers or immunologic targets in WT. The purpose of this study is to utilize RNA-Seq data to determine the differential expression of HERV-K in WT.

Methods: We annotated the 92 known HERV-K human proviruses for all transcripts and protein coding regions. Using this bioinformatic tool, we evaluated RNA-seq libraries of 5 WT samples and 5 corresponding blood normal samples (NC) from the NCI TARGET Initiative (Bio-project PRJNA89521). Differential provirus expression between WT and NC was analyzed using Salmon and DESeq2 (significance- $\text{padj} < 0.05$ and $|\text{fold change}| > 1.5$).

Results: Eleven proviruses were differentially expressed between WT and NC (Figure 1). The provirus at 8p23.1c had a 45-fold increased expression profile in WT. This provirus has an open reading frame (ORF) for the proviral protein Rec, which has been previously described as a potential onco-protein. Additionally, differentially expressed proviruses 8p23.1b ($\text{fc} = 3.45$, $\text{padj} = 0.0041$), 11p15.4 ($\text{fc} = 2.5$, $\text{padj} < 0.0001$) and 8p23.1d ($\text{fc} = 2.5$, $\text{padj} = 0.005$) also have ORFs for Rec. None of the proviruses with increased expression in NC express Rec.

Conclusions: These data demonstrate that HERV-K is expressed from multiple proviral locations in WT. Several loci, including 8p23.1c is significantly over-expressed in WT as compared to NC and has the potential to encode for the viral protein Rec. This makes HERV-K expression a potential intriguing tumor marker in WT. Further investigations are warranted to discover if HERV-K expression may play a role in development of WT.

Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)



Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)

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A SINGLE CENTRE MATCHED PAIR SERIES COMPARING MINIMALLY INVASIVE AND OPEN SURGERY FOR THE RESECTION OF PEDIATRIC RENAL TUMORS

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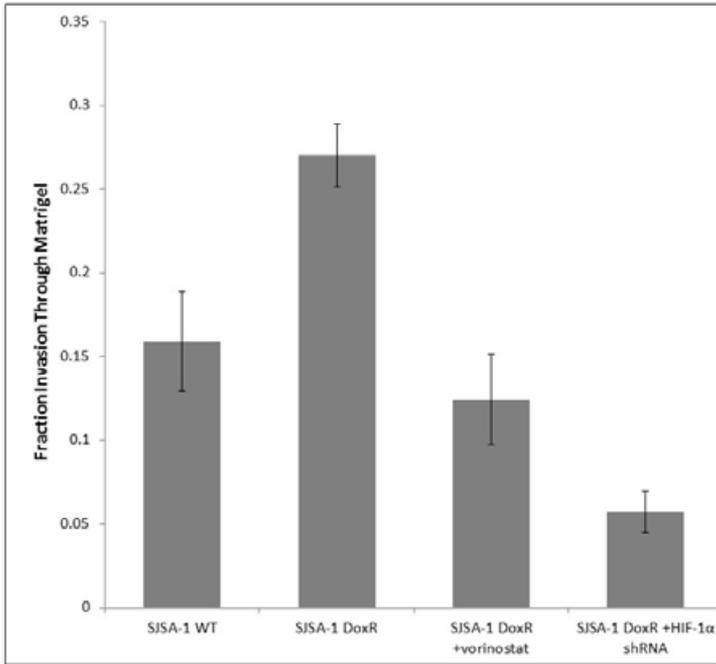
Introduction: Minimally invasive surgery(MIS)for the resection of pediatric renal tumors is controversial due to concerns about worse oncological outcomes and a lack of randomised trials or prospective data. We compared patients who underwent MIS paediatric tumor nephrectomy(MIN)with controls who underwent open surgery(ON).

Method: A single centre retrospective analysis of prospectively collected data for MIN. Tumor volume was calculated from pre-operative imaging and volume matched patients who had had ON were identified from the regional tumor database. Demographics, complications, operative time, length of stay, number of nodes resected, status of margins, radiotherapy(RT) requirement, relapse and/or recurrent disease and follow-up were analysed.

Results: There were 13 MINs performed between 09/2016 and 08/2019(six male:seven female;median age was 27(range 2-73)months). Diagnoses were mesoblastic nephroma(MN)in 1, malignant rhabdoid tumour of the kidney(MRTK)in 1, nephroblastomatosis in 1 and Wilms Tumour(WT)in10. All patients except the child with MN received pre-operative chemotherapy. MIN took a median of 180(125-240)minutes, with 3 conversions. There was no intra-operative rupture and 3 tumours had positive margins. Median number of nodes removed was 3(0-6). One patient suffered a significant chyle leak requiring laparotomy. Median length of stay was 3(2-15)days. Two patients required radiotherapy. The 13 volume matched ON controls (seven male:six females, median age was 36 (1-74)months) had diagnoses of WT in 12 and MN in 1. The median number of nodes taken was 4(2-22)and 2 tumours had positive margins. Median operating time was 150(103-205)minutes. Five patients required radiotherapy. Median length of stay was 4(2-6)days. Differences were not significant. Median follow up of 17(1-36)months for MIN and 65(26-100)months for ON patients was significantly different. There have been no local recurrences in either group but the child with MRTK died following recurrence of central nervous system disease.

Conclusion: MIS for pediatric renal tumours is a safe alternative to open nephrectomy in carefully selected patients.

Scientific Session 4: Oncology II - Sarcoma and Renal Tumors (continued)



Scientific Session 5: Trauma

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DOES IN-HOUSE ANESTHESIA IMPROVE CARE AT LEVEL II PEDIATRIC TRAUMA CENTERS? A RETROSPECTIVE REVIEW OF 2014 ACS GUIDELINES

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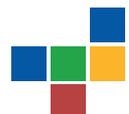
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Introduction: The updated 2014 American College of Surgeons (ACS) guidelines require 24-hour in-house anesthesia at Level II pediatric trauma centers. Quality improvement of traumatic and acute surgical care has not been reported since changes were introduced, which is a 1-million-dollar annual investment for our institution. We reviewed quality metrics before and after implementation of ACS guidelines to determine if the increased resource utilization is justified.

Methods: A retrospective single-center review included all operative trauma cases from October 2011 to December 2018. Demographics, trauma activation level, trauma type (blunt/penetrating), arrival time, operative incision time, surgical subspecialists, morbidity, and mortality were determined for each case. Comparative analysis of demographic, arrival-to-incision time, morbidity, and mortality was performed before and after implementation of ACS recommendations (February 2016). Subanalysis was performed for nightshift traumas defined as arrivals from 1800 to 0600.

Results: 433 traumas required operative intervention (197 pre-ACS changes, 237 post-ACS changes). Patient demographics, trauma type, and trauma activation levels were similar between both groups. No significant difference was detected in arrival-to-incision time in the overall population, by trauma level, or by cases requiring general surgery (all $p > 0.05$). Nightshift traumas accounted for 66% ($n=284$) of cases. Nightshift arrival-to-incision time was significantly faster after implementing ACS guidelines for all trauma levels (29 minutes) and for 922 trauma activations (50 minutes) ($p < 0.05$, Table 1). 911 trauma activations and cases requiring general surgery were also faster (39 and 46 minutes, respectively) following ACS changes ($p > 0.05$, Table 1). The morbidity rate was significantly lower following ACS changes ($p=0.0105$) while no significant difference existed for mortality (Table 1).

Conclusions: Nightshift arrival-to-incision time and morbidity have improved for surgical trauma patients since adding in-house anesthesia at our Level II institution. Continuing analysis of acute care surgical cases will help clarify if the cost burden for in-house anesthesia justifies the improved quality of surgical care.



Scientific Session 5: Trauma (continued)

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GEO-DEMOGRAPHIC PROFILING OF PEDIATRIC FIREARM INJURIES

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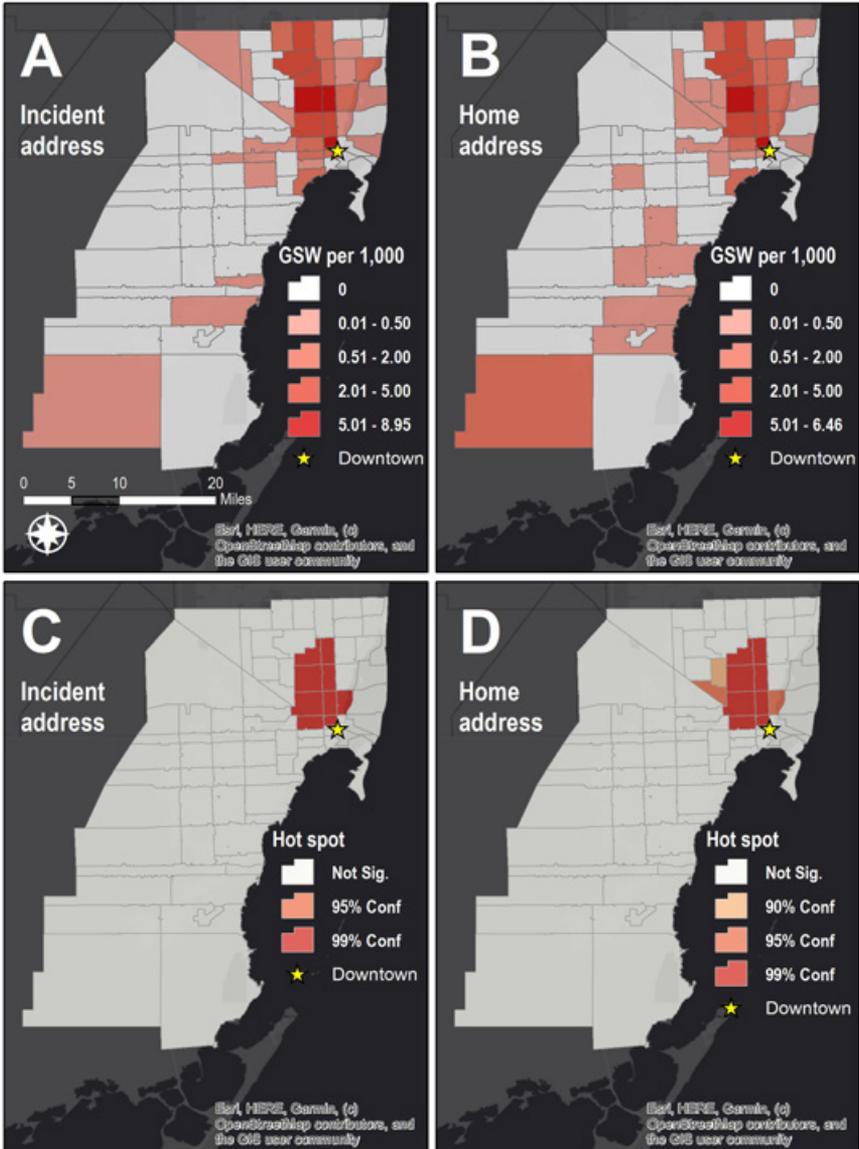
Purpose: Firearm injuries (GSW) are a growing public health concern and a leading cause of death among pediatric patients. Predictors of injury among children remain understudied. Identifying such indicators is crucial for implementing preventive strategies within local communities. This study aims to examine the correlates of GSW injuries among children within our county.

Methods: After obtaining IRB approval, we retrospectively queried the registry of an urban Level 1 trauma center for pediatric (0-18 yrs) GSW, from September 2013 to January 2019. Demographic and clinical variables were examined. We used a Geographic Information System to map the rates of GSW injury per 1,000 residents < 18 years, aggregated to the zip code level by incident address and home address. Spatial cluster analysis was performed using the Getis-Ord G_i^* statistic to identify hot spots.

Results: 393 cases of pediatric GSW were identified from the registry. Mortality was 11%, with 59% of deaths occurring in the resuscitation unit. 87% of patients were African-American, 10% Hispanic, and 2% Caucasian. Males accounted for 89% of patients. 92% of injuries were the result of violence, 3% unintentional, and 0.5% self-inflicted. 55% of injuries occurred on the weekend after Friday school dismissal and only 6% occurred during school hours. Zip-level GSW rates ranged from 0-9 (per 1,000 < 18 years) by incident address, and 0-6 by home address. The highest rates corresponded to several predominantly African-American and Hispanic neighborhoods (Figure 1-A,B). We observed statistically significant hot spots of high GSW rates in the zip codes spanning underserved minority communities (Figure 1-C,D)

Conclusions: Geo-demographic analysis of GSW injuries in pediatric patients can be utilized to identify at-risk populations and neighborhoods. This methodology can be applied to other metropolitan areas where targeted interventions and community programs may be implemented to reduce the burden of gun violence among children.

Scientific Session 5: Trauma (continued)



Scientific Session 5: Trauma (continued)

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PEDIATRICIAN EXPERIENCE USING THE AMERICAN ACADEMY OF PEDIATRICS FIREARM INFOGRAPHIC IN THE DELIVERY OF SAFE FIREARM ANTICIPATORY GUIDANCE: A MIXED-METHODS STUDY

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Purpose: Unintentional firearm injuries are common and preventable; however, pediatricians do not routinely provide firearm safety guidance (FSG). Our purpose was to evaluate the effectiveness of a training program for community-based pediatricians.

Methods: The trauma team visited community pediatric clinics to deliver a FSG training program that included local firearm injury data to raise awareness, conversation scenarios, and distribution of the American Academy of Pediatrics (AAP) infographic (Figure 1). Pediatricians then provided FSG for one month. To evaluate experience, an IRB-approved, mixed-methods study was performed. Quantitative methods included pre and post surveys and qualitative methods included focus group sessions. Focus group data were analyzed using content analysis identifying emergent themes on pediatrician experience.

Results: Of 35 pediatricians, 86% were female. Pre-intervention, 34% perceived time as a barrier to FSG, which dropped to 0% post-intervention ($p = 0.0002$). Incorporating FSG increased from 37% to 80% following the intervention ($p = 0.01$). Three themes were identified: increased comfort/awareness (47%), effectiveness of the infographic as a visual aide (28%), and barriers/modifications (32%). Parents were receptive to real-life examples such as "a child as young as 22 months old pulled a trigger". Pediatrician awareness was most increased for depressed teens living in homes with guns. Effective use of the infographic included its visibility, useful statistics, and assistance broaching the topic. Although most parents were receptive to counseling, fear of offending some parents was the most common barrier identified. The most common modification was intermixing FSG with other injury prevention topics.

Conclusion: The training program, combined with the AAP infographic, was effective for community pediatricians. It led to a positive experience providing FSG, raised awareness of need, and increased likelihood of providing FSG without interrupting clinic workflow. Training in FSG should be incorporated for pediatric providers and trainees, especially in states with high firearm ownership.

Scientific Session 5: Trauma (continued)

GUN SAFETY and CHILDREN

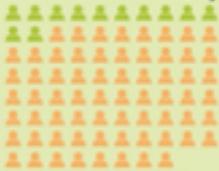
If you own a firearm, the AAP recommends it be **stored unloaded, locked up** (lock box, cable lock, or firearm safe), with the ammunition stored separately.



About 1/3 of the homes with children in the United States have a gun. Many are stored **loaded and/or unlocked**.



Every day, **78 children,**



teens and young adults are **injured or killed** by guns in the United States.

 = death  = injury

Source: CDC WISQARS database including data for all states, ages 0-21, from 2013-2016.

The risk of dying by suicide is **4 to 10 times higher** in homes with guns. If you have a **teen who is at risk for suicide**, remove guns and ammunition from your house.

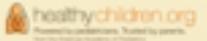


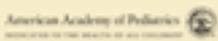
Children as young as **3 years** may be strong enough to **pull the trigger** on a handgun.



The **safest home** for children and teens is one without guns.







Scientific Session 5: Trauma (continued)

44

NOVEL INSIGHTS FROM A UNIQUE COLLABORATION BETWEEN A LEVEL 1 PEDIATRIC TRAUMA CENTER AND SCHOOL OF APPLIED SOCIAL SCIENCES

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Purpose: Violence is the second leading cause of death in children ages 6-18. A high incidence of reinjury has been observed in survivors. Although evidence has emerged that an enhanced understanding of the social determinants of health specific for a community may prevent violence, this information is seldom captured within the individual medical records. This data in some communities may be available through alternative sources. We hypothesize that more profound and granular insights into the root causes of violence may be achieved through collaboration with integrated data system (IDS) to more effectively prevent violence and reinjury.

Methods: IRB approval was received. A retrospective review of a 2 year cohort from Jan 1, 2017 through December 31, 2018 of pediatric patients (ages 6-15) who had gun-shot wounds and assault were identified trauma registry at our Level 1 Pediatric Trauma Center. Medical records were reviewed to collect type of violent injury, reinjury rates, and demographics. Information was then linked at an individual level with the IDS by our affiliate School of Applied Social Sciences which captured data from 35 domains including education, social service utilization, juvenile justice involvement, and housing security.

Results: 429 of 452 patients seen at our institution for violent injuries in the two year study period were successfully matched to the IDS. There were 358 victims of assault and 71 victims of GSWs. The majority of patients were male, African-American, recipients of nutritional assistance and Medicaid. A third of patients had substantiated abuse/neglect records and 18.4% had foster care placement. The majority of patients had chronic school absenteeism. Thirty percent of GSW victims had juvenile justice delinquency records.

Conclusion: There is growing recognition of the need to address violence with a public health approach. We propose that multidisciplinary collaboration and secure data-sharing can better inform violence intervention programs to allow a personalized medicine approach

Scientific Session 6: Basic Science

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FUNCTIONAL FECAL METAGENOMICS REVEAL BIOMARKERS OF NECROTIZING ENTEROCOLITIS IN THE PREMATURE INFANT GUT

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Introduction: The major limitation in Necrotizing Enterocolitis (NEC) prevention results from the inability to identify sub-cohorts of newborns at heightened risk for developing NEC based upon biologically relevant features. Dysbiosis has emerged as a significant associated feature in NEC. We hypothesized that functional and taxonomical data from infant gut microbiomes would identify metagenomic biomarkers of NEC for functional empiric evaluation of mechanism in vitro and in vivo.

Methods: A total of 1,712 raw publicly available shotgun metagenomic datasets were collected, (NEC=253; and healthy preterms=1,459). Taxonomic and functional analyses were carried out and dataset was divided based on corrected gestational age (cGA). Several machine learning models were tested to identify functional core biomarkers able to distinguish NEC from healthy preterm microbiomes. Mass spectrometry was used to measure a panel of SCFA in NEC and matched human fecal samples. Human intestinal cells (HIEC-6) and 14-21 day weanling mice were used for to assess toxicity of specific SCFA metabolites.

Results: The 29-32 weeks cGA population was associated with high prediction accuracy among models (up to 99.8%). The identification of leading proteins and super pathways coupled with taxonomic classification established a collection of biomarkers able to discriminate NEC from healthy preterms. Fecal samples from patients with NEC demonstrated a significant pattern of specific SCFA (acetate, butyrate, propionate, lactate, valerate, formate, pyruvate) that matched Enterobacter cloacae metagenome endowed metabolism (EC2.3.1.54 Pyruvate/formate lyase). Empiric testing of specific metabolites produced by fermentation pathways enriched through E. cloacae colonization in NEC patients demonstrated significant intestinal cytotoxicity.

Conclusions: We report the results of in silico modeling with empiric in vitro testing to demonstrate a plausible link between the functional taxonomy represented in newborns with NEC with disease pathophysiology. Together, these results suggest a novel mechanism for the observed dysbiosis associated with NEC and reveals a possible functional biomarker approach to resolving high-risk premature newborns.

Scientific Session 6: Basic Science (continued)

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PREDICTING NECROTIZING ENTEROCOLITIS DEVELOPMENT USING INTESTINAL MICROVASCULAR PERFUSION DEFICITS VIA LASER SPECKLE CONTRAST IMAGING IN NEWBORN MICE

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Purpose: Necrotizing enterocolitis (NEC) is characterized by patchy intestinal ischemia, and we have shown that activation of endothelial TLR4 in the premature intestine restricts perfusion in the pathogenesis of NEC. Conventional approaches for measuring perfusion in NEC have been imperfect, limiting our ability to predict disease development. We now hypothesize that a novel technology for in-vitro perfusion imaging, Laser Speckle Contrast Imaging (LSCI), will reveal the presence of NEC, and demonstrate that NEC primarily affects the microvascular perforating vessels of the intestinal wall rather than the mesenteric arterial arcade.

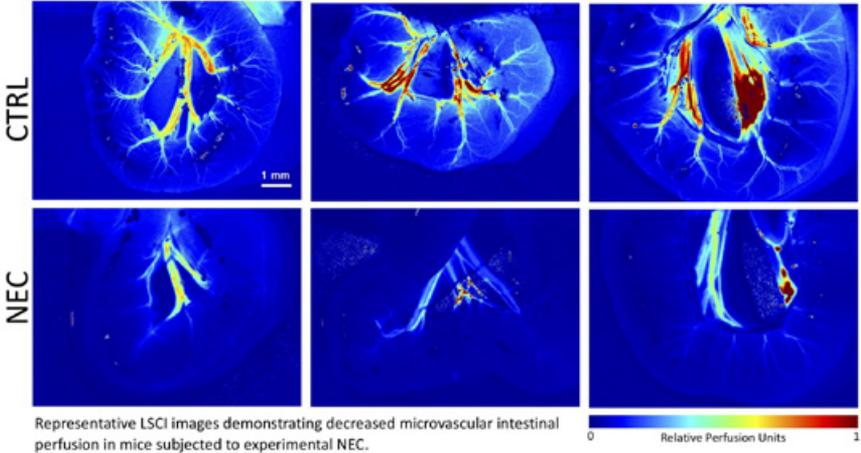
Methods: NEC was induced in neonatal C57BL/6 mice (n=6 per group) through four days of formula-gavage, hypoxia, and NEC stool treatment. At the conclusion of the model, a mini-laparotomy was performed to expose a single loop of small intestine and accompanying mesentery for LSCI. LSCI is an optical imaging technique that utilizes red blood cell movement to quantify perfusion in-vitro without the need for contrast administration. Breast-fed pups were used as controls. Perfusion was assessed by the average perfusion unit intensity in the intestinal wall and mesenteric arterial arcade. Disease severity was determined by histologic score and gene expression of IL1B by qRT-PCR of ileal segments. Comparisons were by t-test with $p < 0.01$ for significance.

Results: Experimental NEC resulted in a significant reduction in perfusion in the vessels of the intestinal wall (NEC: 9,995, Ctrl: 2968, $p < 0.01$), which was more severe than the corresponding relative reduction through the mesenteric arterial arcade (NEC: 49,282, Ctrl: 26,801, $p < 0.01$). Perfusion deficits correlated with histologic severity score (NEC: 2.8, Ctrl: 0.3, $p < 0.05$) and gene expression of IL1B (NEC: 2.2, Ctrl: 1.2, $p < 0.01$).



Scientific Session 6: Basic Science (continued)

Conclusion: LSCI reliably predicted NEC development by identifying intestinal perfusion deficits in NEC, which occur predominately in the microvessels of the intestinal wall, representing a potential novel approach for the identification of neonates at risk for this devastating disease.



Representative LSCI images demonstrating decreased microvascular intestinal perfusion in mice subjected to experimental NEC.

Scientific Session 6: Basic Science (continued)

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HYDROGEN SULFIDE DERIVATIVE OF MESALAMINE REDUCES THE SEVERITY OF NECROTIZING ENTEROCOLITIS THROUGH ENDOTHELIAL NITRIC OXIDE SYNTHASE

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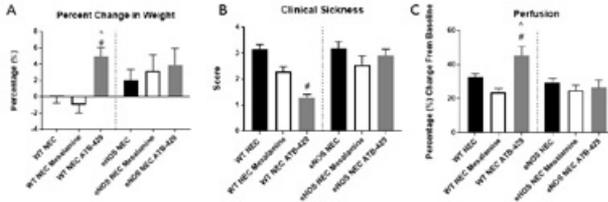
Purpose: Necrotizing enterocolitis (NEC) remains a devastating disease that affects preterm infants. Intraperitoneal hydrogen sulfide (H₂S) has been shown to reduce the severity of NEC, but has a high-risk safety profile. We hypothesized that oral H₂S-Mesalamine (ATB-429) would improve outcomes in experimental NEC, and its benefits would be dependent upon endothelial nitric oxide synthase (eNOS).

Methods: NEC was induced in five-day-old wild-type (WT) and eNOS knockout (eNOSKO) pups by formula feeding and stress. Eight groups (n=9-14) were studied in both WT and eNOSKO mice: (1) breastfed controls, (2) NEC, (3) NEC + 50 mg/kg Mesalamine, (4) NEC + 130 mg/kg ATB-429. Mesalamine and ATB-429 doses were equimolar. Pups were monitored for sickness scores and perfusion to the gut was measured by Laser Doppler Imaging (LDI). After euthanasia, intestines were H&E stained and scored for injury in a blinded fashion. TLR4 expression was quantified by western blot. Data were analyzed using Kruskal-Wallis tests and p<0.05 was significant.

Results: Both WT and eNOSKO breastfed controls underwent normal development and demonstrated milder intestinal injury compared to NEC groups. For the WT groups, ATB-429 significantly improved weight gain, reduced clinical sickness score, and improved perfusion compared to the NEC group. Additionally, WT ATB-429 pups had significantly milder macroscopic gut scores and histologic intestinal injury compared to NEC. WT pups given traditional mesalamine showed no statistical difference in outcomes compared to the NEC group. When the experiment was repeated in eNOSKO pups, ATB-429 offered no benefit in weight gain, sickness scores, perfusion, or intestinal injury. Western blot TLR-4 analysis showed elevated TLR4 expression in both WT and eNOSKO NEC groups.

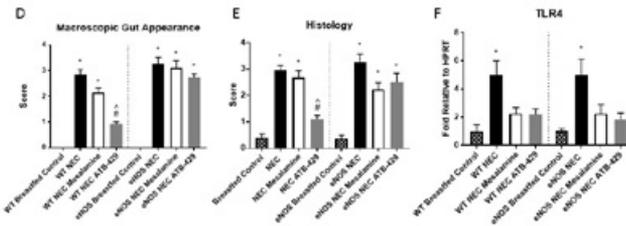
Conclusions: An H₂S-derivative of mesalamine improves outcomes in experimental NEC. Protective effects appear to be mediated through eNOS. Further research is warranted to explore whether ATB-429 may be an effective oral therapy to combat NEC.

Scientific Session 6: Basic Science (continued)

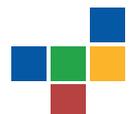


- A. WT NEC ATB-429 gained more weight than counterparts, #p<0.05 vs. NEC, *p<0.05 vs. NEC Mesalamine
- B. ATB-429 Improved clinical sickness score, #p<0.05 vs. NEC
- C. ATB-429 significantly improved perfusion, #p<0.05 vs. NEC, *p<0.05 vs. NEC Mesalamine

Post NEC Experiment Tissue Data



- D. ATB-429 improved macroscopic gut score, *p<0.05 vs. Breastfed Control, #p<0.05 vs. NEC, *p<0.05 vs. NEC Mesalamine
- E. ATB-429 improved histologic injury, *p<0.05 vs. Breastfed Control, #p<0.05 vs. NEC, *p<0.05 vs. NEC Mesalamine
- F. TLR4 significantly increased in WT and eNOS NEC group, *p<0.05 vs. Breastfed Control



Scientific Session 6: Basic Science (continued)

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N-ACETYLCYSTEINE REDUCES SEVERITY OF NECROTIZING ENTEROCOLITIS BY PRESERVING INTESTINAL EPITHELIAL BARRIER INTEGRITY IN MICE

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Purpose: Oxidative stress plays an important role in the disease process of NEC. Supporting this statement, current literature has proven that oxygen free radical quencher, N-acetylcysteine (NAC), reduces the severity of NEC in animal models. We now seek to study the mechanisms involved in this process and hypothesize that NAC reduces the severity of NEC by improving intestinal epithelial barrier integrity.

Methods: NEC was induced in neonatal C57BL/6 mice through four days of formula-gavage, hypoxia, and NEC stool treatment. Mice with NEC were divided in formula-fed (FF) (n=8) and formula-fed supplemented with NAC (FF+NAC) (n=7). These groups were compared to breastfed controls (BF) (n=6). Development of NEC was evaluated in the small intestine by measurement of inflammatory cytokine expression by qRT-PCR. Assessment of the intestinal barrier integrity was accomplished through oral administration of 150µL of a FITC-dextran solution (20mg/mL) at the conclusion of the model, and the fluorescent units in serum were measured 3 hours after administration. Tight junction protein, zonula-occludens-1 (ZO-1), was measured via immunohistochemistry using confocal microscopy.

Results: Expression of TNF- was increased in the FF group as compared to BF and FF+NAC groups (BF: 1.2±0.2, FF: 8.0±2.1, FF+NAC: 2.0±1.1, p<0.001). The integrity of the intestinal barrier, measured by passive leakage of FITC dextran from the intestinal epithelium into the blood, was significantly increased in the FF group when compared to the FF+NAC group and BF group (BF: 42.7±0.9, FF: 84.5±6.5, FF+NAC: 61.7±4.6, p<0.001). Additionally, NEC in the FF group resulted in internalization and loss of ZO-1 from the apical surface towards the basolateral side, supplementation with NAC prevented the loss of tight junctions and preserves barrier integrity.

Conclusion: Administration of NAC may reduce NEC severity by improving tight junctions decreasing intestinal permeability. These findings provide insight into the protective mechanisms of NAC in this devastating disease.

Scientific Session 6: Basic Science (continued)

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INVESTIGATION OF A PROLYL HYDROXYLASE INHIBITOR IN PREVENTION OF HYPEROXIC LUNG INJURY

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Purpose: Bronchopulmonary dysplasia (BPD) affects up to 40% of infants born before 28 weeks' gestation, in whom prematurity, hyperoxic toxicity, and barotrauma lead to deficiency of pulmonary parenchyma and alveolar simplification. Decreased levels of vascular endothelial growth factor (VEGF) are observed in BPD. FG-4592, a prolyl hydroxylase inhibitor, increases endogenous VEGF by stabilizing upstream regulatory factors. We investigate the use of FG-4592 in preventing development of the BPD phenotype in a neonatal murine hyperoxic lung injury model.

Methods: Newborn C57Bl/6J mice were exposed to room air or 75% oxygen for 10 days. Pups were randomized to receive 10mg/kg FG-4592 or vehicle control every other day via subcutaneous injection. At postnatal day 10, pups underwent pulmonary function testing, followed by lung harvest for morphometric and protein analysis. Vehicle treatment in normoxia served as a control for comparative analysis.

Results: Hyperoxia exposure was associated with increased compliance and significantly increased inspiratory capacity (0.017mL/g vs. 0.013mL/g; $p=0.04$). In normoxia, FG-4592 treated pups had further increased compliance and significantly increased inspiratory capacity (0.020mL/g; $p=0.0004$), an effect which was not as pronounced in hyperoxia exposed, FG-4592 treated pups (0.019mL/g; $p=0.002$). On morphometric analysis, hyperoxia induced significantly increased mean linear intercept (40.6 microns vs. 16.2 microns; $p<0.0001$) and decreased alveolar count per field (47.2 vs. 25.3; $p=0.002$), which are indicators of alveolar simplification. Treatment with FG-4592 in hyperoxia was associated with a milder elevation of MLI (34.0 microns; $p=0.002$). On immunoblot analysis, FG-4592 in hyperoxia rescued lung expression of pro-angiogenic factors HIF-2 α , VEGF, and VE-Cadherin, and decreased expression of the anti-angiogenic pigment-epithelium derived factor (PEDF).

Conclusion: FG-4592 has potential to modulate alveolar simplification and key angiogenic factors in a neonatal murine hyperoxic lung injury model of bronchopulmonary dysplasia. Further investigation FG-4592 use in bronchopulmonary dysplasia is warranted, as it is currently safe in phase III clinical trials as treatment for anemia.

Scientific Session 6: Basic Science (continued)

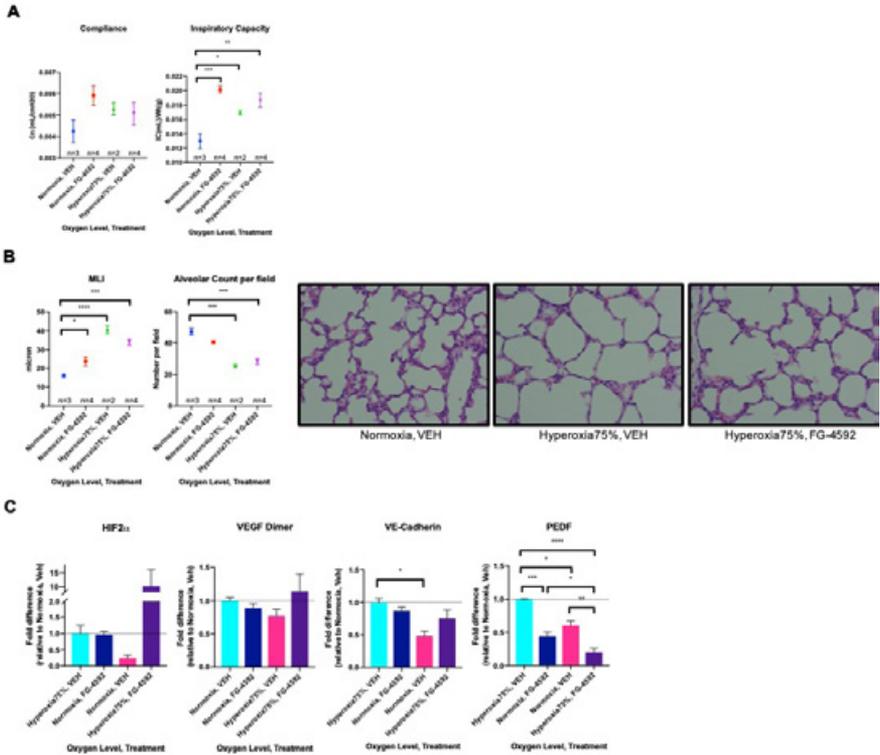


Figure 1. FG-4592 modulates pulmonary mechanics, alveolar simplification, and angiogenic factors in a neonatal murine hyperoxic lung injury model of bronchopulmonary dysplasia.

A. Hyperoxia and FG-4592 treatment induces increased compliance and inspiratory capacity, although a less pronounced treatment effect is observed in hyperoxia. **B.** Hyperoxia results in alveolar simplification, as demonstrated by increased mean linear intercept (MLI) and decreased alveolar count per field. Treatment with FG-4592 is associated with decreased MLI in hyperoxia compared to vehicle (VEH). Representative H&E stained lung tissue demonstrate alveolar simplification in the hyperoxia group treated with vehicle compared to normoxia group treated with vehicle, an effect which is partially rescued by FG-4592 treatment. **C.** FG-4592 treatment rescued lung angiogenic protein expression profile, including increased pro-angiogenic factors HIF2 α , VEGF, and VE-Cadherin and further decreased anti-angiogenic pigment-epithelium derived factor (PEDF). Results are expressed as mean \pm SEM. *p \leq 0.05; **p \leq 0.01; ***p \leq 0.001; ****p \leq 0.0001

Scientific Session 6: Basic Science (continued)

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INTERLEUKIN-22 IMPROVES INTESTINAL ADAPTATION AND COUNTERACTS INTESTINAL DYSBIOSIS IN A MOUSE MODEL OF SHORT BOWEL SYNDROME

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Purpose: Interleukin-22 (IL-22) promotes intestinal epithelial regeneration and prevents intestinal dysbiosis in acute burn injury and chronic graft-versus-host disease. Using a 75% small bowel resection (SBR) as our mouse model of short bowel syndrome (SBS), we have previously shown that IL-22 expression levels significantly decrease in both the serum and small intestine in C57Bl/6J mice following SBR. We hypothesize that exogenous IL-22 may improve bowel adaptation and counteract dysbiosis in SBS.

Methods: Under an ACUC-approved protocol, we performed a 75% SBR on C57Bl/6J mice. IL-22 rescue therapy was started on post-operative day (POD) 1. Mice were treated daily for six days via intraperitoneal injections with either 100 μ L PBS in the control group (n=3) or 100 μ L PBS containing 4 μ g recombinant mouse IL-22 (rmIL-22) in the treatment group (n=4). On POD 7, intestinal tissue and cecal luminal contents were collected after euthanasia. Villi length were measured under light microscopy. Relative abundance of Proteobacteria and Bacteroidetes in cecal contents, as well as antibacterial Reg3b and Reg3g gene expression in the intestine were quantified by q-PCR. Statistical analysis was performed using Student's t-test with p<0.05 considered significant.

Results: On POD 7, control SBR mice had lost 12% of their body weight; whereas, the rmIL-22-treated SBR mice had only lost 9% of their body weight. Compared to the control group, the mice treated with rmIL-22 had significantly longer jejunal villi and decreased relative amounts of pro-inflammatory Proteobacteria with increased relative amounts of healthy Bacteroidetes in the cecal contents. In addition, the treatment group had increased gene transcription of the IL-22 mediated anti-bacterial peptides, Reg3b and Reg3g, in both the jejunum and colon (Figure 1).

Conclusion: Rescue therapy with exogenous IL-22 administration successfully improves intestinal adaptation and counteracts dysbiosis following 75% SBR. This study supports IL-22 as a potential therapeutic target for short bowel syndrome patients.



Scientific Session 6: Basic Science (continued)

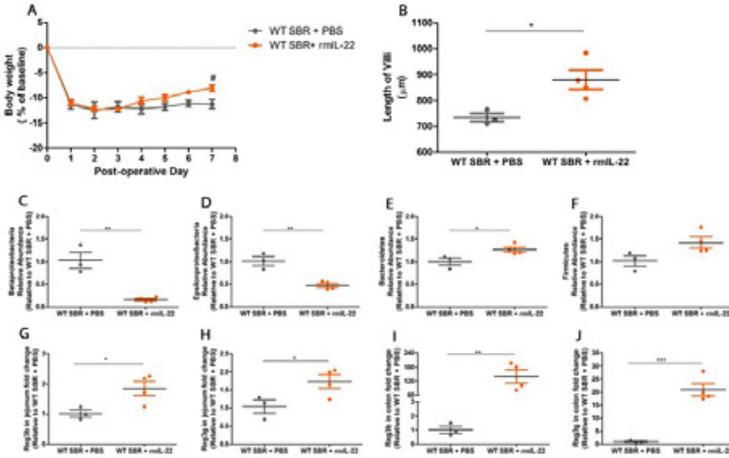


Figure 1. Interleukin-22 (IL-22) Promotes Intestinal Adaptation and Counteracts Intestinal Dysbiosis in Short Bowel Syndrome. (A) Body weight after 75% small bowel resection (SBR) improves with rmlL-22 treatment. (B) Length of villi in jejunum increases with rmlL-22. Following rmlL-22 treatment, relative abundance of (C) Betaproteobacteria decreases, (D) Epsilonproteobacteria decreases, (E) Bacteroidetes increases and (F) Firmicutes shows a trend to increase (P=0.0678). IL-22 mediated anti-bacterial peptide genes increase with rmlL-22 treatment: (G) Reg3b in jejunum, (H) Reg3g in jejunum, (I) Reg3b in colon, (J) Reg3g in colon.
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, # $p < 0.05$ vs. WT SBR + PBS.

Scientific Session 6: Basic Science (continued)

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FETAL BONE MARROW GENE DELIVERY VIA TRANSAMNIOTIC STEM CELL THERAPY

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Purpose: The fetal bone marrow is a common homing site of labeled donor mesenchymal stem cells (MSCs) in different experimental models of transamniotic stem cell therapy (TRASCET). We sought to determine whether TRASCET could also be a strategy for targeted gene delivery to the fetal bone marrow.

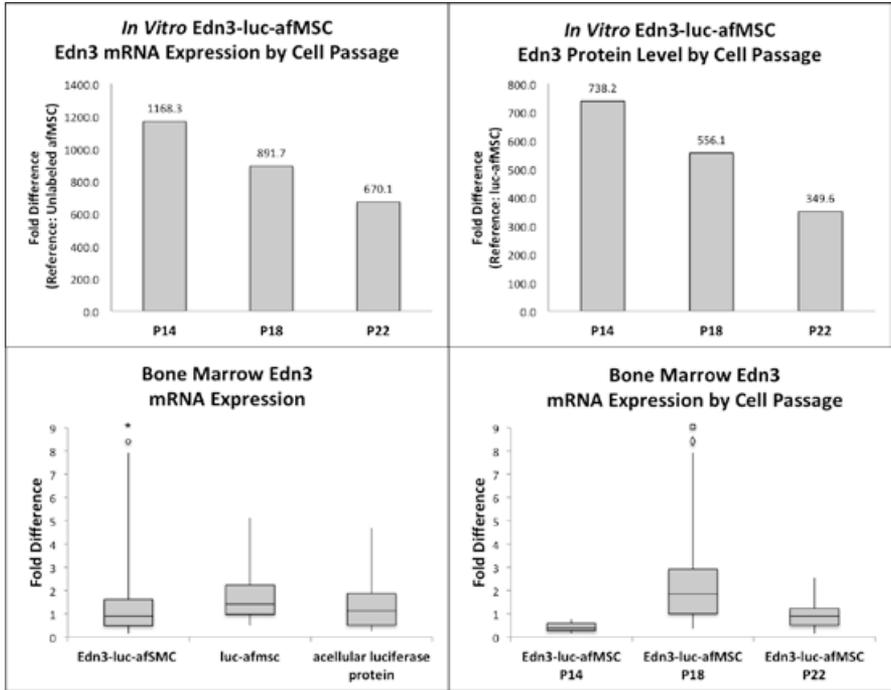
Methods: Syngeneic rat amniotic fluid MSCs (afMSCs) underwent transduction either with a luciferase label only (luc-afMSC) or with a luciferase plus Endothelin-3 gene construct (Edn3-luc-afMSC). Edn3 mRNA expression and protein levels were measured by RT-qPCR and ELISA, respectively, at different cell passages in vitro (P14, P18, P22). After IACUC approval, Sprague-Dawley fetuses underwent matched intra-amniotic injections of either Edn3-luc-afMSCs (n=108), luc-afMSCs (n=52), or an acellular luciferase protein suspension (n=46) on gestational day 17 (E17, term=E21-22). Injected Edn3-luc-afMSCs were subdivided by cell passage: P14 (n=23), P18 (n=48), or P22 (n=37). Fetal bone marrow and bowel (Edn3 is expressed in bowel mesenchyme) were procured at term for multiple analyses. Statistical comparisons were by Bonferroni-adjusted quantile regression ($p < 0.017$).

Results: In vitro, Edn3 mRNA expression was increased in Edn3-luc-afMSCs up to 1168-fold above reference at P14, with a progressive cell passage-dependent decrease (figure). Increased Edn3 protein levels were also documented up to 738-fold above reference at P14, in a corresponding passage-dependent pattern (figure). In vivo, among 115 surviving fetuses analyzed, Edn3 mRNA expression was significantly upregulated in the bone marrow of Edn3-luc-afMSC-injected versus luc-afMSC-injected and luciferase protein-injected fetuses (both $p < 0.001$) (figure). Edn3-luc-afMSC passage had a significant impact on bone marrow Edn3 mRNA expression, which was optimized at P18 ($p \leq 0.001$) (figure). There were no significant differences in bowel Edn3 mRNA expression or protein levels across treatment groups.

Conclusion: Transamniotic stem cell therapy could be a practicable alternative for gene therapy strategies targeting the fetal bone marrow. Gene delivery in this setting can be optimized by donor cell passage.



Scientific Session 6: Basic Science (continued)



* p<0.017 vs. luc-afMSC. † p<0.017 vs. acellular luciferase protein. ‡ p<0.017 vs. Edn3-luc-afMSC P14. § p<0.017 vs. Edn3-luc-afMSC P22.

Scientific Session 6: Basic Science (continued)

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DECREASED INTESTINAL STEM CELLS REGENERATION IN HIRSCHSPRUNG'S DISEASE

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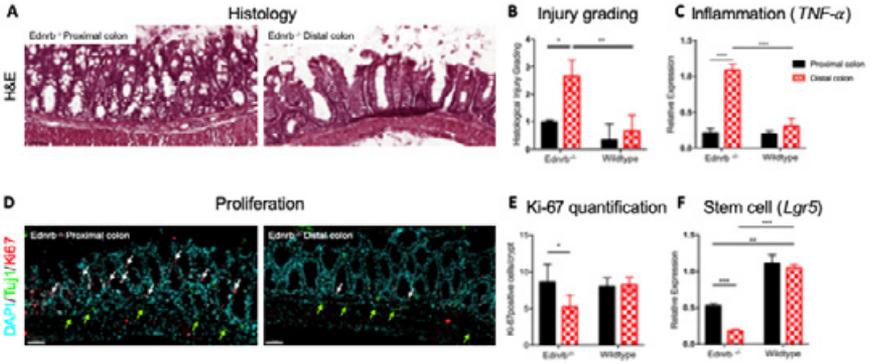
Purpose: Hirschsprung's-associated enterocolitis is the leading cause of mortality in children with Hirschsprung's disease. Colonic epithelial regeneration is impaired in other diseases such as inflammatory bowel disease. We hypothesize that impairment of stem cell regeneration is present in Hirschsprung's disease in the ganglionic colon contributing to Hirschsprung's-associated enterocolitis.

Methods: Ednrb knockout mice (Ednrb^{-/-}) with aganglionosis of rectum (Hirschsprung's disease model) were studied. Mice were sacrificed at P21 and colonic tissue was harvested for analysis. We compared the distal ganglionic with the proximal ganglionic colon in Ednrb^{-/-} mice (n=6) and with the corresponding colon of wildtype littermates (n=6). Colonic epithelium was evaluated by H&E staining. Proliferation marker Ki-67 and neuron marker Tuj1 were analysed by immunofluorescent staining. Quantification was carried out by counting the number of Ki-67 positive stained cells per crypt. mRNA expression levels of inflammation and stem cell markers were studied by qPCR. Statistical analysis was performed by t-tests.

Results: Distal ganglionic colon of Ednrb^{-/-} mice showed the highest histological injury when compared with proximal ganglionic colon and with corresponding colon of wildtype mice (Fig. A, B). Expression of pro-inflammatory cytokine TNF- α was also upregulated in distal ganglionic colon of Ednrb^{-/-} mice (Fig. C). Immunofluorescent staining of Ki-67 (Fig. D; white arrows indicate proliferative cells; green arrows indicate presence of neurons) and quantification of Ki-67 (Fig. E) were decreased in distal ganglionic colon compared with proximal ganglionic colon and with wildtype mice, indicating reduced epithelial proliferation. Similarly, stem cell marker Lgr5 expression was decreased in the distal ganglionic colon of Ednrb^{-/-} mice (Fig. F).

Conclusions: Epithelial damage occurs in the distal ganglionic colon of Hirschsprung's (Ednrb^{-/-}) mice. This injury is associated with decreased intestinal stem cells and epithelial regeneration. These novel findings can explain the occurrence of Hirschsprung's-associated enterocolitis.

Scientific Session 6: Basic Science (continued)



Scientific Session 6: Basic Science (continued)

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HUMAN SKIN-DERIVED PRECURSOR CELLS XENOGRAFTED IN AGANGLIONIC BOWEL

Lauren S. Wood, MD, Anne-Laure A. Thomas, MS, Jordan S. Taylor, MD, James C.Y. Dunn, MD, PhD

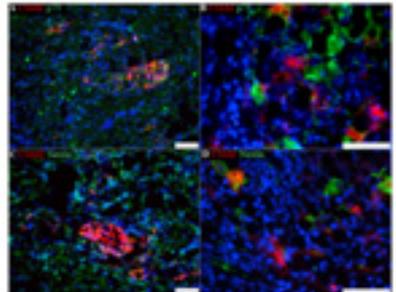
Stanford University School of Medicine, Stanford, CA USA

Purpose: 1 in 5000 newborns is diagnosed with Hirschsprung's disease each year in the United States and often requires a surgical intervention to resect the aganglionic segment of colon. Many investigations studied the regenerative potential of the neural crest stem cells, which could serve cell therapies to restore nerves. Skin-derived precursor cells are non-invasively available multipotent progenitors able to differentiate into neurons and gliocytes in vitro, and generate ganglion-like structures in rodents. We report our approach of injecting human skin-derived precursor cells into a large animal model of aganglionosis in order to recreate enteric ganglia.

Methods: The aganglionosis was established on juvenile mini-pigs undergoing chemical denervation of an isolated segment of colon. The human skin-derived precursor cells (hSKPs) were extracted from foreskin specimens of circumcision, then cultured in vitro in neuroglial-selective medium. After a week, the human cells were labeled with a red dye and injected into the aganglionic bowel wall of the pigs. The injected colons were retrieved within a week after transplantation for immunohistochemistry. Human cells in vitro and in vivo were assessed for markers of multipotency and neuroglial differentiation.

Results: After neuroglial selection 97% of the hSKPs stained positive for nestin and S100b, respectively markers of neural and glial precursors from neural crest origin. The differentiated markers of neurons TUJ1 and gliocytes GFAP were counted in 20% and 95% of the cells. After xenograft, the hSKPs were identified in both myenteric and submucosal plexuses of the treated pig colons. Nestin co-expression was detected in the hSKPs within the aganglionic bowel in vivo. Injected hSKPs appeared to express early neuroglial differentiation markers (Figure 1).

Conclusions: Human skin-derived precursor cells implanted into aganglionic bowel demonstrated immunophenotypes of neuroglial progenitors. Our results suggest that human SKPs may be potentially useful for cell therapy for patients with enteric nervous system disorders.



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MIND THE GAP: THE EFFECT OF TIME BETWEEN PROCEDURES ON COMPLICATIONS FOR PEDIATRIC SURGEONS

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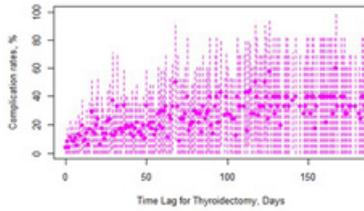
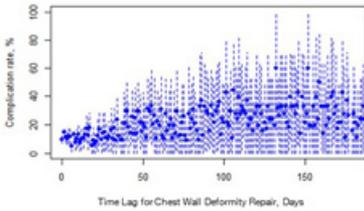
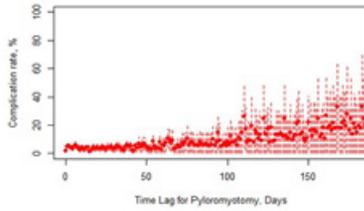
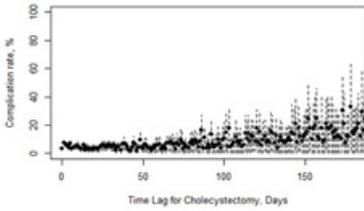
Purpose: Surgeon-specific volume and experience are known to be associated with clinical outcomes. In children's surgery, several "common" procedures performed by seasoned surgeons may occur with varying regularity. We sought to study the effect of time between procedures on complication rate for pediatric general surgical procedures.

Methods: We queried the Children's Hospital Association's Pediatric Health Information System database to examine surgeons performing cholecystectomy, pyloromyotomy, chest wall deformity repair, and thyroidectomy (hemi and total). The interval of time between procedures (Delta-T) was determined by calculating the number of days between two same procedures per surgeon. Complication rates for various Delta-Ts were calculated for each procedure. A critical Delta-T was defined as the interval between procedures beyond which the complication rate increased significantly. Descriptive statistics and logistic regression modeling were used to determine association between Delta-Ts and complication rates.

Results: Overall, 20,499 cholecystectomies, 18,772 pyloromyotomies, 5363 chest wall repairs, and 1854 thyroidectomies were analyzed. Longer Delta-T was associated with increased risk of complication across all procedures, though the average critical Delta-T varied between procedures (Figure). For cholecystectomy, an additional day beyond 64 days increased complication rates by 0.021% per day. Intervals shorter than this exhibited a decreased complication rate by approximately 0.097% per day (Table 1). Similarly, critical Delta-Ts were 61 days for pyloromyotomy, 37 days for chest wall repair, and 14 days for thyroidectomy. After these intervals, the trend in complication rates were observed to increase by 0.033 (0.032-0.035), 0.036 (0.028-0.046), and 0.094 (0.083-0.101) percentage points per day, respectively .

Conclusions: Increased time between procedures is associated with increased risk of complications. We found this effect to hold true for both higher and lower volume procedures. The time interval between performance of common surgical procedures should be considered among providers delivering pediatric surgical care.

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SURGEON VOLUME DOES NOT IMPACT OUTCOMES FOR INFANTS UNDERGOING KASAI PORTOENTEROSTOMY: A WESTERN PEDIATRIC SURGERY RESEARCH CONSORTIUM STUDY

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Tweet it! First study from the Western Pediatric Surgery Research Consortium finds that surgeon volume does not impact outcomes for infants undergoing Kasai portoenterostomy #APSA2020

Background: Portoenterostomy for treatment of biliary atresia is a highly technical surgery with successful, long-term biliary drainage attained in approximately 30-40% of infants. Whether individual surgeon volume impacts outcomes after portoenterostomy is unknown.

Methods: A multi-institutional retrospective cohort study was performed at nine free-standing children's hospitals. Infants who underwent portoenterostomy from January 1, 2009 to May 19, 2017 were identified. Cumulative surgeon volume was defined as high (performing >2 portoenterostomies during the study period) versus low. Individual surgeon volume changed as the study progressed and each surgeon increased their cumulative volume. The primary outcome evaluated was incidence of



Scientific Session 7: Practice and Education (continued)

orthotopic liver transplantation (OLT). Secondary outcomes included hospital readmission, cholangitis, reoperation and mortality. Likelihood of OLT was evaluated using logistic regression adjusting for age at time of surgery.

Results: Overall, 239 infants with biliary atresia were identified. Individual surgeon volume ranged from 1-26 at the conclusion of the study period, with 118 infants (49.4%) undergoing surgery by a high-volume surgeon. Mean age at time of surgery was 64.3d (\pm 24.7d). After excluding infants who died prior to transplant or were lost to follow-up, 216 infants were evaluated for the primary outcome, with 120 (55.6%) ultimately undergoing OLT. Incidence of OLT did not differ by surgeon volume, (High:57.4% vs Low:52.8%, p-value 0.50), even after adjustment for age at time of Kasai surgery (OR 1.20, 95% CI 0.70-2.06). Overall incidence of 1-year readmission (High:77.2% vs Low:83.1%, p-value 0.26), cholangitis (High:54.7% vs. Low:60.5%, p-value 0.39), surgical revision (High:2.6% vs Low:5.0%, p-value=0.50), and death (High:4.4% vs Low:6.0%, p=0.58) also did not differ by surgeon volume. Sensitivity analysis with surgeon-volume cut-offs evaluated up to >15 cumulative cases or cumulative cases in the past 1, 2 or 3 years also did not yield significant differences.

Conclusions: Individual surgeon volume does not appear to impact likelihood of later liver transplantation for infants undergoing portoenterostomy.

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OUTCOMES AFTER THYROID SURGERY AT MEDIUM-VOLUME CENTERS WITH PEDIATRIC SURGICAL TEAMS ARE SIMILAR TO HIGH-VOLUME CENTERS

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Purpose: Thyroid surgery carries the risk of long-term consequences which is reduced with increased surgeon experience. However, the American Thyroid Association definition of “high volume” as 30 cases annually can be difficult to achieve. The use of “pediatric surgical teams” where two attending surgeons operate has been shown to increase exposure to index cases. We hypothesized that adopting a similar team approach for thyroid surgery would allow for outcomes comparable to a high-volume center.

Methods: A retrospective review of patients who underwent thyroid surgery for any indication between June 2012 and September 2019 was performed. Variables collected included demographics, surgical indication, operative details, and post-operative complications. We compared our results to published results from a high-volume center.

Results: 120 surgeries in 114 patients were included; 80% were female; the median age was 15 years. Diagnosis was a benign nodule in 48% (n=57), Graves disease in 30% (n=36), and papillary or follicular thyroid cancer in 22% (n=27). Two attendings were present in 55% (n=66), and were more likely to be present for cancer cases (OR=2.71, CI=1.04-7.06, p=0.036). Compared to a high-volume center, there were proportionally more benign nodules and fewer cancer cases (p<0.001), but a similar amount of Graves disease. Our patients had favorable rates of parathyroid tissue in the specimen (13% vs. 42%, p<0.001) and hypocalcemia requiring calcium and calcitriol (6% vs. 30%, p<0.001), but higher rates of long-term calcium supplementation (1.7% vs. 0.6%, p=.003). There were no hematomas or permanent vocal cord injury in our patients, compared to 1.3% and 0.4%, respectively, in the high-volume center.

Conclusion: Use of an operating team consisting of two attending surgeons for thyroid surgery allows for complication rates similar to those seen at a high-volume center. This strategy may be an alternative to referral for lower-volume centers in select cases.

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THE IMPACT OF ELIMINATING GLOBAL PERIODS IN PEDIATRIC SURGERY

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Purpose: CMS is proposing to remove postoperative care from the global periods for surgical procedures and instead requiring surgeons to bill for postoperative inpatient visits using evaluation & management codes (EMCs). This policy may dramatically alter reimbursement to pediatric surgeons.

Methods: To assess the impact of this policy, we first used 2017 NSQIP pediatric data to calculate median length of hospital stay (LOS) for high-volume procedures. We then merged these data with CMS physician work time and RVU files for procedures with 10 or 90 day global periods. A CMS LOS variable was created by counting the number of hospital-based EMCs built into the global period based on the fact that, if global periods are removed, surgeons may only bill one EMC per postoperative day. We then compared the CMS and NSQIP LOS values.

Results: The dataset included 201 CPT codes with NSQIP LOS estimates derived from a median of 137 operations. Twenty nine procedures (14.4%) had higher, 24 (16.9%) had the same, and 138 (68.7%) had lower NSQIP median LOS than current CMS values. On average, NSQIP values were 40.0% (95% Confidence Interval [95CI] -50.0,-29.9%) lower than CMS values (Figure). Based on a daily average work RVU per postoperative EMC of 1.09 (95CI 1.05,1.12), and \$35.78 per RVU (2017 rate), surgeons in this sample would experience a cumulative reduction in reimbursement of approximately \$3.4M following the policy change.

Conclusions: Most pediatric surgical procedures have RVU valuations that include more hospital-based EMCs than the current median number of postoperative days. The removal of global periods would reduce reimbursement for pediatric surgeons. The downstream effects of this policy are uncertain, but may include increasing compensation to other specialties or the creation of adverse incentives.

Scientific Session 7: Practice and Education (continued)

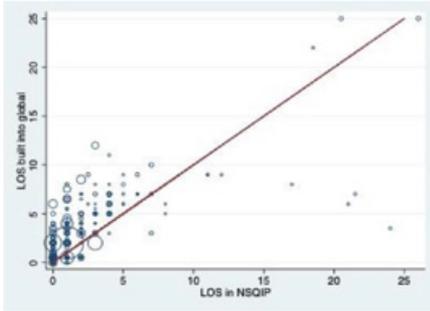


Figure: Weighted scatterplot comparing median length of stay in NSQIP to the presumed LOS currently incorporated into RVU valuations for the same surgical procedure.

LOS= Length of Stay, NSQIP=National Surgical Quality Improvement Project.

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DEFINING THE ROLE OF ADVANCED CARE PRACTITIONERS IN PEDIATRIC SURGERY PRACTICE

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Introduction: Work force constraints, including limitations on trainees as well as increased demands on physicians, have driven profound growth in the number of advanced care practitioners (ACPs) in medicine. However, the role of ACPs in pediatric surgery is not well described.

Methods: An electronic survey regarding ACP utilization was disseminated to pediatric surgery divisions in February 2019.

Results: Of 164 survey requests, we received 80 responses (49%). The average number of ACPs per practice was 4.5 (range 0-34.7). ACP number was associated with inpatient census, number of surgeons, annual case volume and fellowship programs status ($p < 0.001$), but not with the presence of residents or hospitalists, trauma center designation, hospital setting or private vs. university-based practice ($p > 0.05$) (Table). Nurse practitioners were incorporated in over twice as many programs compared to physician assistants (88% vs. 41%). Approximately one-third of ACPs were designated for certain subspecialties (35%), most commonly trauma (22%) and colorectal (21%), with only 9% of centers having surgeon-specific ACPs. ACP responsibilities included floor (93%) and clinic (88%) duties, discharges (86%), consults (75%), phone calls (75%), trauma activations (41%), and operating room assistance (30%). ACPs were utilized during daytime shifts (96%), with fewer during evenings (18%), overnights (23%), and weekends (36%). ACPs are frequently billing for services (86%). Satisfaction with ACP coverage (64%) did not correlate with number of ACPs ($p = 0.14$). Only 30% of respondents felt that they would benefit from increased number of ACPs, 24% from increased coverage, and 6% from increased responsibility. A majority of respondents



Scientific Session 7: Practice and Education (continued)

felt that ACPs help, and do not hinder, the resident/fellow training experience (85%).

Conclusion: ACPs play a major role in contemporary pediatric surgical practices. A better understanding of practice patterns in divisions of pediatric surgery may help optimize utilization to enhance patient care.

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EDUCATION OF PEDIATRIC SURGERY RESIDENTS OVER TIME: EXAMINING 15 YEARS OF CASE LOGS

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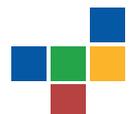
Tweet it! Analysis of graduating Pediatric Surgery resident case logs reveals how changing surgical indications have impacted training and education over the last 15 years. @ClaireMD7 @DrRaviMD #APSA2020

Purpose: Surgical indications and techniques have changed over the last fifteen years. The number of Pediatric Surgery training programs has also increased. We sought to examine the effect of these changes on resident education by examining case log data.

Methods: Accreditation Council for Graduate Medical Education (ACGME) case logs for graduating Pediatric Surgery residents were examined from 2004-2018. Using the summary statistics provided, linear regression analysis was conducted on each case log code and category.

Results: In 2004, there were 24 Pediatric Surgery training programs and 24 Pediatric Surgery residents graduating with an average of 979.8 total cases logged; in 2018, there were 36 programs with 38 residents graduating with an average of 1260.2 total cases logged. Total case volume of graduating residents significantly increased over the last 15 years ($p < 0.001$). Significant increases were demonstrated in skin/soft tissue/musculoskeletal ($p < 0.01$), abdominal ($p < 0.001$), hernia repair ($p < 0.001$), genitourinary ($p < 0.01$), and endoscopy ($p < 0.001$). No significant changes were seen in the head and neck, thoracic, cardiovascular, liver/biliary, and non-operative trauma categories. No categories significantly decreased over the time period. No significant changes were seen in many index congenital cases, including tracheoesophageal fistula/esophageal atresia repair, omphalocele, gastroschisis, choledochal cyst excision, perineal procedure for imperforate anus, and major hepatic resections for tumors. Pertinent increases in specific procedures include diaphragmatic hernia repair ($p < 0.01$), ECMO cannulation/decannulation ($p < 0.05$), thyroidectomy ($p < 0.001$), parathyroidectomy ($p < 0.001$), biliary atresia ($p < 0.001$) circumcision ($p < 0.001$) as well as most laparoscopic abdominal procedures. Specific procedure codes with significant decreases include tracheostomy ($p < 0.05$), minimally invasive decortication/pleurectomy/blebectomy ($p < 0.001$), laparoscopic splenectomy ($p < 0.001$), as well as most open abdominal procedures.

Conclusions: Despite increasing numbers of Pediatric Surgery residents and training programs, the number of cases performed by each graduating resident has increased. This increase is primarily fueled by increase in abdominal, skin/soft tissue/musculoskeletal, hernia repair, genitourinary, and endoscopic cases.



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DIGITAL EDUCATION IN PEDIATRIC SURGERY: A 6 MONTH EXPERIENCE WITH A SPECIALTY-SPECIFIC MOBILE APPLICATION FOR KNOWLEDGE DISSEMINATION

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Purpose: Staying up to date with practice-changing knowledge as medical information increases exponentially is hard to accomplish. Recognizing pediatric surgeons' limited time—and for some, limited access to this information—we developed a mobile application to curate and deliver educational content to physicians around the world. We sought to explore user preferences in accessing this digital content.

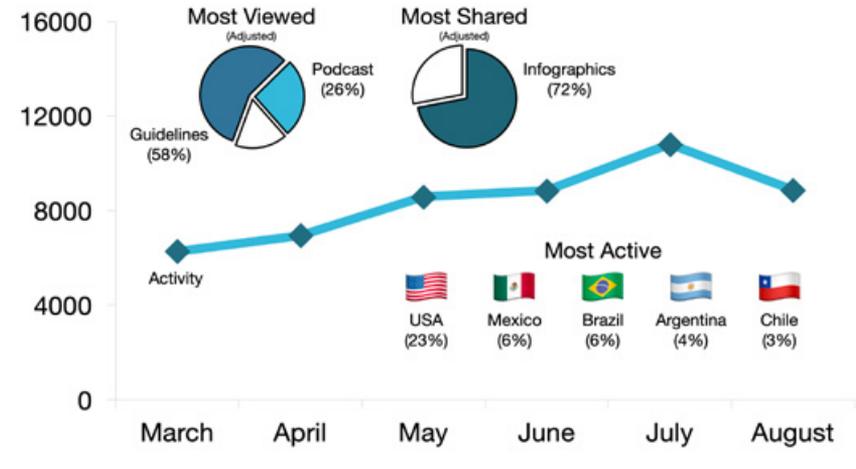
Methods: User behavior was retrospectively analyzed for a period of six months between March and August of 2019. User characteristics and activity were examined using Heap analytics. Search queries were consolidated and categorized to identify knowledge gaps.

Results: A total of 3,506 registered users, representing 145 countries, were included. Highest activity was recorded from the United States of America, Mexico, Brazil, Argentina, and Chile. iOS (64%) and Android (32%) were the preferred platforms for access. Video was the most popular content type with 9,837 views, but guidelines were most popular when adjusted proportionally (57%, n=33, 5,304 views). Of the content viewed, 13% was shared with others. Infographics were the most shared content format with 276 shares, accounting for 72% of adjusted shares and 33% of total shares. Of the top ten performing posts, 41% were guidelines or guideline videos and 59% focused on gastrointestinal disorders. The top ten searches—constituting 26% of searches overall—included Hirschsprung disease, esophageal atresia, lobectomy, biliary atresia, intussusception, diaphragmatic hernia, hernia, appendicitis, pyloric stenosis, and gastroschisis.

Conclusions: Our early experience with this specialty-specific knowledge dissemination platform demonstrates the feasibility of global reach while also identifying knowledge gaps and preferred format for educational multimedia content. This mobile solution represents a viable alternative for knowledge acquisition and offers a forum to promote international discussion and collaboration.



Scientific Session 7: Practice and Education (continued)



Scientific Session 8: General Pediatric Surgery

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2019 Jay Grosfeld, MD, Scholar Grant

**Current Management of Pediatric Pilonidal Disease:
A Prospective Multicenter Surgeon-choice Cohort Study**

Beth A. Rymeski, DO

Cincinnati Children's Hospital Medical Center, Cincinnati, OH USA

Scientific Session 8: General Pediatric Surgery (continued)**62****A PHYSICIAN'S GUIDE TO MINIMALLY-INVASIVE SURGERY FOR PILONIDAL DISEASE**

Alejandra M. Casar Berazaluze, MD¹, Nelson Rosen, MD², Daniel von Allmen, MD², Beth A. Rymeski, DO², on behalf of the Midwest Pediatric Surgery Consortium³

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The Gips procedure is a minimally-invasive approach for the management of pilonidal disease. Although it was developed in adults, it is increasing in popularity among pediatric surgeons. This video presents a step-by-step description of the technique for use in procedural training of healthcare providers. Additionally, it displays the use of sinus endoscopy for confirmation of success of debridement and extraction of foreign material from the wound cavity.

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MANAGEMENT OF PEDIATRIC BREAST MASSES: A MULTI-INSTITUTIONAL RETROSPECTIVE COHORT STUDY

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Background: Pediatric breast masses are rare. Unlike breast masses in adults, there is wide variation in the management of pediatric breast masses. Our objective was to describe the diagnostic workup, surgical management and outcomes of pediatric patients with breast masses undergoing operative intervention.

Methods: A retrospective cohort study was conducted of girls 11-21 years of age who underwent surgery for a breast mass across seven children's hospitals from 2011-2016. Demographic and clinical characteristics

Scientific Session 8: General Pediatric Surgery (continued)

were summarized. Differences in clinical characteristics by specialty and pathology were analyzed with Chi-Squared and Wilcoxon-Mann-Whitney tests.

Results: 227 female patients with a median age of 16 years (IQR: 15,17) underwent surgery for a breast mass during the study period. Patients were referred to a surgeon most often for a mass identified by the patient (87%). The most common preoperative imaging was breast ultrasound (84%) with BIRADs classification reported in 27%; 9% of patients had no preoperative imaging. Preoperative core biopsy was performed in 13%. The most frequent surgical procedure performed was a lumpectomy (94%), most commonly due to mass size (55%) or symptoms (17%). The median maximum dimension of a mass on preoperative ultrasound that underwent excision was 2.3 cm (IQR 2, 3.6). Most operations were performed by pediatric surgeons (60%) and breast surgeons (35%). The most frequent pathologic diagnosis was fibroadenoma (81%), while 2% were phyllodes. Phyllodes tumors were an average of 8.9 cm in greatest dimension on pathology, as compared to 4.0 cm for fibroadenomas ($p < 0.0001$). BIRADS scoring ≥ 4 on breast ultrasound had a sensitivity of 0% and a specificity of 39% for identifying phyllodes tumors.

Discussion: Most pediatric breast masses are self-identified and benign. Phyllodes was significantly more likely in larger masses. BIRADS classification based upon ultrasound was not consistently assigned and had little clinical utility for identifying phyllodes tumors.

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RECURRENCE AFTER LAPAROSCOPIC HIGH LIGATION IN ADOLESCENTS: A MULTICENTER INTERNATIONAL RETROSPECTIVE STUDY OF TEN HOSPITALS

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Purpose: Inguinal hernia repairs are among the most common operations performed by pediatric surgeons. Unlike adult surgeons – who often use mesh in hernia repair – pediatric surgeons typically perform a high ligation of the hernia sac. Over the past two decades, many have shifted towards laparoscopic high ligation. It is uncertain whether this technique is as effective in adolescents as it is in younger children. We hypothesized that recurrence after laparoscopic high ligation in adolescents would be similar to the reported recurrence of 2% after an open operation.

Methods: We evaluated all adolescent patients (between 12 and 18 years at the time of operation) who underwent laparoscopic high ligation across eleven hospitals in three countries. Six months after their operation, these patients were either contacted by telephone or seen in clinic for follow-up. Variables collected included patient demographics, operative details, recurrence, and other complications at follow-up.

Results: A total of 144 patients were enrolled. One hospital (n=9) had a recurrence rate of 44% and was excluded as a statistical outlier. The remaining 135 patients were included. The average age was 14.1 years;

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64% were male. There were four recurrences, for a rate of 3.0% (inclusion of the outlier in our analysis increased the recurrence rate to 5.6%). Other complications included one wound infection (0.7%), two stitch abscesses (1.5%), three patients with numbness (2.2%), and four patients with persistent pain (3.0%). Use of absorbable suture (OR 42.7, CI 4.4-412.9, $p=0.006$) and monofilament suture (OR 12.1, CI 1.5-95.3, $p=0.04$) were both associated with recurrence. Suturing technique (intracorporeal vs. percutaneous) and intentional injury to the peritoneal surface did not affect recurrence.

Conclusion: Laparoscopic high ligation for inguinal hernias in adolescent patients has a similar recurrence to open repair when performed by experienced surgeons. Use of absorbable or monofilament sutures may increase the risk of recurrence.

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GRACE UNDER PRESSURE: FIRST EXPERIENCE WITH GASTROPLASTY WITH RESTRICTED ANTRUM TO CONTROL EMESIS (GRACE) IN NEUROLOGICALLY IMPAIRED CHILDREN WITH RECURRENT REFLUX

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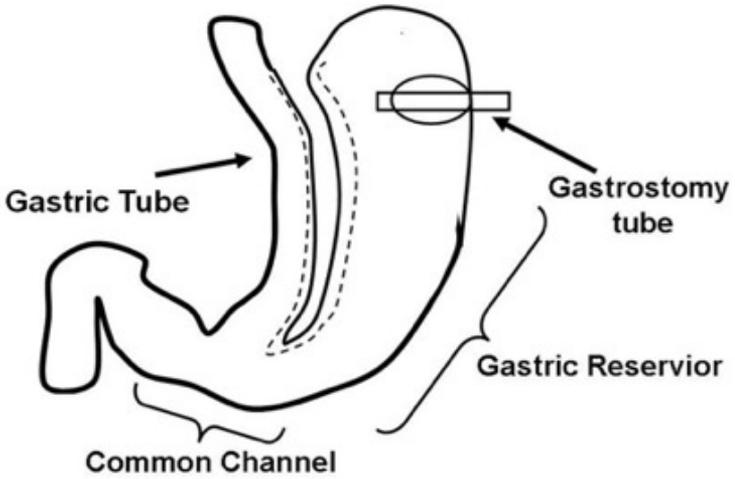
Purpose: Antireflux surgery in the neurologically impaired (NI) child has a significant failure rate, with no consensus on optimal second-line surgical treatment. The gastroplasty with restricted antrum to control emesis (GRACE) procedure recapitulates the anatomic configuration of total esophagogastric dissociation (TEGD) without esophageal or jejunal anastomoses. We developed this innovative surgical procedure in a canine model and now present our experience in our first pediatric patients.

Methods: We reviewed our series of children with significant, medically refractory, recurrent gastroesophageal reflux disease following failed Nissen fundoplication (NF). Families chose GRACE over other surgical alternatives (reoperative NF, TEGD, feeding jejunostomy alone, gastrojejunal feeding tube). Hiatal hernia repair was performed during the procedure. Two patients received a feeding jejunostomy. All had postoperative contrast studies.

Results: Three NI patients (ages 4, 6, 17yrs) underwent GRACE over a 7-year period with follow up of 11, 94, and 5 months respectively. Two patients were failing to thrive preoperatively. Postoperative length of stay ranged from 6-16 days. One patient required early revision for staple line leak. All three patients had subjective decreases in retching, gagging, emesis, regurgitation and abdominal pain per parent reports. Two had complete radiographic resolution of reflux. Two successfully transitioned to bolus gastric feedings, while the most recent patient is still in the early postoperative period and is transitioning gastric feedings. Two patients are tolerating recreational oral intake.

Conclusions: This initial clinical description shows the GRACE procedure to be an effective second-line option for neurologically impaired patients in whom NF has failed. In this early series, GRACE leads to improved enteral and oral tolerance for this challenging patient population. Further study and long term reporting of outcomes is necessary to understand the true value of GRACE.

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COMPARATIVE OUTCOMES OF SLEEVE GASTRECTOMY IN ADOLESCENTS LESS THAN 16 YEARS OF AGE

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Introduction: Laparoscopic sleeve gastrectomy (LSG) has been demonstrated to be an effective weight loss strategy in adolescents. However few, if any, studies have examined the effectiveness of LSG in the younger subset of the adolescent population. This analysis sought to assess weight loss outcomes in adolescents undergoing LSG before the age of 16, with the hypothesis that there would be no difference in outcomes.

Methods: A review of a prospective database containing patients undergoing LSG between January 2010 and April 2019 at a single institution was performed. Preoperative measures included age, weight, and body mass index. Continuous data were compared using Student's t-test, while categorical data were compared using chi-square analysis.

Results: In total, 309 patients were evaluated. Eighty-six (27.8%) were under 16 and 223 (72.2%) were 16 years or older. Age at operation ranged from 4.5 to 24 years. The younger age group was 61.6% female vs. 78.0% in the older group, $p=0.003$. No differences were noted in initial weight (135.4±30.4 kg vs. 139.9±27.6 kg) or BMI (49.2±9.57 kg/m² vs. 50.1±8.57 kg/m²) between younger and older cohorts, $p=0.210$ and 0.436 , respectively. Percent excess weight loss was also similar between younger and older adolescents at all time points post-surgery with the mean at one year being 41.8±23.7 vs. 49.1±17.6%, $p=0.054$. Similarly, percent excess BMI loss demonstrated no statistically significant difference at any time point post-surgery with a mean at one year of 51.5±28.5% vs. 57.9±22.0%, $p=0.184$.

Conclusion: Adolescents with severe obesity have similar outcomes following LSG regardless of age, suggesting that LSG may be considered in younger age groups. Further longitudinal study will permit assessment of long-term outcomes following bariatric surgery and its potential efficacy in the younger adolescent population, but should be considered on a case by case basis in younger children with severe obesity.

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UTILITY OF ROUTINE INTRAOPERATIVE CHOLANGIOGRAM DURING CHOLECYSTECTOMY IN CHILDREN: A NATIONWIDE ANALYSIS OF OUTCOMES AND READMISSIONS

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Purpose: The utility of routine intraoperative cholangiogram (IOC) in children undergoing cholecystectomy remains unknown. This study aims to determine postoperative outcomes in those with routine IOC utilization.

Methods: The Nationwide Readmissions Database (NRD) 2010-2014 was queried for all pediatric cholecystectomies. A propensity score-matched analysis (PSMA) with over 30 covariates was performed between cholecystectomy alone versus those with an additional routine IOC in patients without biliary obstruction, dilatation, or pancreatitis. χ^2 analysis or Mann Whitney U were used for statistical analysis with $p < 0.05$ set as significant.

Results: 34,391 cholecystectomies were performed during the study period: 92% were laparoscopic (2% converted to open) and 8% were open. Most patients were teenage females (75%, 15 years [13-17]) and did not undergo IOC (71%). The overall mortality rate was exceedingly low at 0.1%. The PSMA cohort comprised of 1,412 cholecystectomies and 1,453 cholecystectomies with routine IOC. There was no difference between the groups with respect to age, gender, hospital ownership, payer status, or obesity, however teaching hospitals were less likely than non-teaching hospitals to perform a routine IOC (45% vs 60%, $p < 0.001$). Patients with cholecystectomy alone had higher rates of both 30-day (7% vs 5%) and 1-year readmissions (13% vs 11%) and had higher rates of post-operative complications (22% vs 12%) when compared with those with routine IOC, all $p < 0.05$. Although uncommon, bile duct injuries, were more common in patients who did not receive an IOC (2% vs 0%, $p < 0.001$), while readmissions for retained stones were insignificant. Healthcare utilization was increased in patients without routine IOC, likely due to increased complication rates, Table 1.

Conclusion: This nationwide propensity score-matched analysis suggests that routine IOC in pediatric patients undergoing cholecystectomy is associated with decreased 30-day and 1-year readmissions, overall healthcare utilization, overall complications, and most importantly bile duct injuries.

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Table 1. Propensity Score-Matched Analysis of Routine Intraoperative Cholangiograms (IOC) with Pediatric Cholecystectomies, NRD (2010-2015)

Characteristics	Cholecystectomy Alone n=1,412 (49%)	Cholecystectomy + Routine IOC n=1,453 (51%)	p-value
Age, years ^a	16 (14-17)	16 (14-17)	n.s.
In-hospital Mortality	0.1%	0.0%	n.s.
30-day Readmission	7%	5%	0.01
1-year Readmission	13%	11%	0.04
Postoperative complication*	22%	12%	0.001
Bile Duct Injury	2%	0%	0.001
Length of Stay, days ^a	3 (2-5)	2 (1-3)	0.001
Hospital Cost (Index), \$USD ^a	\$12,219 (\$8,927- \$1734)	\$9,695 (\$7,349- \$13,208)	0.001

^a: data presented as median (IQR), * includes: perforation/laceration, hemorrhage, wound disruption, wound infection, pneumonia, etc. USD: United States, adjusted for inflation

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MUSCULOSKELETAL DEFORMITIES AFTER THORACIC SURGERY IN CHILDREN: AN OBSERVATIONAL LONG-TERM FOLLOW-UP STUDY

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Purpose: Musculoskeletal deformities (MDs) are known to occur in children after thoracotomy. We conducted a longitudinal observational study to assess the incidence, severity, and predictors of MDs in children following thoracic procedures.

Methods: Children who underwent thoracic surgery during a 15-year period (1997 –2012) were contacted to visit the research clinic for follow-up musculoskeletal examination. Exclusion criteria included congenital anomalies predisposing to MDs and post-operative survival less than 3 years. Data were obtained from the follow-up examinations and imaging or from longitudinal clinics that specifically screen for MDs. Incidence of MDs was calculated and logistic regression methods were used to determine independent predictors, including sex, gestational age, serratus anterior muscle division, and chest tube placement.

Results: Of 501 eligible patients, 88 had complete operative and detailed musculoskeletal follow up data, and constituted the study cohort. The thoracic procedure (77 thoracotomies, 11 thorascopies) occurred at a median age of 18 (interquartile range 54) days. Median follow-up duration was 11 (range 3 - 21) years. A total of 52 MDs developed in 36 patients (41%). In descending frequency, MDs were in the form of scapular winging (20; 23%), scoliosis (18; 20%), and chest wall anomalies (14; 16%). The incidence of MDs by thoracic approach is shown in Table 1. The majority of MDs were subclinical with only 8 patients [9% (6 thoracotomies, 2 thorascopies)] requiring intervention. Logistic regression analysis of the thoracotomy cohort demonstrated that serratus anterior muscle division was the only significant independent predictor of the development of MDs [OR 11.7; 95% CI 3.2 – 53.1; p=.0005].

Conclusion: Musculoskeletal deformities develop in a significant proportion of patients following thoracic surgery in early childhood, but the majority are subclinical. A muscle-sparing thoracotomy technique decreases the incidence of these deformities. The potential advantages of thorascopy were not demonstrated in this cohort.

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POSTERIOR TRACHEOPEXY LEADS TO LONG TERM ZERO RECURRENCE RATE AFTER SURGICAL TREATMENT OF RECURRENT TRACHEOESOPHAGEAL FISTULA

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Purpose: Tracheoesophageal fistula (TEF) may recur in 5-10% of children born with esophageal atresia (EA) following the initial EA/TEF repair. The treatment and cure rate of a recurrent tracheoesophageal fistula (rTEF) varies widely, and ranges from endoscopic to surgical approaches. Most reports are limited by small series, short term follow-up and re-recurrence remains a problem, making it difficult to elucidate the treatment of choice. We present our approach to and outcomes of rTEF repairs.

Methods: Retrospective review of patients with rTEF treated at our institution from 2012-2019. We approach rTEF surgically, via complete separation of the airway and esophagus, which reliably reveals the TEF (without need for cannulation) and frees the tissues for repair of the trachea and esophagus. Once repaired, the membranous trachea is sutured to the anterior longitudinal ligament of the spine (posterior tracheopexy) and the esophagus is rotated fully into the right chest (rotational esophagoplasty), fully separating the suture lines. To detect re-recurrence, patients undergo contrast examination postoperatively and during follow-up.

Results: We identified 44 patients with rTEF treated with posterior tracheopexy/rotational esophagoplasty (54% Male, 95% EA type C). Eight (18%) patients had prior failed attempts at endoscopic therapy; and 11 (27%) patients had prior failed reoperations prior to coming to us. The median age at rTEF repair was 15 months (IQR 7 - 26). With a median follow-up of 2.5 years (IQR 1.0 - 4.5), we have identified no recurrences. There has been one unrelated death.

Conclusion: This study represents a large series of surgically treated recurrent TEFs. Based on this data with zero recurrence rate and median follow up of 2.5 years, we propose that recurrent TEF repair by thoracotomy with complete mobilization of the esophagus and trachea, fistula division, posterior tracheopexy and rotational esophagoplasty to separate the suture lines is the treatment of choice for recurrent TEFs.

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EARLY POSTOPERATIVE FEEDING DIFFICULTIES IN ESOPHAGEAL ATRESIA PATIENTS WITH STRUCTURAL AIRWAY ABNORMALITIES

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Purpose: Patients with esophageal atresia and tracheoesophageal fistula (EA/TEF) commonly suffer from dysphagia, and recent studies have suggested that structural airway abnormalities (SAA) may contribute to this. EA/TEF patients with difficulty adjusting to postoperative oral feedings may experience longer lengths of hospitalization, higher rates of complications, and increased distress for families. We sought to assess the prevalence of SAA in newborns with EA/TEF, and to determine the overall effect of SAA on immediate postoperative feeding difficulty, which may alter outcomes.

Methods: Medical records of patients who underwent repair of EA/TEF from 2007-2017 at a single institution were reviewed. Patients with H-type fistulas, those undergoing delayed repair, and those not surviving to discharge were excluded. Patients with SAA (laryngeal clefts, laryngomalacia/tracheomalacia, vocal cord paralysis, cleft palate, and other oropharyngeal abnormalities) were identified. Data was extracted on multiple variables including; demographics, time to full oral feeds, radiological results, lengths of stay, and additional operations. Statistical analysis was performed using Student's t-test and Fisher's exact test.

Results: We identified 72 patients, of which 18 (25%) had SAA. Infants with SAA were significantly less likely to reach full oral feeds prior to discharge ($p < 0.01$). Patients with SAA had higher rates of confirmed aspiration and gastrostomy tube placement ($p < 0.01$), and lower average birth weights ($p < 0.05$). Total length of stay was longer for those with SAA ($p < 0.01$) (Table 1).

Conclusion: SAA is a common comorbidity of EA/TEF, representing 25% of patients in our study. These patients often have associated aspiration difficulties and rarely reach full oral feeding prior to discharge. Identifying these patients can help tailor appropriate postoperative management and provide more accurate expectations for clinicians and patients' families. Surgeons managing infants with EA/TEF need to have a high index of suspicion for the presence of SAA and initiate early diagnostic evaluation, especially via laryngoscopy and bronchoscopy, if feeding difficulties arise.

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DIAGNOSTIC ACCURACY OF PREOPERATIVE CT IMAGING IN PLEUROPULMONARY BLASTOMAS AND CONGENITAL LUNG MALFORMATIONS: RESULTS FROM A MULTI-INSTITUTIONAL OPERATIVE REGISTRY

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Introduction: The ability of computed tomography (CT) imaging to accurately discriminate between pleuropulmonary blastoma (PPB) and benign congenital lung malformations (CLM) is controversial. Therefore, we performed a blinded study to determine whether pediatric academic radiologists could adequately discern PPB from CLM using cases from a multicenter research collaborative.

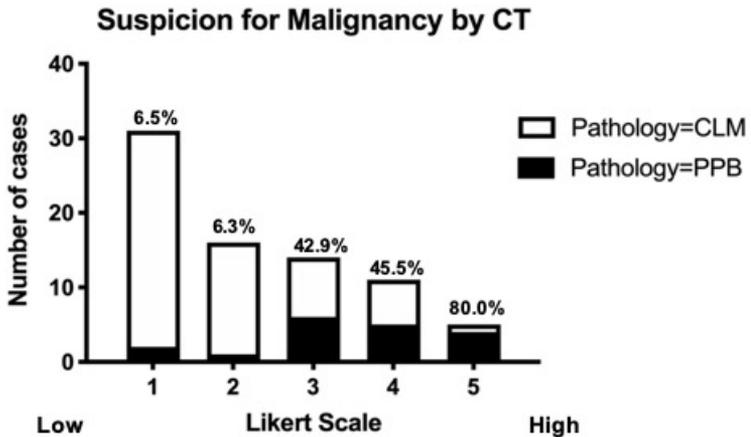
Methods: After central reliance IRB approval, pathologically confirmed cases of PPB were reviewed from a multicenter operative registry of lung lesions (n=521) from 2009-2015. Preoperative CT scans of PPB lesions were age matched with scans from children with pathologically confirmed CLMs and interpreted independently by two blinded, board-certified pediatric radiologists. Diagnostic confidence and suspicion for malignancy scores were captured using 5-point Likert scales. Statistical analysis included Cohen's kappa statistics and logistic regression as appropriate.

Results: Forty patients with new, postnatally detected lung lesions were selected. Pathologic diagnoses included cystic PPB (n=9, 22.5%), congenital pulmonary airway malformation (n=20, 50%), and bronchopulmonary sequestration (n=5, 12.5%). There were no significant differences in age at CT [PPB: 8.2 mos, interquartile range (IQR), 4.0-70.1 vs. non-PPB: 7.3 mos, IQR, 2.0-22.3; p=0.75] and age at resection (PPB: 10.2 mos, IQR, 4.2-71.2 vs. non-PPB: 8.8 mos, IQR, 5.1-24.4; p=0.83). The interrater reliability (kappa score) was 41.1+/-8.4% (p<0.001). The mean diagnostic confidence score was 3.8+/-0.3, and the accuracy rate of CT for differentiating benign versus malignant lesions was 75.5%. The positive predictive value and negative predictive value for a CT diagnosis of cancer were 52.8% and 90.1%,

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respectively. However, logistic regression showed that increasing suspicion for malignancy (mean score, 2.2+/-0.5) was significantly associated with PPB pathology (odds ratio, 13.6; 95% confidence, 4.1-44.8; $p < 0.001$, Figure).

Conclusion: This multi-institutional study suggests that there is relatively low agreement and reliability in distinguishing CLM and PPB lesions amongst experienced radiologists. A low threshold for operative management in any child with a newly diagnosed lung lesion is warranted.



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SUBCUTANEOUS ANALGESIC SYSTEM VS. EPIDURALS FOR POST-OPERATIVE PAIN CONTROL IN PEDIATRIC PATIENTS UNDERGOING OPEN PROCEDURES FOR TUMOR RESECTION

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Purpose: Pediatric oncology patients often undergo open operations for tumor resection. The subcutaneous analgesic system (SAS) consisting of two catheters and an elastomeric pump provides pain medication delivery directly into the incision. Our purpose was to evaluate pain management in patients receiving the SAS vs. epidural for post-operative pain control.

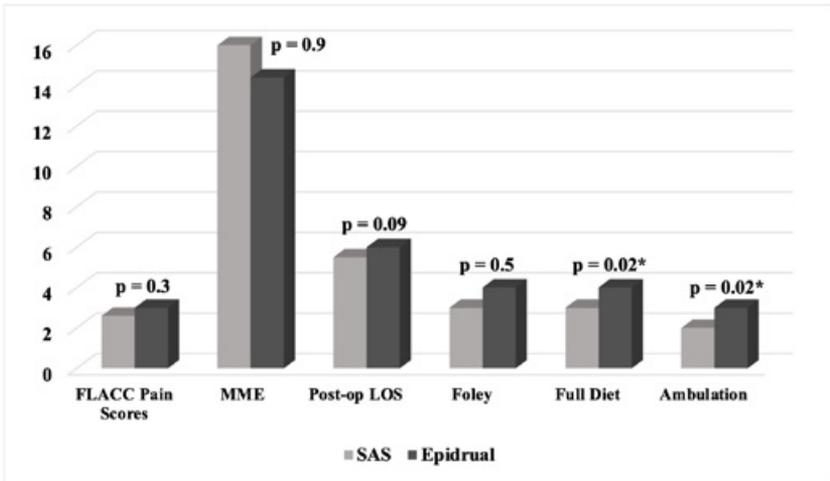
Methods: An IRB approved, retrospective chart review of children age <18 undergoing open surgery for tumor resection between 2017-2019. Dual SAS catheters were tunneled along the peritoneum or along intercostal nerves. Comparisons of morphine milligram equivalents (MME), pain scores, and post-operative course were made using parametric and non-parametric analyses.

Results: Of 101 patients identified, the median age was 7 years (2 months – 17.9 years). There were 65 epidural and 36 SAS patients. Transverse laparotomy was the most common incision (41%), followed by thoracotomy (29%), bilateral subcostal (15%), midline laparotomy (14%), and Pfannenstiel (2%). Pain scores, MME, foley days, and post-operative length of stay (LOS) were similar between the two groups (Figure 1). Foley use was more common in epidural patients [70% (45/64) vs 30% (19/64), $p = <0.001$]. SAS patients had faster time to ambulation and time to regular diet by 1 day ($p = 0.02$). When stratified by incision, pain scores, MME, and LOS were similar. Transverse laparotomy SAS patients had fewer foley days by 2 ($p = <0.001$) and bilateral subcostal SAS patients had fewer days to ambulation by 2 days ($p = 0.04$). Epidural patients more commonly had a complication with the pain device [20% (13/65) vs 3% (1/36), $p = 0.02$]. Eight epidural catheters malfunctioned, 3 were accidentally dislodged, and 2 leaked. The one SAS complication was a break in the tubing.

Conclusion: In pediatric oncology patients, SAS provides similar pain control to epidural, but with faster post-operative recovery, decreased foley use, and fewer complications. A prospective trial is ongoing.

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Figure 1. SAS vs Epidural Outcomes



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LINE HOLIDAYS PROTECT AGAINST ACUTE INFECTIOUS RELAPSE IN PEDIATRIC ONCOLOGY PATIENTS WITH TREATED CATHETER-ASSOCIATED BACTEREMIA

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Purpose: Central venous line (CVL) exchange outcomes after treated bacteremia require elucidation as high-risk oncology patients are frequently access-dependent. We hypothesized that exchange of CVL without a "line holiday" after treated bacteremia would result in higher risk of acute relapse compared with replacement after holiday.

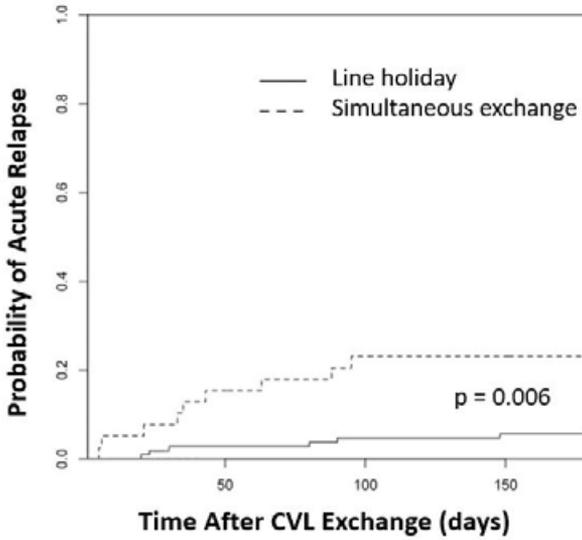
Methods: We performed a single-institution retrospective analysis of oncology patients (n = 163) undergoing CVL exchange after treated bacteremia from 2009 – 2019. Patients receiving a holiday of > 48 hours between CVL removal and replacement (n = 113) were compared to those undergoing simultaneous exchange (n = 50). "Acute relapse" was defined as reinfection with the same organism within 6 months. Demographics and clinical parameters were compared using Fisher's exact and two-sample t-tests. Multivariate and cumulative incidence analyses were then constructed. P < 0.05 indicated significance.

Results: Demographics, previous bone marrow transplant (BMT), time since BMT, ANC, active chemotherapy, active antibiotic therapy, infecting organism type, and ICU status were similar between cohorts. Acute relapse occurred in 30% (n = 15) after simultaneous exchange and 7% (n = 8) after line holiday (p = < 0.001). Time to reinfection was significantly different between groups (32 +/- 29 days after simultaneous exchange vs 75 +/- 54 days after holiday (mean +/- SD); p = 0.003). In patients with negative cultures at exchange, line holiday independently predicted decreased (OR 0.229, 95% CI 0.075 – 0.704; p = 0.009) and AML increased (OR 4.016; 95% CI 1.202 – 13.423; p = 0.021) risk of acute relapse. In a subgroup analysis of simultaneous exchange patients, use of a temporary bridging line showed a trend towards protection against acute relapse (p = 0.053).

Conclusions: After treated bacteremia, line holiday of > 48 hours is protective against acute relapse. A bridging line strategy may also confer protection and should be considered if holiday is impossible.

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Cumulative Risk of Acute Relapse after CVL Exchange with Negative Blood Cultures after Bacteremia



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A NOVEL TWO-COMPONENT, EXPANDABLE BIOADHESIVE FOR EXPOSED DEFECT COVERAGE: APPLICABILITY TO PRENATAL PROCEDURES

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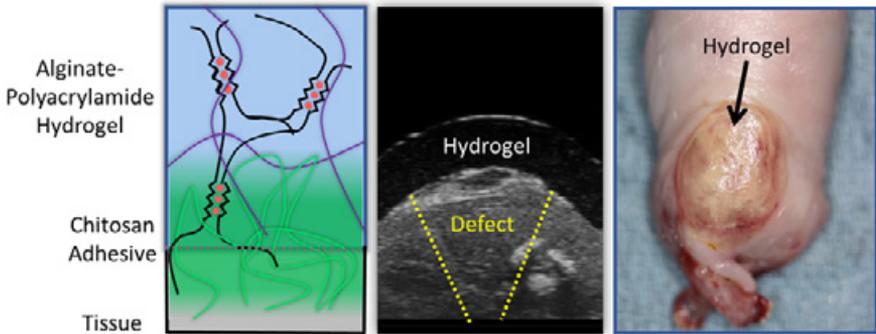
Purpose: Prenatal coverage of congenital defects involves unique challenges, including defect expansion over time and continuous exposure to amniotic fluid. In spina bifida, tethering of the spinal cord to the covering patch is a common additional complication. We sought to test whether a novel bioadhesive composite could overcome these obstacles.

Methods: After IACUC approval, New Zealand rabbit fetuses (n=23) from 16 does underwent surgical creation of spina bifida on gestational day 22-25 (term 32-33 days). Defects were immediately covered with a two-component, inordinately tough adhesive patch consisting of a hydrogel made of a double network of ionically crosslinked alginate and covalently crosslinked polyacrylamide linked to a bridging chitosan polymer adhesive (figure). This system allows for controlled adhesion exclusively where both components interact – in this case at the periphery of the defect, thus preventing cord tethering. Animals were euthanized prior to term for different analyses, including hydraulic pressure testing. Statistical comparisons were by Mann-Whitney U tests (p<0.05).

Results: Hydrogels remained adherent in 70% (16/23) of the recovered fetuses and in all of the last 14 fetuses, as the procedure was optimized. Fetuses with evidence of recent demise were also analyzed. Adherent hydrogels showed a median two-fold (IQR:1.7-2.4) increase in area at euthanasia, with defect coverage further confirmed by histology and ultrasound (figure). The median maximum pressure to repair failure, defined as leak/detachment or rupture, was 15mmHg (IQR:7.8-55.3), with no significant differences between survivors and recently demised fetuses (p=0.20). These pressures exceed reported neonatal cerebrospinal fluid pressures.

Scientific Session 10: Neonatal Surgery (continued)

Conclusion: This novel bioadhesive composite allows for selective and stable attachment of an alginate-polyacrylamide hydrogel to specific areas of the spina bifida defect in a fetal rabbit model, while the hydrogel expands with the defect over time. It could become a valuable alternative for the prenatal repair of spina bifida and other congenital anomalies.



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THE INFLUENCE OF PREMATURETY ON NEONATAL SURGICAL MORBIDITY AND MORTALITY

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Tweet it! The Influence of Prematurity on Neonatal Surgical Morbidity and Mortality, premature infants are high risk! #APSA2020

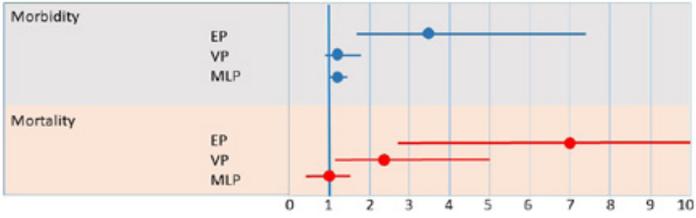
Purpose: As initial survival rates among premature infants have improved, prematurity remains a leading contributor to neonatal morbidity and delayed mortality. This includes care surrounding surgical intervention for congenital anomalies. The purpose of this study was to better assess and characterize the influence of prematurity on surgical outcomes.

Methods: Outcomes between preterm and term infants undergoing surgical repair of tracheoesophageal fistula (TEF), congenital diaphragmatic hernia (CDH), malrotation, or gastroschisis/omphalocele from 2012 to 2017 were compared using the National Surgical Quality Improvement Program-Pediatric database. Prematurity was categorized as extremely premature (EP) for those <29 weeks, very premature (VP) for those 29-32 weeks, moderate-late preterm (MLP) for those 33-36 weeks, and term for those >37 weeks. Chi-square tests, Cochran-Armitage trend tests, and adjusted logistic regression analysis were used to determine significance.

Results: 4,717 infants were identified with 43 (0.9%) EP, 205 (4.3%) VP, 1,452 (30.8%) MLP, and 3,017 (63.9%) term. Complication profiles changed for each stratum for prematurity with the premature populations having higher rates of septic shock, pneumonia, bleeding requiring transfusion and death within 30 days. Compared to term infants, preterm infants have incrementally increased odds of surgical morbidity (EP Odds Ratio (OR) 3.6 95% Confidence Interval (CI) 1.8-7.5, VP OR 1.2 95%CI 0.9-1.7, and MLP OR 1.2 95%CI 1.0-1.4). Moreover, 30-day mortality decreased as neonatal age increased from 23.3% EP, to 5.9% VP, to 2.3% MLP to 2.8% term (p<0.001).

Conclusions: Prematurity increases morbidity and mortality among neonates undergoing surgery and this work helps quantify and qualify the added risk profile associated with prematurity. Appropriate risk-adjustment for prematurity is needed to compare hospital-level performance for these neonatal surgical conditions and premature infants may have unique quality improvement targets.

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COSTLY IMPLICATIONS IN THE MANAGEMENT OF GASTRO-JEJUNOSTOMY TUBES

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Introduction: Children with gastroesophageal reflux and/or gastric dysmotility who cannot receive adequate nutrition via a gastrostomy tube (GT), may be offered a gastro-jejunosotomy tube (GJT) as a promising alternative. Unfortunately, GJTs have high dislodgement rates (cited up to 34.6%). Dislodged GJTs are also associated with significant resource utilization and caregiver strain. We sought to define the frequency and cost of GJT replacement, quantify the radiation exposure associated with replacement, and evaluate the number of conversions to surgical jejunostomies.

Methods: All pediatric patients between 2010 to 2018 who underwent GJT replacement at a single center were retrospectively reviewed. We evaluated resource utilization associated with the care of these patients, including total cost of replacement of each GJT, number of replacements, and radiation exposure time.

Results: We identified 203 unique patients who required GJT placement or replacement. The average age was 7.2 +/- 5.8 years old, and 104/203(53%) were male. There were concomitant neurologic diagnoses in 69.0%, cardiac diagnoses in 17.2%, and cancer diagnoses in 2.4%. GJT patients each required a median of 5 replacements during the study period (range 0-88), with an average of 3 replacements within the first year. There was an average of 156 minutes of radiation exposure time and approximate 5 cGy dose per replacement. Overall, the total hospital cost per patient for replacements averaged \$8,430, which translated to more than \$1.6 million dollars for our cohort. Only four patients were converted from GJT to surgical jejunostomy, due to recurrent dislodgement.

Conclusions: Children with a GJT undergo a high number of replacements each year. Many experience significant radiation exposure and encumber significant inconvenience and economic costs. Consideration should be given to Nissen fundoplication versus early conversion to a primary jejunostomy to avoid these risks and costs.

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RISK PROFILE OF SUBCUTANEOUS PORT PLACEMENT IN SMALL CHILDREN

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Purpose: Long-term vascular access is commonly necessary in children. Concerns exist that smaller children may represent a high-risk group for subcutaneous port placement, but little data exists to guide the surgeon in selecting the optimal intervention (port vs tunneled central line) in this population. We aimed to evaluate the complication profile of ports in <5-years-olds, hypothesizing they have increased complication rates.

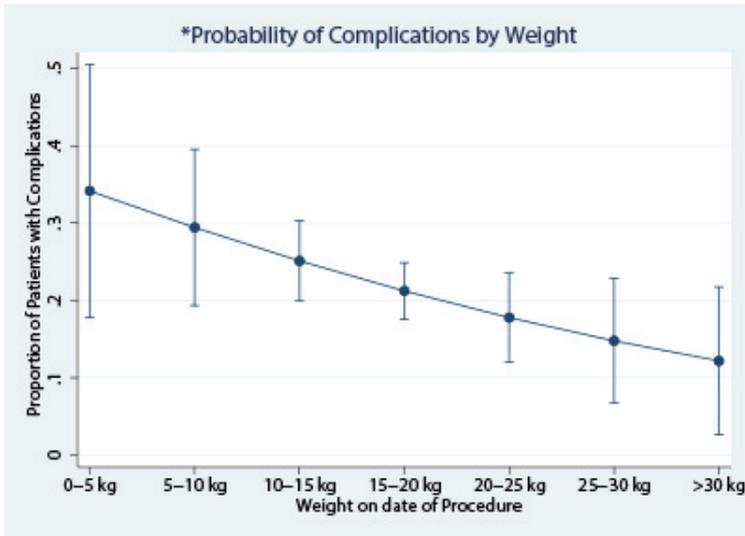
Methods: An IRB-approved, multi-institutional review was conducted examining all patients <5-years-old who underwent port placement between 2014-2018. The primary outcome was any complication after port placement. Patients were divided into two groups based on weight above or below 10kg, a commonly used size to determine eligibility for port placement. Analysis was performed using Fishers-exact and Chi-squared tests and a multivariable-logistic regression model.

Results: Of 509 patients reviewed, 83 (16.3%) were <10kg at port placement. Indications were chemotherapy (71.3%), chronic infusions (19.1%), and difficult access (9.6%). Patients for chronic infusions(34%) or difficult access(24.5%) were more likely to be smaller (<10kg) than for chemotherapy (10.5%; $p<0.01$). Overall, there was no difference in complications above or below 10kg (28.9% vs 20.9%, $p=0.108$). Complications were classified as mechanical(59.5%), infectious(33.3%) or wound complications(7.2%) with no significant difference in complication type by weight. After adjusting for other variables, the only variable significantly associated with complications was the indication for placement (difficult access OR=4.00, 95%-CI 2.07-7.71; chronic infusions OR=2.45, 95%-CI 1.41-4.24, $p=0.000$). There was a trend toward an association between weight and complications, but this was not statistically significant (OR=0.95 per 1kg weight increase, 95%-CI 0.90-1.01, $p=0.10$)*.

Conclusion: In the largest series to date, port placement in children <10kg is reasonable, without a higher rate of complication compared to

Scientific Session 10: Neonatal Surgery (continued)

children ≥ 10 kg. Additionally, wound complications represent only 7.2% of complications and do not increase in smaller children, a commonly cited concern. This data will inform individualized decision-making for the best intervention for each patient.



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A NOVEL NEEDLE DRIVER TO FACILITATE LAPAROSCOPIC INTRACORPOREAL KNOT TYING

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Purpose: Intracorporeal knot tying is one of the most challenging techniques in laparoscopic surgery. Proficiency requires a series of technical movements in a restricted space. We developed a novel needle driver to increase ease and efficiency of intracorporeal knot tying.

Methods: Initial designs for the device were developed using Solidworks® computer-aided 3D design (Dassault Systemes, Velizy-Villacoublay, France). A laparoscopic bipolar vessel sealing device was used as the framework for our prototype. This instrument was modified using components 3D printed by an Eden 260VS Polyjet 3D printer (Stratasys, Eden Prairie, MN) to construct a functional device.

Results: Using rapid-prototyping, a novel laparoscopic needle driver was created in which a segment of the device proximal to the needle holder is magnetized and rotates around the axis of the shaft. The surgeon forms a knot using the following steps: (1) after a stitch is thrown, the suture tail is grasped with the needle driver, (2) the needle is placed on and secured by the magnetized shaft segment, (3) a trigger on the device handle is depressed, rotating the magnetized segment and needle one revolution, creating a loop in the suture, (4) the suture tail is pulled through the loop, producing one throw of a knot. This process can be repeated for further throws.

Conclusion: Our novel laparoscopic suturing device facilitates efficient intracorporeal knot tying that is not hindered by suboptimal triangulation conditions. It does so while allowing continuous control of the suture tail, automated loop formation, and surgeon preference of needle and suture. Our device simplifies a complex laparoscopic skill while maintaining the familiarity and versatility of a conventional needle driver and suture.

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PRETERM NEONATAL BLOOD TRANSFUSIONS ARE ASSOCIATED WITH INCREASED RISKS OF SEPSIS AND PULMONARY COMPLICATIONS

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Purpose: Blood transfusions are associated with significant risks. Although restrictive blood transfusion guidelines have been widely implemented in adult critical care settings, similar implementation has not occurred in neonatal intensive care units (NICUs). Currently, there is conflicting evidence regarding the association between neonatal blood transfusions and poor clinical outcomes. We hypothesize that neonatal blood transfusions are associated with increased risks of sepsis, bronchopulmonary dysplasia (BPD), and complications.

Methods: Following institutional review board approval, a retrospective cohort study was performed for all preterm neonates (< 37 weeks gestational age) transfused over a 1-year period in our NICU. Data were collected including birthweight, gestational age, type and volume of blood products transfused, and outcomes including sepsis, BPD, necrotizing enterocolitis (NEC), time to full enteral feeds, and complications.

Results: 101 patients were included in the study. The patients' mean gestational age and birthweight were 28.7 weeks and 1213 grams, respectively. The mean number of transfusions administered was 3.7 for packed red blood cells (RBC), 0.8 for platelets, 1.3 for fresh frozen plasma, and 0.2 for cryoprecipitate. 58 patients developed sepsis, 63 had BPD, and 45 developed complications, predominantly pneumonia. On multivariate analysis including gestational age, birthweight, and Apgar score, number of RBC transfusions emerged as a significant independent predictor of sepsis (AUC 0.78), BPD (AUC 0.78), NEC (0.82), time to full enteral feeds ($p < 0.0001$), and complications (AUC 0.78).

Conclusion: Blood transfusions were independently associated with poor outcomes including sepsis, BPD, NEC, prolonged time to full enteral feeds, and complications, even when considering patient risk factors including gestational age and birthweight. These findings suggest caution with unrestricted use of blood transfusions in neonates. Prospective trials of restrictive neonatal blood transfusion criteria should be undertaken to determine if selectively limiting transfusions can help avoid poor outcomes such as sepsis and BPD.

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OPTIMAL MANAGEMENT OF CHILDREN WITH NEUTROPENIC APPENDICITIS: A PEDIATRIC SURGICAL ONCOLOGY RESEARCH COLLABORATIVE STUDY

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Background: Optimal management of neutropenic appendicitis (NA) in children undergoing cancer therapy has not been established. Management strategies include early appendectomy versus medical management (\pm interval appendectomy). Cancer therapy may be affected by management choice. We aimed to characterize the frequency and duration of chemotherapy delay as well as postoperative complications based on treatment strategy.

Methods: Contributing sites from the Pediatric Surgery Oncology Research Collaborative (PSORC) performed a retrospective chart review on children with NA over a 10-year period.

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Results: 49 children were identified with a diagnosis of NA while undergoing cancer treatment. Patients ranged from 3 - 17 years old (median 11, IQR 6-14), were 55% (n=27) male, and 59% (n=29) non-Hispanic white. The most common cancer diagnoses were leukemia 67% (n=33) and brain tumor 14% (n=7). Early appendectomy was performed in 41% (n=20) and the remainder were managed medically; rates of imaging findings of abscess or perforation were equivalent in the two treatment groups. Of those managed medically, 45% (n=13) subsequently underwent appendectomy during the same hospitalization. The reasons for appendectomy after initial medical management were failure of medical management in 62% (n=8), and count recovery in 38% (n=5). Cancer therapy was delayed in 39% (n=19) of all patients; including >14 days in 8 and >21 days in 4. Neither management strategy was significantly associated with delay in cancer treatment (OR 0.35, $p = 0.10$), development of a postoperative abscess, 10% (n=5, OR 0.30, $p = 0.30$), or mortality (n=0). However, patients who underwent early appendectomy had a shorter length of stay (11 vs. 34 days, $p=0.018$) (Table).

Table 1. Patient Detail and Outcomes

	Early Appendectomy (n=20)	Medical Management (n=29)	p-value
Absolute Neutrophil Count (thous/uL)	0.049	0.056	$p = 0.98$
Findings of Complicated Appendicitis (phlegmon, abscess)	6 (30%)	6 (21%)	$p = 0.51$
Postoperative Abscess Formation	1 (5%)	4 (14%)	$p = 0.38$
Chemotherapy: Delay Alteration Any of the above	5 (25%) 0 5 (25%)	14 (48%) 1 (3%) 14 (48%)	$p = 0.10$
Length of Stay (days)	11	34	$p = 0.018$
Appendicitis-related Mortality	0	0	N/A

Conclusion: Early appendectomy for neutropenic appendicitis is safe, effective, and associated with a reduced length of stay. Patients who undergo initial medical management have a high rate of failure and have no reduction in operative complications.

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EXPEDITED SURGICAL CARE OF APPENDICITIS IS ASSOCIATED WITH IMPROVED RESOURCE UTILIZATION

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Tweet it! Expedited surgical management of appendicitis is associated with decreased cost and length of stay. What do you do at your institution? @JonathanVacek #APSA2020

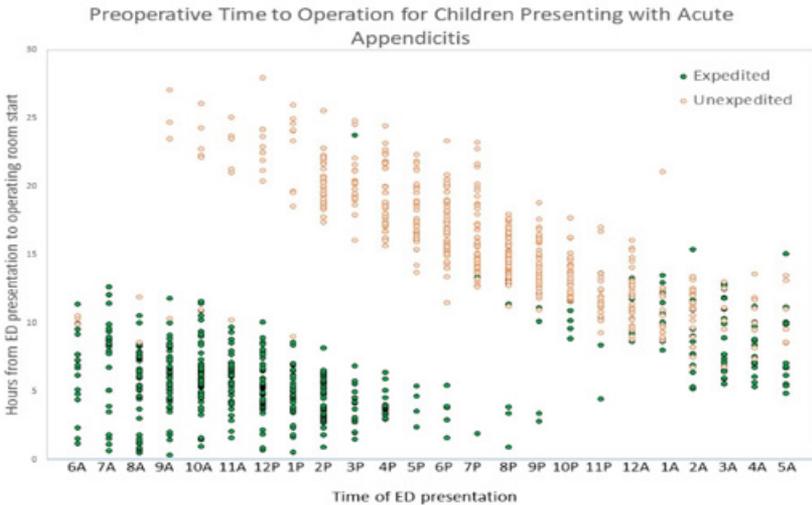
Purpose: Appendicitis is the most common indication for an intra-abdominal operation in children. In light of a growing body of evidence that modest delays do not result in a higher incidence of complicated disease, it is increasingly common to postpone after-hours appendectomies until the next day. Thus, we hypothesized that the hour of initial emergency department presentation plays a role in appendicitis hospital resource utilization.

Methods: Medical records from 2015 to 2019 were reviewed for patients who underwent an appendectomy in a freestanding children's hospital. Patients were considered expedited if they proceeded directly to the operating room from the emergency department, or if the surgery start time was fewer than four hours after floor admission. Adjusted quantile and logistic regressions were performed. Hospital length of stay and charges were the primary outcomes.

Results: Over the study period 943 patients acutely presented for appendectomy, of whom 427 (45.3%) were classified as expedited. Hour of initial presentation was the most significant predictor of being expedited, which demonstrated a bimodal distribution of hours prior to operation (Figure). When adjusting for patient demographics and hour of presentation the expedited cohort had an 11.4 hours shorter hospital stay ($p < 0.0001$) and \$1,113 fewer charges ($p < 0.0001$) compared to the non-expedited cohort. There were no differences in perforation rates, surgical complications or 30-day readmissions.

Scientific Session 11: Colorectal Surgery (continued)

Conclusion: We found that in a high-volume institution, timely delivery of surgical appendicitis care is bimodal. The hour of presentation exerts the most significant influence on whether a child proceeds to operation in an expedited fashion. Although our findings are consistent with reports that hospital wait time is not associated with detrimental patient outcomes, we do find that delays in surgical care lead to increased utilization of hospital resources. This must be balanced against the costs of after-hours operations when crafting appendicitis practice patterns.



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INFLUENCE OF STAPLER USE ON PERIOPERATIVE EFFICIENCY, COST AND OUTCOMES IN APPENDICITIS IN CHILDREN: A MULTICENTER SEVERITY-ADJUSTED COHORT STUDY

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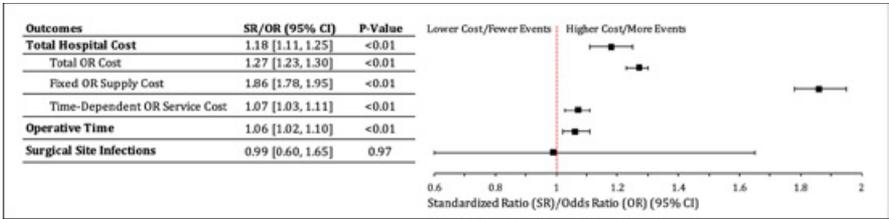
Purpose: Controversy exists surrounding the impact of surgical stapler use on cost and resource utilization in children with appendicitis. Advocates justify stapler use by a perceived decrease in operative time, while opponents cite high cost of the device as a major disadvantage. The purpose of this study was to quantify the influence of stapler use on resource utilization and outcomes in children undergoing appendectomy

Methods: This was a multicenter retrospective cohort study of children 3-18 years of age undergoing appendectomy between Jan 1, 2013 and Jun 30, 2015. Outcomes included perioperative efficiency measures (case duration and time-dependent OR service costs), fixed OR supply costs, total OR-related costs (fixed and time-dependent OR costs together), total hospital cost, and surgical site infections (SSIs). Multivariable regression was used to calculate standardized ratios (cost and operative duration) and odds ratios (SSI data) associated with stapler use after adjusting for patient characteristics, disease severity (using NSQIP defined criteria), and hospital-level differences in cost accounting methods.

Results: 3011 patients were included from 16 hospitals (median 205/hospital). Staplers were utilized in 64.6% of cases, ranging from 0–97.1% across hospitals ($p < 0.01$). Stapler utilization was associated with higher fixed supply costs (\$1296 vs \$696, SR 1.86 [95%CI 1.78–1.86]), longer operative time (50.4 vs. 47.8 minutes, SR 1.06 [95%CI 1.02–1.10]), higher time-dependent OR costs (\$2076 vs \$1947, SR 1.06 [95%CI 1.02–1.10]), higher total OR-related costs (\$3441 vs \$2720, RR 1.27 [95%CI 1.23–1.30]) and higher total hospital costs (\$13,187 vs \$11,194, RR 1.18 [95%CI 1.11–1.25]). No differences in SSI rates were found between groups (5.25% vs 5.30%, OR 0.99 [95% CI 0.60–1.65]) (Figure).

Conclusion: In the surgical management of pediatric appendicitis, stapler utilization is associated with longer operative time and higher OR-related and total hospital costs.

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PATIENT RECOVERY IS FASTER FOLLOWING NON-OPERATIVE TREATMENT OF UNCOMPLICATED APPENDICITIS COMPARED TO APPENDECTOMY – A RANDOMISED CONTROLLED FEASIBILITY TRIAL

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Tweet it! non-operative treatment of appendicitis in children may allow them to get back to school quicker and their parents to take less time off work - important patient centered outcomes #APSA2020

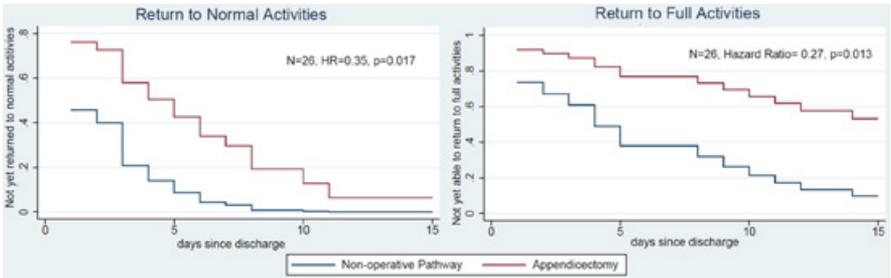
Purpose: Non-operative treatment is emerging as a valid treatment alternative to appendectomy for children with uncomplicated acute appendicitis. A potential benefit of non-operative treatment is more rapid recovery, including faster return to pre-illness status, following appendicitis, but data on these outcomes, which are important to patients, parents and surgeons, are lacking. We investigated these under-reported outcomes in a feasibility RCT.

Methods: Multicentre prospective randomised controlled feasibility trial comparing non-operative treatment with appendectomy for children aged 4-15 with uncomplicated acute appendicitis. Short term patient reported outcomes and quality of life (CHU-9D) were recorded at randomisation, discharge and 2 weeks later. Data are mean±SD or median [range]. Cox proportional hazard was used for survival analysis. Ethical approval: 16/SC/0596.

Results: 57 children were randomised, 28 to appendectomy, 29 to non-operative treatment. Quality of life scores at randomisation were similar between groups (0.61±0.18 vs. 0.57±0.13; p=0.5). At hospital discharge (76 [34-194] hours after randomisation in the non-operative treatment group, 63 [21-196] in the appendectomy group), quality of life scores were significantly better in children randomised to non-operative treatment compared to appendectomy (0.89±0.1 vs. 0.69±0.1; p<0.0001) and this persisted 2 weeks later (0.97±0.1 vs. 0.86±0.2; p=0.07). Children randomised to non-operative treatment reported taking analgesia for fewer days and a significantly faster return to both normal and full activities than those randomised to appendectomy (p=0.017 and p=0.013 respectively; Figure). Parents of children randomised to non-operative treatment took significantly fewer days off work as a result of their child's illness than those randomised to appendectomy (p=0.01).

Scientific Session 11: Colorectal Surgery (continued)

Conclusion: These results suggest more rapid recovery from uncomplicated acute appendicitis with non-operative treatment compared to appendectomy and improved quality of life. Non-operative treatment may be superior to appendectomy for some patient-centred outcomes. It is important to measure and report these patient-centred outcomes in a larger randomised controlled trial.



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ENHANCED RECOVERY AFTER SURGERY PATHWAYS IN PEDIATRIC COLORECTAL SURGERY IMPROVES PATIENT OUTCOMES

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Introduction: Enhanced recovery after surgery (ERAS) pathways in adult colorectal surgery are known to reduce postoperative complications, readmissions, and length of stay. However, there is a paucity of data for pediatric colorectal ERAS pathway implementation.

Methods: A retrospective cohort study was performed from 2014–2018 on pediatric patients (less than or equal 18 years) undergoing colorectal surgery before and after implementation of an ERAS pathway at a single institution. Bivariate analysis was performed over the presence or absence of an ERAS pathway. Linear regression was used to determine if ERAS pathway implementation reduced total morphine milligram equivalents (MME) per kilogram while controlling for age, sex, surgical procedure, and the use of pre-operative opioids, epidural, and post-operative ERAS medications.

Results: Of the 139 patients included, 98 (70.5%) and 41 (29.5%) were managed with ERAS and non-ERAS pathways, respectively. There was no statistical difference in age, sex, or diagnosis between cohorts. The ERAS cohort primarily underwent ileocectomy (n=33, 33.7%) and total abdominal colectomy with ostomy (n=19, 19.4%) versus ileostomy takedown (n=9, 22%), ileocectomy (n=7, 17.1%), and completion proctocolectomy (n=7, 17.1%) in the non-ERAS cohort, p=0.04. There was no difference in the use of open versus laparoscopic techniques for procedures performed in either cohort. The ERAS cohort experienced a significant reduction in total MME per kilogram, foley duration, time to oral intake, and length of stay with no increased risk of complications. On linear regression, the presence of an ERAS pathway reduced the total MME (-0.071, 95% CI [-0.10,-0.043], p<0.001) when controlling for covariates.

Conclusion: We conclude the use of an enhanced recovery pathway reduces opioid utilization, foley duration, and length of stay, as well as expediting the initiation of oral intake in pediatric patients undergoing colorectal surgery. Pediatric enhanced recovery after surgery pathways are a viable and safe method to improve perioperative care in pediatric colorectal surgery.

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SURGICAL MANAGEMENT OF AN OBSTRUCTIVE MÜLLERIAN ANOMALY IN A PATIENT WITH ANORECTAL MALFORMATION

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Purpose: To describe the incidence and workup of Müllerian duct anomalies (MDA) in patients with anorectal malformation, present a case of laparoscopic excision of an obstructed MDA, and provide management recommendations.

Introduction: MDAs are rare in the general population, occurring in less than 3% of women, but much more prevalent in female patients with anorectal malformation, occurring in up to 30% of these patients. These anomalies may be asymptomatic until the patient develops dysmenorrhea or devastating obstetrical complications. The unicornuate uterus represents nearly 15% of MDAs. The most common subtype is associated with a non-communicating rudimentary uterine horn on the contralateral side. The non-communicating horn can become obstructed after menarche (Figure 1), causing cyclic abdominal pain.

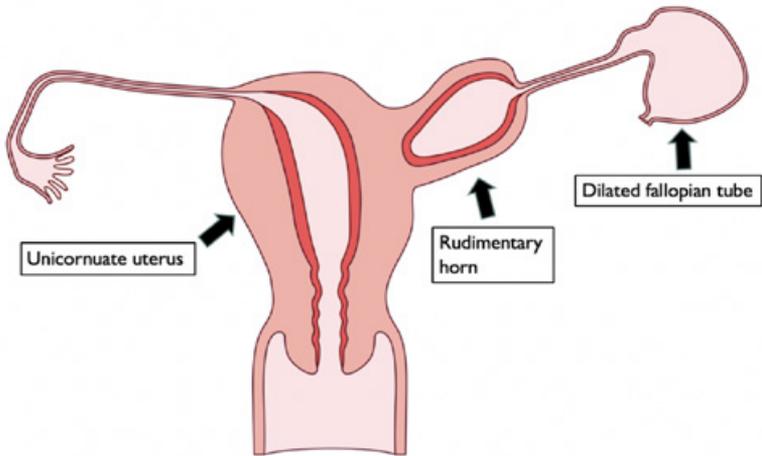
Methods: A 14-year-old girl with anorectal malformation and unilateral renal agenesis presented with chronic intermittent left sided abdominal pain since menarche three years prior. She was diagnosed with a right unicornuate uterus with a left non-communicating rudimentary uterine horn. The rudimentary uterine horn and fallopian tube were massively dilated with old menses. We performed an ovary-sparing laparoscopic excision of the non-communicating uterine horn and fallopian tube.

Results: The patient recovered well and was discharged on the second post-operative day. Pathology was consistent with the intraoperative findings above. She has had no recurrence of her chronic abdominal pain.

Conclusion: We recommend maintaining a high suspicion for gynecologic anomalies in patients with anorectal malformation. Providers should evaluate the anatomy when the patient is scheduled to undergo other needed surgical procedures. Routine imaging should be obtained after thelarche to assess for obstruction in incompletely-developed Müllerian structure as the patient goes through puberty. A multidisciplinary approach with a pediatric gynecologist is recommended to determine ability for future parturition in complex cases. Excision of rudimentary structures is indicated in select symptomatic women after a complete assessment of Müllerian anatomy.

Scientific Session 11: Colorectal Surgery (continued)

Figure 1: Anatomy of a dilated rudimentary non-communicating uterine horn and fallopian tube



Scientific Session 11: Colorectal Surgery (continued)

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INPATIENT MANAGEMENT OF HIRSCHSPRUNG'S ASSOCIATED ENTEROCOLITIS (HAEC) TREATMENT - THE BENEFITS OF STANDARDIZED CARE

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Introduction: Patients with Hirschsprung's disease (HD) remain at risk of developing Hirschsprung's associated enterocolitis (HAEC) after surgical intervention. Inpatient management is highly variable, with differences in treatments and length of treatment offered. An algorithm directed at standardizing treatment practices was implemented at our institution. This study's aim was to compare the outcomes of patients pre- and post-algorithm implementation.

Methods: A retrospective institutional review of patients with HD who were admitted for HAEC or suspected HAEC was performed; patients admitted from January 2017 – June 2018 became the pre-implementation group and patients admitted from October 2018 – October 2019 were the post-implementation group. The three months surrounding initiation of the algorithm were excluded. The algorithm included standardization of irrigation practices and antibiotic duration, home teaching and botox injections. Demographics, outcomes, associated comorbidities, inpatient length of stay, and duration of antibiotic treatment were compared between the two groups. STATA® (StataCorp, College Station, TX) was used for analysis; $p < 0.05$ was significant.

Results: Fifty-four patients met criteria; 63 episodes of HAEC (34 pre-algorithm, 29 post-algorithm) occurred during the study period. Twelve patients (22%) had more than one episode. The median age at pull-through was 135 days (IQR 15, 213); 72% were male and 14.8% had Trisomy 21. The most common levels of the transition zone was the rectosigmoid (42.6%) and descending colon (29.6%). Following algorithm implementation, the median length of stay (2 vs 7 days, $p < 0.001$) and total duration of IV antibiotics (3 vs 7 days, $p < 0.001$) decreased significantly in the post-implementation cohort, with similar readmission rates for recurrent enterocolitis prior to clinic follow-up between groups. [Table 1]

Conclusions: Use of a standardized algorithm significantly decreases length of stay and total duration of antibiotics without increasing readmission rates while still providing appropriate treatment for HAEC.

Scientific Session 12: Pediatric Gynecologic Surgery

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EVALUATION OF TISSUE FRAGMENTS FOR PRESENCE OF PRIMORDIAL FOLLICLES IN THE DISCARDED PROCESSING MEDIA IN PEDIATRIC OVARIAN TISSUE CRYOPRESERVATION

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Purpose: Ovarian tissue cryopreservation (OTC) is an experimental method for female fertility preservation in which the cortex containing the primordial follicles (e.g. the ovarian reserve) is isolated and stored for future use to restore fertility and/or endocrine function. Standard processing of the ovary for OTC is based on methods established for adults. However, because pediatric tissue does not have distinct separation of ovarian compartments we predict that primordial follicles may be lost in tissue fragments.

Methods: Prospective evaluation of processing media from pediatric OTC cases at a tertiary children's hospital, from 6/2018–3/2019. Ovaries were processed using standard methods with processing media filtered to collect residual tissue fragments. Fragments possibly containing follicles were identified by light microscopy and three sections from two–four tissue fragments per participant were analyzed by histology. Follicles were counted and classified according to morphological criteria.

Results: Seventeen patients had media collected, and tissue was present and analyzed in ten participants. The participants were prepubertal (5/10), peripubertal (4/10) and postpubertal (1/10; range 6 months – 22 years). Tissue collected from seven out of ten participants contained follicles of any stage (6.6 +/- 4.3 follicles/mm²). Of those, primordial follicles were present in three prepubertal (1.97, 8.55 and 28.15 follicles/mm²) and three peripubertal patients (0.04, 0.54 and 2.09 follicles/mm²). There were no follicles of any stage present in the postpubertal patient.

Conclusion: Primordial follicles exist within tissue that is removed during standard OTC processing. Most importantly, the presence of primordial follicles is more likely in prepubertal and peripubertal children, supporting our hypothesis that the adult processing technique is inappropriate for pediatric use. Additional research is ongoing to identify steps within this multi-step process that can be improved and to identify whether primordial follicles exist beyond the cortical thickness routinely saved for OTC.

Scientific Session 12: Pediatric Gynecologic Surgery (continued)

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Ovarian Follicle Density Is Preserved Following Ovarian Tissue Cryopreservation in Young Females with Cancer

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Purpose: Cancer therapy in young females results in irreversible damage to their ovaries potentially leading to premature ovarian failure (POF) and infertility. Ovarian follicle density (FD) serves as a key predictor of future reproductive potential for a woman. The specific aim of this study was to assess the efficacy of ovarian tissue cryopreservation (OTC) in young females with cancer by evaluating its impact on FD before and after OTC.

Methods: As part of an IRB approved prospective trial, girls (ages 6 to 18 years) with cancer at high risk for POF was initiated. Each girl underwent left hemi-oophorectomy. The ovarian tissue was allocated into 5 sections: 1. Immediate pathologic analysis; 2. & 3. Cryopreserve for future use by child; 4. Immediate xenotransplantation (FRESH); 5. Cryopreserved (90 days) followed by xenotransplantation (CRYO). Following a 30 day engraftment, the xenografts were harvested. The grafts were analyzed histologically and FD was estimated by determining number of follicles per square millimeter of ovarian tissue. Comparative analyses were performed using the Graph Pad Prism 4 program and the Student's t-test.

Results: Six girls were enrolled in this study, contributing to 20 FRESH and 24 CRYO xenografts. Overall, 85% of FRESH grafts (17/20) were viable after xenotransplantation and 79.1% of CRYO grafts (19/24) were viable. Ovarian follicles were identified and FD was calculated in all of the viable grafts. Mean FD was 48.7 +/- 19.1 follicles/square mm for FRESH grafts and 42.8 +/- 19.8 follicles/square mm for CRYO grafts. ($p = 0.8$)

Conclusions: Mean FD is not significantly different before and after OTC in a high risk group of girls with cancer. This is the first study in adolescent girls to provide histologic evidence of preservation of FD and efficacy of the OTC strategy. By providing this evidence base, the potential benefit to the young female with cancer is significant.

Scientific Session 12: Pediatric Gynecologic Surgery (continued)

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SURGICAL STAGING FOR OVARIAN STROMAL TUMORS

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Purpose: Although malignant ovarian neoplasms arise at all ages and from 3 distinct cell types of origin, surgical staging principles have all been based on epithelial ovarian cancer, the most common histology in adult women. Current NCCN guidelines for sex cord-stromal tumors follow FIGO recommendations with the exception of lymphadenectomy. This review was undertaken to review compliance and utility of surgical staging for ovarian sex cord- stromal tumors.

Methods: A retrospective review was undertaken of patients with ovarian stromal tumors enrolled in the International Ovarian and Testicular Stromal Tumor and International PPB/DICER1 Registries with IRB approval. Demographics and medical records were reviewed. Operative notes and pathology reports were analyzed regarding individual components of the surgical procedure (avoidance of capsule rupture in situ, peritoneal fluid cytology, peritoneal surface/omentum and lymph node management) and histologic findings of tissue removed.

Results: 131 females age 2 days -60 years were diagnosed from 1985-2019. Operative and pathology reports were available for 130 patients and form the basis for this review. Surgical staging was complete in 1.5% patients by FIGO requirements and in 36% by COG requirements. Histology included: Sertoli-Leydig cell tumor (n=68), juvenile granulosa cell tumor (n=36) and other stromal or sex cord-stromal tumor types (n=26). Tumor diameter ranged from 1.7 to 35 cm (mean 13.96). Preoperative rupture was found in 12.5%, intra-operative inadvertent rupture in 11.7% and deliberate capsule entry in 11.7%. Staging compliance is described in Table.

Conclusions: Compliance with documentation and surgical staging by both FIGO and COG germ cell guidelines is poor in all age groups. As expected, lymph node involvement is uncommon. Involvement of peritoneal fluid, peritoneal surfaces and omentum is found in 7-12% of samples obtained, confirming continued need for inspection and assessment of these components of staging including peritoneal fluid in all patients and tissue biopsy for abnormal findings.

Scientific Session 12: Pediatric Gynecologic Surgery (continued)

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OVARIAN VOLUME RATIO IS A RELIABLE PREDICTOR OF OVARIAN TORSION IN GIRLS WITHOUT AN ADNEXAL MASS

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Purpose: Ovarian torsion in the absence an adnexal mass predominately occurs in premenarchal girls and is associated with a delay in diagnosis. The aims of this study were to identify ultrasound-based predictors of ovarian torsion in girls without an adnexal mass and establish a set of normal values for ovarian volume ratio (OVR).

Methods: A retrospective review was performed of all premenarchal patients >3 years of age with a normal pelvic ultrasound between January 2016 and January 2019. A comparison group of premenarchal girls presenting between 2011 and 2019 with torsion in the absence of an adnexal mass was utilized. Ovarian width was defined as the size of the ovary in the largest dimension. Ovarian volumes were calculated using the formula for a prolate ellipsoid. OVR was calculated by dividing the volume of the larger ovary by that of the smaller. Demographic and radiologic data were analyzed and a p-value<0.05 was used to determine statistical significance.

Results: Five-hundred and four premenarchal girls underwent pelvic ultrasound evaluation with a normal examination. The mean OVR was 1.6 ± 0.7 (range 1.0-6.5). OVR did not vary with age ($r=-0.06$), as compared to ovarian width which increased steadily with age ($r=0.47$, $p<0.001$). Greater OVR and ovarian width, as well as abnormal Doppler flow all correlated with the presence of torsion ($n=15$). OVR was increased in girls with torsion (7.6 vs 1.4, $p<0.0001$), and by receiver operating characteristic (ROC) analysis a cut-off value of >2.5 demonstrated the best diagnostic accuracy of any predictive variable (sensitivity 100%, specificity 94%, AUC 0.991, $p<0.001$).

Conclusions: OVR is an excellent predictor of ovarian torsion in premenarchal girls without an adnexal mass. Unlike ovarian width, OVR does not increase with age and a cutoff OVR>2.5 demonstrates high sensitivity and specificity for identifying ovarian torsion in this population.

Presented in the New Technology Committee Educational Session

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THE I-FASTENER: A NOVEL TISSUE APPPOSITION DEVICE

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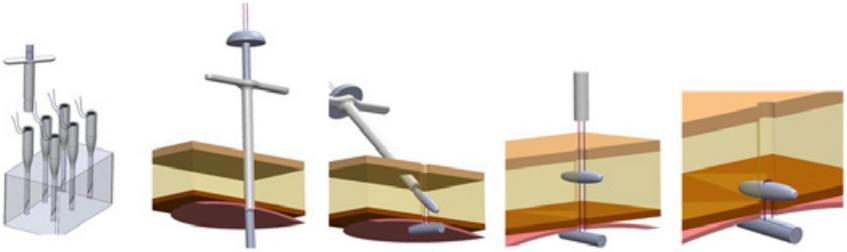
Purpose: Tissue apposition is an essential element of surgical procedures and presents a particular challenge in minimally invasive surgery. Current percutaneous tissue apposition devices such as T-fasteners are limited by the need for an external anchor. We developed a novel "I-fastener" device to percutaneously deploy two bioabsorbable fasteners affixed along a bioabsorbable suture to easily appose two tissues with a single needle pass.

Methods: Initial designs for the device were developed using Solidworks® computer-aided 3D design (Dassault Systemes, Velizy-Villacoublay, France). A prototype was created using the components of a laparoscopic insufflation needle and syringe.

Results: A novel tissue apposition device was developed with two components: (1) a needle which houses two suture-threaded fasteners and (2) a multiuse plunger to serially deploy the linked fasteners. The I-fastener is deployed as follows: (1) the surgeon passes the needle tip into the desired location, (2) depresses the plunger once to deploy the first fastener, (3) withdraws the needle tip to the second desired location, (4) depresses the same plunger again to deploy the second fastener, and (5) withdraws the needle from the field leaving the two suture ends exiting the single needle hole. The two suture ends are tied together, burying the knot to pull the T-fasteners together and appose the tissues between them as a bioabsorbable rivet.

Conclusion: The I-fastener device allows for easy and secure apposition of two tissues through a single needle hole with no external fixation. It eliminates the need for cumbersome techniques by streamlining the steps into the passage of a single needle, press of a button, and tying of a knot. Our device simplifies tissue apposition in a confined space and is applicable to a wide range of procedures including gastrostomy tube placement and ventral hernia repair.

**Presented in the New Technology Committee
Educational Session** (continued)



Presented in the New Technology Committee Educational Session (continued)

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CONTRAST ENHANCED COLOSTOGRAPHY - NEW APPLICATIONS IN PREOPERATIVE EVALUATION OF ANORECTAL MALFORMATION

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Introduction: In planning surgical repair of anorectal malformations (ARMs) it is important understand the position of the rectum and its attachments to the urinary tract. Traditional imaging techniques involve ionizing radiation, distention of the rectum with supraphysiologic pressures, and sometimes require sedation. Recent developments in the field of contrast agents have allowed the emergence of an ultrasound-based technique that can avoid these requirements while providing high resolution structural information in three dimensions.

Methods: 13 children (12 male, 1 female, age 1-11 months) with ARMs (10 rectourethral fistula, 1 imperforate anus without fistula, 1 rectoperineal fistula, 1 occult rectoperineal fistula) underwent contrast enhanced colostography (ceCS) and traditional preoperative imaging techniques to delineate anatomic relationships of pelvic structures. A small subset of this population has previously been presented in a limited capacity; our experience with a larger cohort is here reported.

Results: ceCS and colostogram yielded concordant anatomic information, including structural relationships and fistulous connections, in 9/13 patients (69%). ceCS detected fistulous connection in 2/13 patients (15%) that were not seen by initial colostogram. ceCS did not detect the fistulous connection in 1 patient. One patient was unable to undergo colostogram due to stricture of mucus fistula; ceCS was performed in the operating room after mucus fistula was opened and successfully identified a very small, anterior rectoperineal fistula.

Conclusions: ceCS is a safe, effective and flexible method for defining important structural information in ARM patients. When compared with traditional methods, it provided equivalent or superior structural information 85% of the time and does not require high rectal distention pressures. ceCS also demonstrates three dimensional relationships of soft tissue and bony structures, while avoiding radiation (as in colostograms) and anesthesia/sedation (often required for MRIs). Based on these characteristics, it bears consideration as a standard tool in preoperative planning for this population.

Presented in the Informatics Committee Educational Session: Social Media and Informatics Demystified - How You Integrate Your Brand with APSA's

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NOT JUST CLICKBAIT: MULTIMEDIA CONTENT SHARED ON SOCIAL MEDIA LEADS TO MORE THAN 50% INCREASE IN JOURNAL WEBSITE ARTICLE VIEWS

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Purpose: The distribution of academic publications via conventional avenues alone risks limiting their impact in an increasingly digital world. Creating multimedia content based on journal articles, such as video reviews and visual abstracts, can help consolidate their message into a digestible format while furthering their reach. We sought to evaluate the impact this content had on article views, and which type of content was most effective.

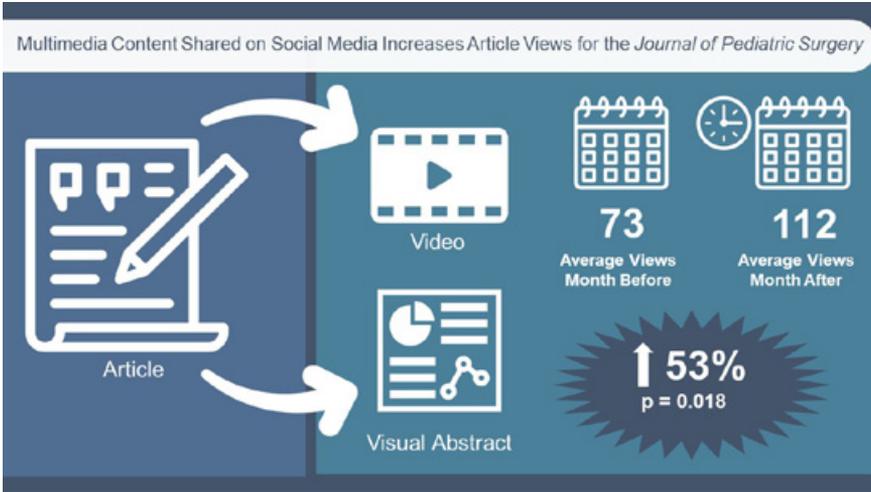
Methods: All created content posted to the Journal of Pediatric Surgery Facebook page between July 2016 and August 2019 was analyzed. Metrics from Facebook – including the reach and the number of reactions, comments, shares, and link clicks – were collected. The number of article views in the month prior to and following the posting of created content were acquired from Elsevier.

Results: Created content resulted in an average increase of 53% (38.7±121.6 views) in the month following its posting (p=0.018). The content type (video vs. visual abstract), day of posting, and topic of the content were all factors in a post's popularity. Videos had more reactions (126.4±124.8 vs. 60.6±61.7, p=0.004), comments (18.2±2.8 vs. 2.8±4.4, p<0.0001), and shares (33.3±28.9 vs. 20.0±15.9, p=0.01) than visual abstracts, but fewer clicks to the linking article (34.9±44.3 vs. 83.5±73.9, p<0.0001); both types had similar reach. Posts on the weekend had more reactions (p=0.009), comments (p=0.01), and shares (p=0.02). Post topic impacted its reach (p=0.009), shares (p=0.003), and click rate (p=0.002) – with esophageal atresia/tracheoesophageal fistula, urology/gynecology, and thoracic surgery being the most popular.

Conclusion: User-created multimedia content posted to the Journal of Pediatric Surgery Facebook page increased traffic to the referenced articles by an average of 53%. Pediatric surgeons should continue to harness the

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power of this knowledge dissemination strategy on social media platforms to increase the reach of practice-changing literature. Reviewing trends in consumption on these platforms can help identify knowledge gaps.



Presented in the Informatics Committee Educational Session: Social Media and Informatics Demystified - How You Integrate Your Brand with APSA's (continued)

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JOURNAL OF PEDIATRIC SURGERY: EFFECTS OF AN AUTOMATED SOCIAL MEDIA STRATEGY FOR KNOWLEDGE DISSEMINATION

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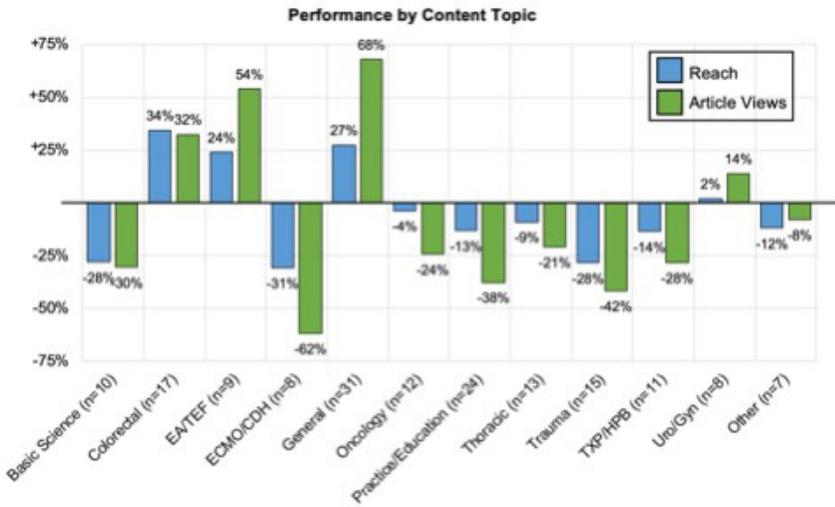
Purpose: With increasing number of publications, it has become harder to stay up to date in surgical literature. Social media is increasingly being recognized as a valuable educational resource with global reach. We sought to analyze the impact of an automated social media strategy on knowledge dissemination for the Journal of Pediatric Surgery (JPS).

Methods: Analytics for a 6-month period (March-August 2019) were retrospectively reviewed for posts automatically published to JPS social media using a Social Pilot queue derived from the journal's RSS feed. Descriptive and inferential statistics were utilized to examine measures of content reach and user engagement including journal article views.

Results: A total of 165 automated posts amassed 512,316 impressions leading to 9,795 article views during this period. Facebook had greater overall impact ($p < 0.01$), but Twitter was stronger when adjusted by number of followers ($p < 0.01$). Engagements and article views had a strong correlation between platforms (0.6 and 0.7, $p < 0.01$). Day of the week had limited impact in performance, with mild Monday-Tuesday increase in Facebook engagement rate ($p = 0.02$). Photographs were the most impactful content format ($p < 0.05$). Topic had the highest effect on performance ($p < 0.05$) – with colorectal, EA/TEF, and general pediatric surgery leading to higher reach and engagement in both platforms. ECMO/CDH was the least popular content category. Comments were fewer than one per post overall, and shares were fewer than two per thousand followers.

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Conclusions: Our automated social media strategy reached an average of 3,105 users and led to 59 journal article views per post, with content topic having the strongest effect in performance. For comparison, custom-made infographics reached an average of 7,368 users and lead to 101 article views each. Alternative knowledge dissemination strategies or platforms are likely needed to foster online discussion and build more robust forums for collaboration given the negligible effects of comments and replies in post engagement.



Presented in the Fetal Committee Education Session

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OBSERVED TO EXPECTED CONTRALATERAL LUNG VOLUMES ON FETAL MRI ARE SUPERIOR TO OBSERVED TO EXPECTED LUNG TO HEAD RATIO IN PREDICTING OUTCOMES IN CONGENITAL DIAPHRAGMATIC HERNIAS

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Introduction: In congenital diaphragmatic hernia (CDH), ultrasound (US) measurements of the contralateral lung commonly provide observed to expected lung to head ratio (O/E LHR). Fetal magnetic resonance imaging (MRI) measurement of the observed-to-expected total lung volume (O/E TLV) has been compared favorably to O/E LHR in predicting outcomes. Since O/E LHR only measures the contralateral lung, we sought to investigate if MRI measurements of the contralateral lung volume (O/E CLV) are accurate at predicting outcomes in CDH. Focusing on the contralateral lung volume excludes the hypoplastic ipsilateral lung which can be underestimated when performing volumetric assessments. We hypothesize that O/E CLV is more accurate at predicting outcomes compared to O/E LHR.

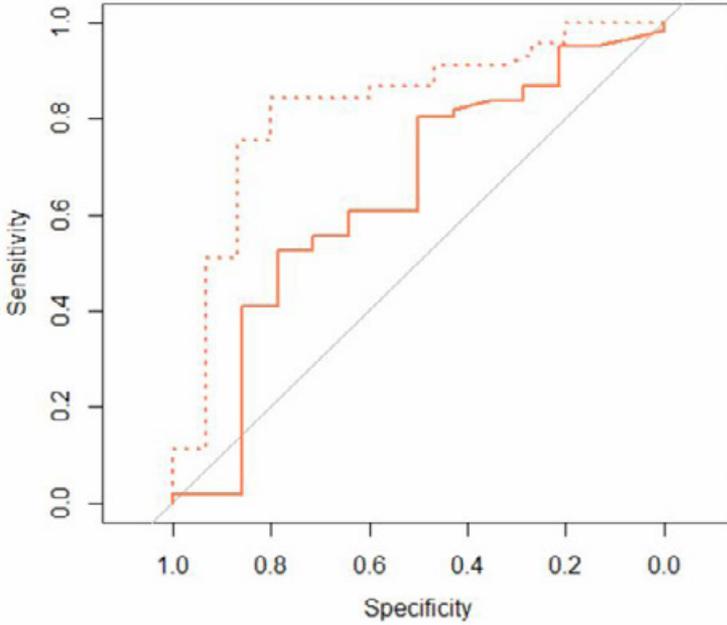
Methods: We identified all prenatally diagnosed CDH at our fetal center that had both MRI and U/S measurements. Using lung volume ratios of right-left 55:45, we calculated O/E CLV from O/E TLV. We used an area under the ROC curve (AUC) to compare the predictive accuracy of O/E CLV to O/E LHR for the need for ECMO support, as well as survival to both discharge and 1-year.

Results: Seventy-four patients had complete prenatal imaging, with 39% requiring ECMO support. The median O/E CLV was 48.0 and the median O/E LHR was 42.3. O/E CLV was a better predictor of the need for ECMO support (AUC 0.81 vs. 0.74). O/E CLV was a better predictor of survival to discharge (AUC 0.84 vs. 0.64, shown in figure 1) and one-year survival (AUC 0.83 vs. 0.63).

Conclusion: O/E LHR is a well-validated standard for predicting outcomes and guiding prenatal counseling in CDH. We provide evidence that MRI measurements of the contralateral lung volume corrected for gestational age are superior at predicting the need for ECMO and survival. We intend to validate these results using larger multi-institutional collaborative databases.

Presented in the Fetal Committee Education Session
 (continued)

Figure 1. Area under the ROC curve (AUC) for Predicting Survival to Discharge in CDH



Dotted line = O/E CLV on MRI
 Solid line = O/E LHR on US

Presented in the Fetal Committee Education Session

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EVALUATION OF PRENATAL ULTRASOUND FINDINGS IN NEONATES WITH CLOSING VERSUS NON-CLOSING GASTROSCHISIS

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Purpose: Fetuses at risk for closing gastroschisis may benefit from earlier delivery or advanced surgical planning. No current guidelines exist for prenatal detection of development of this severe form of gastroschisis. We aimed to evaluate prenatal ultrasound findings of fetuses with gastroschisis to identify indicators of closing gastroschisis risk.

Methods: We conducted a case-control study of neonates with closing gastroschisis at a single institution. Closing gastroschisis patients were matched with non-closing gastroschisis patients based on year of delivery and estimated gestational age at delivery. A blinded Maternal-Fetal Medicine physician reviewed prenatal ultrasound images from 16 weeks gestation and collected measurements including: extruded bowel volume(EBV), abdominal defect diameter, head circumference(HC), and abdominal circumference(AC). Statistical analysis was performed using Pearson and Fisher's exact tests, as appropriate.

Results: We identified a total of 163 patients with gastroschisis over a 16 year period, including eleven(6.7%) with closing gastroschisis. These were matched with 22 patients with non-closing gastroschisis. For these 33 cases, 201 ultrasound exams were used for measurements from available images. In the closing gastroschisis group, 6/7(85.7%) of patients had abdominal defect measurements <8mm beyond 30 weeks, compared to 2/36(5.5%) in 21 measurements from the non-closing gastroschisis group. Additionally, significantly more fetuses in the closing gastroschisis group demonstrated progressive narrowing of the abdominal wall defect during pregnancy(5/11, 45%) compared to those without closing gastroschisis(2/22, 9%), $p=0.027$. No differences were seen between the groups with respect to EBV and AC even when adjusted by HC.

Conclusions: Identifying prenatal predictors of closing gastroschisis is challenging given the rarity of this diagnosis and lack of standard prenatal ultrasound assessment. Our data suggest that decreasing defect size and an absolute measurement <8 mm may portend compromise of extracorporeal bowel. Further studies are needed with prospective image goals to better inform the perinatal plan to prevent an intraabdominal catastrophe.

Presented in the Fetal Committee Education Session

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PREDICTION ACCURACY OF FETAL MAGNETIC RESONANCE IMAGING FOR ANORECTAL MALFORMATIONS AND BOWEL OBSTRUCTIONS

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Purpose: As evolving imaging techniques improve visualization of the developing gastrointestinal tract, magnetic resonance imaging (MRI) is being increasingly used for prenatal diagnosis of anorectal malformations (ARM) and bowel obstruction (BO). We evaluated the prediction accuracy of fetal MRI at our institution to allow for more precise guidance in parental counseling.

Methods: All patients diagnosed with ARM or BO with fetal MRI on record were reviewed from 2004 to 2017. Patients with incomplete records or follow-up were excluded, leaving 102 patients for analysis. Prediction accuracy was defined as postnatal confirmation of fetal MRI-predicted diagnosis.

Results: Of the 102 patients evaluated, 29 were diagnosed postnatally with BO (28%), 40 with ARM (39%), and 15 with both (15%). Average age at birth was 35.9 +/- 3.2 weeks; 65% were female. Prenatal MRI had high accuracy in patients with ARM (Sn=87%, Sp=89%, PPV=87%, NPV=89%). In subgroup analysis, diagnostic accuracy was highest in cloacal exstrophy, with a moderate rate of false positives in our patient population (Sn=100%, Sp=98%, NPV=85%, PPV=85%). MRI sensitivity was lowest among ARM patients with isolated fistula (10%), while remaining highly specific (99%) with an acceptable NPV (82%). MRI accuracy was slightly lower in patients with BO (Sn=85%, Sp =68%, NPV=76%, PPV=79%). In subgroup analysis, diagnostic accuracy was highest in duodenal atresia (Sn=100%, Sp=99%, PPV=90%, NPV=100%).

Conclusions: Fetal MRI shows promise as a prenatal diagnostic tool for colorectal disease, with relatively high accuracy for both ARM and BO. Guided by this data, counseling for parents can be offered with confidence in our patient population.

Presented in the Jay and Margie Grosfeld Scientific Session on Stem Cells and Tissue Engineering

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THE FIBROGENIC INJURY OF LIVER DUCTAL ORGANIDS IS RESCUED BY HUMAN AMNIOTIC FLUID STEM CELLS

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Purpose: Liver fibrosis is a wound healing process resulting from chronic liver injury. This process can lead to liver cirrhosis, which may require liver transplantation. Damaged hepatocytes as well as cholangiocytes play a role in liver fibrogenesis. Human amniotic fluid stem cells (hAFSCs) are pluripotent cells which have potential to repair injured tissue and stimulate tissue regeneration. We aimed to investigate whether hAFSCs have anti-fibrogenic effect in an injury model of liver ductal organoids.

Methods: Following ethical approval (#47780), liver ductal organoids were generated from the liver of healthy postnatal day 9 C57BL/6 mice. These organoids composed of cholangiocytes which can differentiate into functional hepatocytes. hAFSCs were co-cultured with liver ductal organoids in Matrigel for 4 days before injury induction. The injury model was induced by administration of acetaminophen in culture medium for 24 hours. mRNA expressions of fibrogenic cytokines and proliferation marker were analyzed by RT-qPCR. Data were compared using one-way ANOVA.

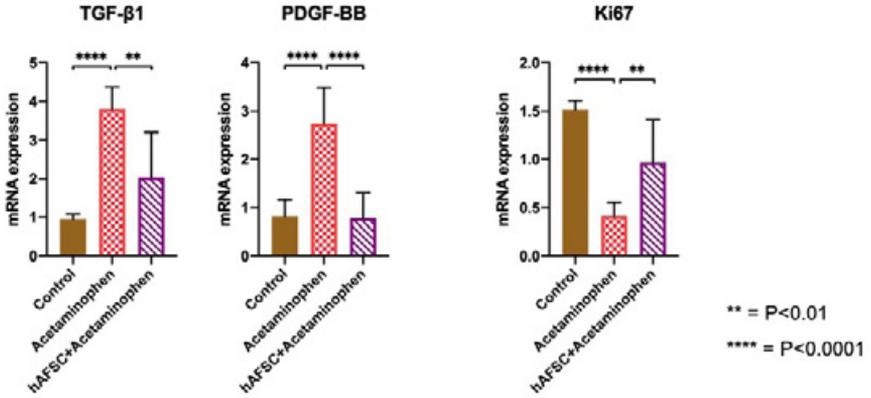
Results: Acetaminophen induced injury in liver ductal organoids by increasing the expression of transforming growth factor beta-1 (TGF- β 1) and platelet-derived growth factor-BB (PDGF-BB) (Fig. A), the potent cytokines that play role in stimulation of liver fibrogenesis. This process was prevented by hAFSCs. Moreover, proliferation marker Ki67 was decreased in damaged ductal liver organoids while hAFSCs increased proliferation (Fig. B).

Conclusion: In liver ductal organoids, damaged cholangiocytes play a role in fibrogenesis by secreting fibrogenic cytokines. Administration of hAFSCs decreases fibrogenic cytokines and increase proliferation of damaged organoids. hAFSC have important therapeutic potentials for the treatment of liver fibrosis in diseases that involve bile duct injury such as biliary atresia.

Presented in the Jay and Margie Grosfeld Scientific Session on Stem Cells and Tissue Engineering
(continued)

A) Fibrogenic cytokines

B) Proliferation



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COMPARISON OF MESENCHYMAL STEM CELLS FROM PEDIATRIC NORMAL AND ESOPHAGEAL ATRESIA PATIENTS FOR USE IN REGENERATIVE MEDICINE

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Introduction: Esophageal Atresia (EA) is a congenital defect and current procedures to bring together long gaps have high morbidity. If replacement tissue is needed, it does not possess the same physiologic properties as the esophagus. Our group recently published on the successful regeneration of an esophagus using a retrievable scaffold seeded with adipose derived mesenchymal stem cells (AD-MSK) in a porcine model. The goal of this study was to evaluate phenotypic differences between patient derived AD-MSKs from normal (N), Tracheoesophageal fistula (TEF) and EA patients to determine if they could be used for translational tissue engineering approaches.

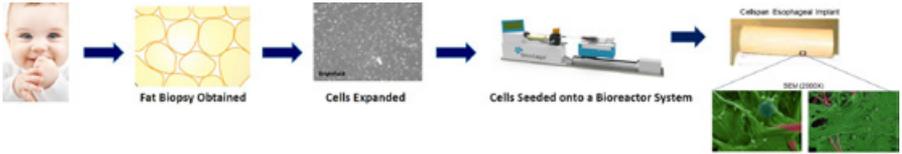
Methods: Informed consent was obtained from parents and subcutaneous fat was removed from 8 patients (IRB# 17-188). Normal patients were 14-18 years old undergoing bariatric surgery, while TEF/EA patients were less than 30 days of age. Cells were isolated, expanded and characterized by flow cytometry and qRT-PCR. Following expansion, cells were seeded onto a commercially manufactured nanofiber scaffold by (Biostage) and incubated for 6 days with rotation. Seeded scaffolds were harvested at Day 6 for viability, gene expression and growth factor analysis.

Results: Cells from all patients expressed mesenchymal stem cell markers. Cells from TEF/EA had robust growth compared to growth kinetics of N. All cells were viable over 6 days on the synthetic scaffold. There was a significant difference in IL6 production between N and TEF/EA patients.

Conclusions: In conclusion, the phenotype of AD-MSKs is similar between groups. It is expected that neonatal cells will grow faster compared to stem cells from teenagers. Increased levels of IL6 in adipocytes and in serum of obese patients have been described and this could explain the differences seen in our study. This study demonstrates the feasibility of utilizing autologous AD-MSKs from TEF and EA patients for tissue engineering. This is the first step demonstrating translational potential in esophageal tissue engineering.

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(continued)



Presented in the Jay and Margie Grosfeld Scientific Session on Stem Cells and Tissue Engineering

(continued)

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MESENTERIC NEOVASCULARIZATION DURING SPRING-MEDIATED INTESTINAL LENGTHENING

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Background: Short gut syndrome is a condition characterized by inadequate absorption of nutrients due to decreased bowel length which has minimal avenues for treatment. We have proposed the use of spring-mediated distraction enterogenesis, the process of applying a mechanical force in order to lengthen bowel, as a treatment of short gut, as we have observed significant lengthening in porcine jejunum with intraluminal springs. We aim to evaluate the extent of mesenteric neovascularization in segments of lengthened bowel via spring-mediated enterogenesis.

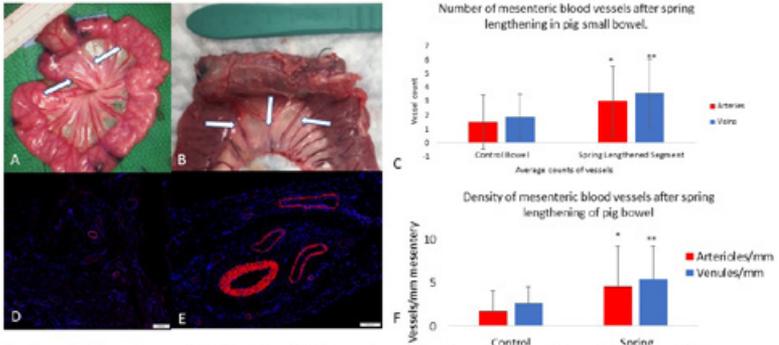
Methods: Female juvenile Yucatan pigs underwent laparotomy and insertion of gelatin encapsulated compressed nitinol springs into the lumen of the jejunum. These were held in place with proximal and distal plication sutures. At surgery and time of sacrifice, macroscopic mesenteric blood vessels were counted between the plication stitches. Microscopic vasculature was then analyzed within this mesentery after obtaining formalin-fixation, paraffin-embedded sections, staining for hematoxylin and eosin, smooth-muscle actin (SMA, Abcam, Cambridge, UK) and DAPI. Student's t-test was used to determine statistical significance at $p < 0.05$.

Results: The number of macroscopic mesenteric vessels prior to the spring being inserted and at time of sacrifice was significantly different (mean \pm SD: before spring: 2.3 ± 0.49 vessels, after lengthening: 4.6 ± 1.1 vessels, $p = 0.004$) with an increase in mesenteric blood vessels seen. A statistical significance is also seen in the density of arterioles (control 2 ± 2 vessels/mm; spring 5 ± 5 vessels/mm, $p = 0.02$) and venules (control 3 ± 2 vessels/mm; spring 5 ± 4 , $p = 0.004$) at time of sacrifice.

Discussion: Intestinal segments lengthened by intraluminal springs demonstrated a total greater number of macroscopic vessels and increased microscopic blood vessels per length of mesentery as compared to control. This suggests local changes within the mesentery to recruit blood supply to growing intestine. Future study may elucidate length-dependent or time-dependent vessel density.

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(continued)



- A. Segment of jejjunum from porcine intestine at time of initial surgery demonstrating 2 macroscopic mesenteric vessels (white arrows) within the plication sutures.
- B. Segment of jejjunum for porcine intestine at time of sac demonstrating 3 macroscopic mesenteric vessels within the plication sutures (white arrows).
- C. Statistical significance in the number of mesenteric vessels at time of sac for arterioles (mean±SD: control 2±1.96 vessels, spring 3±2.50 vessels, *p<0.023) and venules (control 2±1.61 vessels, spring 4±2.44 vessels, **p<0.004)
- D. SMA immunohistochemistry of bowel mesentery at time of surgery, demonstrating 2 microscopic mesenteric vessels.
- E. SMA immunohistochemistry of bowel mesentery at time of sac, demonstrating 4 microscopic mesenteric vessels.
- F. Statistical significance in density of mesenteric blood vessels at time of sac for arterioles (control 2±2 vessels/mm, spring 5±5 vessels/mm, *p<0.016) and venules (control 3±2 vessels/mm, spring 5±4 vessels/mm, **p<0.0047)

Presented in the Trauma Committee Educational Session

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SURGEON CHOICE IN MANAGEMENT OF PEDIATRIC ABDOMINAL TRAUMA

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Purpose: To determine factors contributing to surgeons' management choices of hemodynamically stable children with suspected non-solid organ abdominal injury.

Methods: Surgeon members of the Eastern Association for the Surgery of Trauma completed a survey on their practices for 3 pediatric blunt abdominal injury scenarios: (1) isolated injury, (2) with severe multisystem injury, and (3) with severe traumatic brain injury (TBI); and a penetrating abdominal injury scenario. Multivariable logistic regression was used to determine factors associated with initial management choice of observation vs. operation, and if operative, laparoscopy vs. laparotomy for blunt injury and observation vs. local wound exploration vs. laparoscopy for penetrating injury.

Results: Of 174 participating surgeons (response rate 15.7%), 16% were pediatric surgeons and median years in practice was 20 (IQR:11-24) for pediatric surgeons and 10 (IQR:11-24) for trauma surgeons. For scenarios 1-3, 40%, 57%, and 71% of surgeons chose operation over observation, respectively. Compared to patients with isolated blunt abdominal trauma, surgeons were more likely to choose operation over observation for patients with multisystem injury and severe TBI (Table). Pediatric surgeons were less likely to choose operation over observation. Of surgeons who chose operation for patients with blunt trauma, 35-46% chose laparotomy over laparoscopy and they were more likely to choose laparotomy for patients with multisystem injury or severe TBI. For patients with penetrating injury, 43%, 31%, and 26% of surgeons chose observation, local wound exploration, and laparoscopy, respectively and surgeon type, years in practice, and facility level were not associated with management choice.

Conclusions: There is large variation in surgeon management choice of hemodynamically stable children with non-solid organ abdominal injury. Although patient injury characteristics account for some variation, surgeon factors, such as type of surgeon also play a role. Evidence-based national practice guidelines should be developed to standardize care of this group of patients.

Presented in the Trauma Committee Educational Session

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DEFINING THROMBOELASTOGRAPHY ABNORMALITIES IN PEDIATRIC TRAUMA PATIENTS WHO REQUIRE MASSIVE TRANSFUSION

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Introduction: Ongoing hemorrhage is the leading cause of preventable deaths in pediatric trauma patients. In adults, goal-directed thrombelastography (TEG) was shown to reduce mortality when guiding massive transfusion (MT) resuscitation. There remains a paucity of data on the utility of TEG in directing resuscitation of pediatric trauma patients. We hypothesize that abnormalities on admission TEG will differ in pediatric trauma patients requiring MT compared to those who will not.

Methods: We identified highest level trauma activations in pediatric trauma patients (40 cc/kg total blood product within 6 hours of admission) versus those who did not. We defined TEG abnormalities based on each institution's normative values and compared TEG abnormalities between the groups.

Results: Of 118 children included, 40 had MT. MT patients had significantly shortened alpha angle (35.0% vs. 18.7%, $p=0.02$), maximum amplitude (42.5% vs. 10%, $p=0.0005$), and significantly lower platelet counts compared to those who did not receive MT. There was no difference in R-time, LY30 (lysis or shutdown), or fibrinogen between the groups. MT patients had higher ISS (30 vs. 23, $p=0.0004$), lactates (6.8 vs. 3.5, $p=0.001$), base deficits (-12.3 vs. -5.7, $p<0.0001$), and INR (1.8 vs. 1.3, $p<0.0001$).

Conclusions: Pediatric trauma patients who require MT are more likely to have lower alpha angles and MA values in addition to lower platelet counts. This suggests need for increased TEG use in hemorrhaging pediatric trauma due to prevalence of low fibrinogen and abnormal platelet function. TEG provides real-time information, unlike conventional coagulation labs which can take one hour to result. Thus, TEG can aid in expediting delivery of blood products beyond RBC and plasma during trauma resuscitation.

Presented in the Trauma Committee Educational Session

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CAN WE INCREASE DETECTION? A NATIONWIDE ANALYSIS OF AGE-RELATED FRACTURES IN CHILD ABUSE

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Purpose: Child abuse, a clandestine crisis, often goes undetected by healthcare professionals. The aim of this study was to stratify fractures associated with child abuse in relation to the child victim's age.

Methods: The Kids' Inpatient Database (1997-2012) was queried for all pediatric patients (<18 years) with a diagnosis of fractures due to child abuse (via ICD-9 codes for physical abuse, shaken baby syndrome, emotional/psychological abuse, sexual abuse, neglect, other abuse and related fractures). The primary outcome was age-related determinants of fracture distribution. 2 analysis was used for statistical analysis where appropriate with significance set at $p < 0.05$.

Results: Over 39,000 children were admitted for child abuse, with 26% sustaining fractures. Most were < 1 year of age (median age 0 years [0-1]), 58% male, and almost half the cohort was Caucasian. The overall mortality rate was 4%. 28% sustained multiple fractures while the other 72% sustained only one fracture, the most common being closed skull fractures (27%). Via age stratification, the youngest patients (<1 year) had the highest rate of multiple fractures (33% vs 16% 1-4 years, $p < 0.001$), and also had the highest rate of closed skull fractures (33% vs 21% ages 1-4) while teenage patients were more likely to sustain facial fractures (43% vs 11% ages 9-12), all $p < 0.001$. Multiple rib fractures were more commonly seen in the youngest patients (28% vs 8% ages 1-4) while small children (5-8 years) had the highest rates of clavicular fractures (7% vs 3% in youngest), all $p < 0.001$.

Conclusion: Certain fracture patterns seem to be related to the child's age at time of abuse, which is likely associated with changing mechanism of abuse as a child grows. These age-related fracture patterns can help aid in healthcare detection of child abuse in hopes to thwart further abuse

POSTERS

P1

ATTITUDE AND PRACTICE IMPACT OF THE FDA WARNING ON GENERAL ANESTHETIC USE IN CHILDREN ON APSA MEMBERS

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Purpose: The core mission of the American pediatric surgical association (APSA) is to promote the safe delivery of surgical care to children. In December 2016 the FDA released a communication cautioning parents regarding negative impacts of anesthesia in children younger than age 2. Given the broad implications of such a statement we desired to survey the APSA membership regarding their practice and stance on the issue.

Methods: A twelve question survey was distributed to the APSA membership. Responses were collected through SurveyMonkey®.

Results: We received a total of 299 responses with 290 complete surveys. More than 95% of respondents agree that APSA should have a greater representation in the national discussion of surgical and anesthetic safety. Greater than 90% of respondents discuss the FDA communication with patients at some point before elective surgery; however, the majority (92%) think the data behind the FDA communication is either inadequate (58%) or are unsure of it (34%) with about 50% of responders viewing the communication neutrally and 35% viewing it negatively. Approximately 95% of responders discuss neurocognitive impacts of anesthesia at least some to most of the time and the majority (71%) have changed an operative plan for a child due to anesthetic related concerns. Only 15% of responders believed anesthetic exposure in small children has no deleterious effect on neurocognition with 59% being unsure and 25% believe it is detrimental.

Conclusion: We believe this survey highlights the need for further engagement of APSA in the discussion of neurocognitive effects of anesthetics.

POSTERS

P2

EPIDEMIOLOGY OF PEDIATRIC SURGICAL CONDITIONS IN REFUGEE CHILDREN RESETTLED IN SOUTHERN CONNECTICUT

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Purpose: Reports from Middle Eastern conflict areas and surveys of refugees arriving in Germany have highlighted increased pediatric surgical burden in refugees. However, surgical conditions and barriers to access in refugee children after resettlement in the United States remain largely understudied. Here, we investigated population characteristics and surgical needs of refugee children in Southern Connecticut.

Methods: A retrospective review within a single hospital-network between 09/01/2008- 09/27/2019 identified children aged<18-years from known refugee families or with refugee identity documented in health-encounters. Demographics, diagnoses, and encounters were analyzed and compared between refugee children and all pediatric patients within network.

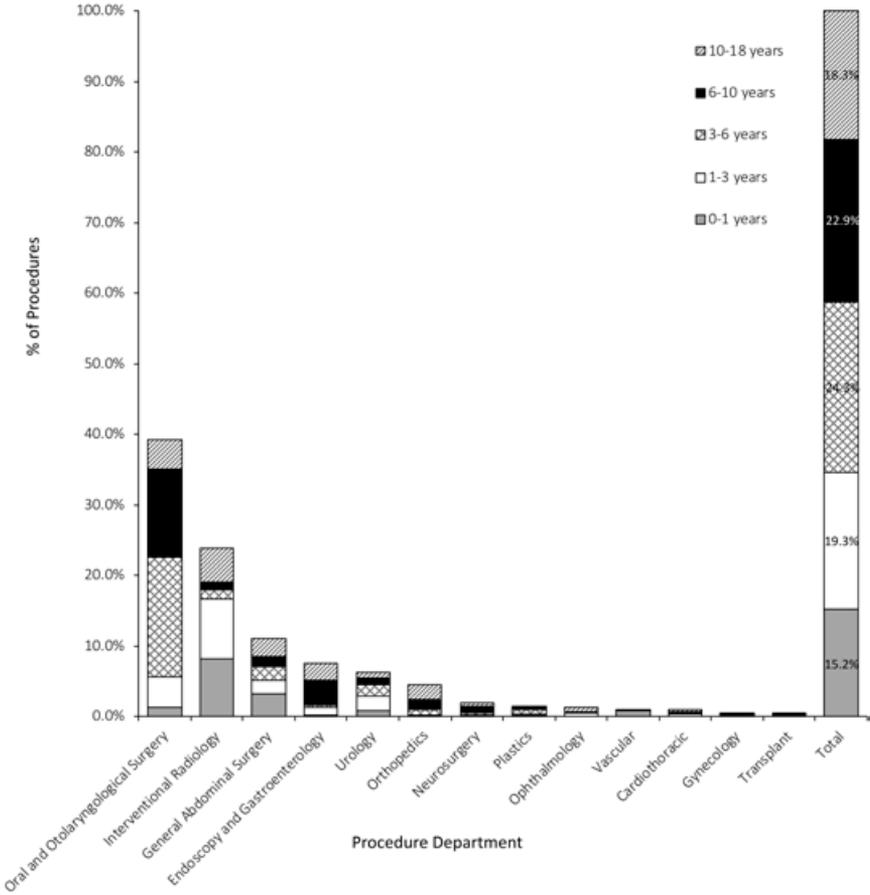
Results: 1211 refugee children were identified. 50.4% were female. Average age at first encounter was 6.1±5.1 years, with 270 (22.3%) aged<12-months. 868 (71.7%) were Middle Eastern. 1837/22134 (8.3%) admissions were for surgical conditions regardless of intervention in refugees and 8877/500121 (1.8%) in all children ($p<0.001$). 10/132 (10.0%) of infants born within network to refugee parents required neonatal intensive care and 2/10 required procedures; 3041/30536 (10.0%) of all newborns within network required neonatal intensive care with 421/3041 undergoing procedures (13.8%). 257 (21.2%) refugees and 4931 (0.99%) of all children underwent at least one operation ($p<0.001$). Of 458 total operations in refugees, oral/otolaryngologic surgeries were most common, followed by interventional radiology and general surgical procedures (Figure). Almost half (206/458, 45.0%) required a hospital-admission, with an average 8.5-day stay (0-175 days). Within a year after surgery, refugee families cancelled 1359/4834 (28.1%) follow-up appointments and never arrived at 533 (11.0%).

Conclusion: Within our Southern Connecticut hospital-network, refugee children require more surgical admissions and undergo more procedures than the general pediatric population. This underscores a role for increased screening of refugee families for disease burden and a need for research on their surgery-specific barriers to access, especially in sanctuary cities such as New Haven with more frequent resettlement.

POSTERS

P2 (continued)

Figure. Distribution of Procedures in Refugee Children by Age and Department



POSTERS

P3

ALARMING TRENDS IN PEDIATRIC DEATH RATES

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In the US motor vehicle fatalities have remained the number one cause of death in adolescents age 10-19. Public policy initiatives, technological developments, and advances in trauma care resulted in a decline in MVC-related fatalities. Recently, young adult and adolescent suicide has become more prevalent. In the state of Tennessee in 2017, suicide deaths surpassed MVC deaths in those 10-17. We proposed that evaluation of a national sample would reveal a similar trend.

The CDC Web-Based Injury Statistics Query and Reporting System of all fatal injuries was queried regarding MVC and suicide fatalities among children ages 0-19 to evaluate national trends. The fatality rate for this 10-19 age group was considered from 1981-2017 using Joinpoint statistical analysis. Suicide mechanism was gathered to better understand the impact of gun violence.

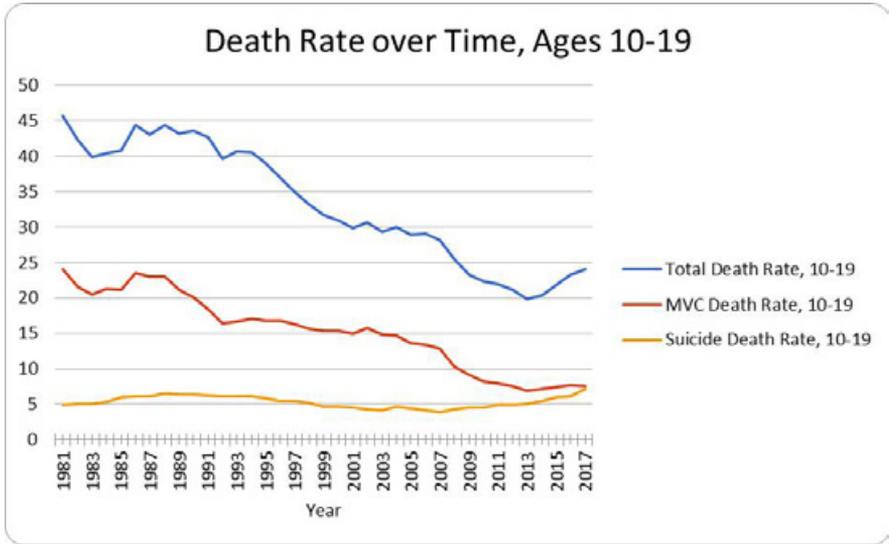
MVC fatalities declined significantly while suicide deaths increased from 1981 to 2017. The overall death rate in this group decreased until 2013 and has increased since with significant positive trend of +0.73 deaths/100,000/yr*. Up to 2010, the MVC death rate among this age group declined significantly from -0.12 to -1.19 deaths/100000/year* and has remained stable while the number of vehicle miles traveled has increased. Trends in suicide death rate varied until 2007 which saw an ongoing significant increase of +0.98 deaths/100000/year.*

We conclude that adolescent MVC death rates have declined significantly over time while suicide death rates have continued to increase since 2007 in the same age group. If similar trends continue, suicide will become the leading cause of death in this age group nationally. The State of Tennessee has used this data as a call to action to improve pediatric trauma systems, access to adolescent mental health care, and state-level policy to combat this alarming trend.

(* denotes $p < 0.05$)

POSTERS

P3 (continued)



POSTERS

P4

HUMAN BREAST MILK PROTECTS AGAINST NECROTIZING ENTEROCOLITIS THROUGH REDUCED TLR4 EXPRESSION IN THE INTESTINAL EPITHELIUM IN A “NEC IN A DISH” MOUSE ENTEROID MODEL

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Introduction: Necrotizing enterocolitis (NEC) is the leading cause of death from gastrointestinal disease in premature infants and is characterized by exuberant TLR4 signaling in the premature intestinal epithelium. Breast milk is protective against NEC, but the underlying mechanisms for this protection remain unknown, and the role of breast milk on the intestinal mucosa versus peripheral cells remains unknown. To study the effect of breast milk on the intestinal epithelium in NEC directly, we developed a novel ex-vivo model of the disease, termed “NEC in a Dish”, utilizing intestinal enteroids incubated with stool bacteria from NEC patients. We now hypothesize that breast milk protects against NEC specifically through its effects on the intestinal epithelium and seek to discover the mechanisms involved.

Methods: Enteroids derived from primary stem cells of neonatal mouse intestines were subjected to the “NEC in a Dish” model which includes treatment with NEC bacteria and periods of hypoxia. To determine the effects of breast milk on the intestinal epithelium in NEC, enteroids were either subjected to NEC (eNEC, n=6) alone, or with the addition of 50uL of human breast milk (eNEC+BM, n=6). Control enteroids (eCTRL) were grown in standard media. Model severity was evaluated by structural integrity, PI staining, and gene expression of TNFa by qRT-PCR.

Results: eNEC enteroids showed structural damage and increased PI staining indicating cell death, and significantly elevated expression of TNFa (eNEC: 7.14, eCTRL: 1.47, p<0.05). In contrast, treatment with breast milk restored structural integrity and decreased PI staining, and reduced TNFa levels (eNEC+BM: 3.2, p<0.05). In seeking the mechanism involved, breast milk treatment significantly reduced expression of TLR4 in enteroids subjected to NEC (eNEC: 34.8, eNEC+BM: 27.0, p<0.05).

Conclusion: This study suggests that human breast milk protects against NEC through a TLR4 dependent pathway directly on intestinal epithelium, thus establishing a novel discovery platform for this devastating disease.

POSTERS

P5

BIFIDOBACTERIUM INFANTIS IS AN EFFECTIVE PROBIOTIC TO DECREASE NECROTIZING ENTEROCOLITIS IN AN ANIMAL MODEL

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Purpose: Necrotizing enterocolitis (NEC) is a gastrointestinal disorder in preterm infants characterized by transmural inflammation and necrosis of the intestines. Immunological deficiencies, enteral feeding, and microbial overgrowth have been implicated in the pathogenesis. Protective organisms such as Bifidobacterium species are less prevalent in gastrointestinal tracts of preterm infants when compared to term infants. We hypothesize that diets containing bifidobacterium will decrease the incidence of necrotizing enterocolitis in our animal model.

Methods: We conducted a randomized control trial using our previously published animal model. Preterm rabbit pups were delivered two days before the due date and assigned to the control group (*Enterobacter cloacae* (10³ cfu/ml diet) or the experimental group (*Enterobacter cloacae* plus *Bifidobacterium infantis* (10⁸ cfu/ml diet). All animals received Ranitidine (20mg/kg) and Indomethacin (0.5mg/kg) daily and had anal plugs placed on day one that were reapplied as necessary. Animals were sacrificed on day five and specimens were graded by a pathologist blinded to both groups (Grade 1-loss of villus tips to Grade 4-transmural necrosis). Statistical analysis was performed using Fisher's exact test and considered significant if $p < 0.05$.

Results: A total of 72 rabbits were included in the study with 35 in the control group and 37 in the experimental group. 26 out of 35 rabbits in the control group had graded NEC vs 18 out of 37 in the experimental group (74.3% vs 48.6%, $p=0.03$). Of those with graded NEC, there were 21 out of 26 with Grade 2/3 in the control group and 10 out of 18 in the experimental group (80.8% vs 55.6%, $p=0.09$). No rabbits had Grade 4 NEC.

Conclusions: Diets containing bifidobacterium significantly decreased the incidence of necrotizing enterocolitis in our animal model. There was also a trend towards less severe disease in the rabbits in the experimental group.

POSTERS

P7

THE VEGF HEPARIN-BINDING DOMAIN IS REQUIRED FOR ACCELERATED COMPENSATORY LUNG GROWTH AFTER LEFT PNEUMONECTOMY

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Purpose: Neonates with hypoplastic lung diseases may be deficient in vascular endothelial growth factor (VEGF). We previously established that VEGF164 (mouse; human VEGF165) enhances compensatory lung growth, rendering it a promising therapy for pulmonary hypoplasia. In moving towards clinical trials, we further investigate the properties of VEGF164 by utilizing VEGF120 (mouse; human VEGF121), which lacks a heparin-binding domain (HBD), postulating that the pro-angiogenic effects of VEGF are dependent on the HBD.

Methods: Human microvascular lung endothelial cells (HMVEC-L) were treated with VEGF121 or VEGF165. VEGFR2 activation was determined by immunoblot. Eight-week old C57Bl/6J mice underwent left pneumonectomy, followed by daily intraperitoneal injections of saline control, 0.25mg/kg or 0.5mg/kg VEGF164, or equimolar doses of VEGF120. On post-operative day four, mice underwent pulmonary function testing and lung harvest for volume measurement and histology. Morphometric analysis assessed parenchymal volume, alveolar volume, septal surface area, and mean septal thickness. Ki-67 index via immunofluorescence staining quantitated pulmonary cell proliferation.

Results: VEGF121 treatment activated VEGFR2 in HMVEC-L in a dose dependent manner, but less potently than VEGF165. Compared to controls, VEGF164 treatment increased lung volume in a dose dependent manner, which was statistically significant at the 0.5mg/kg dose (0.039 vs. 0.047; $p=0.002$), and roughly correlated with total lung capacity. VEGF120 treatment demonstrated dose dependent increases in lung volume and total lung capacity, although these were not statistically significant. 0.5mg/kg VEGF164 increased parenchymal volume (0.037mL/g vs. 0.046mL/g; $p=0.009$), alveolar volume (0.015mL/g vs. 0.019mL/g; $p=0.01$), and septal surface area (20.7cm²/g vs. 28.7cm²/g; $p=0.003$) compared to controls, effects not observed with VEGF120. Pulmonary cell proliferation was similar between VEGF120-treated mice versus controls, but higher in VEGF164-treated mice (31.3% vs. 23.0%; $p=0.09$).

Conclusion: The VEGF heparin-binding domain contributes to potency of endothelial VEGFR2 activation and is required for accelerated compensatory lung growth. Therefore, non-heparin-binding isoforms of VEGF cannot be used as treatment in pulmonary hypoplasia.

POSTERS

P7 (continued)

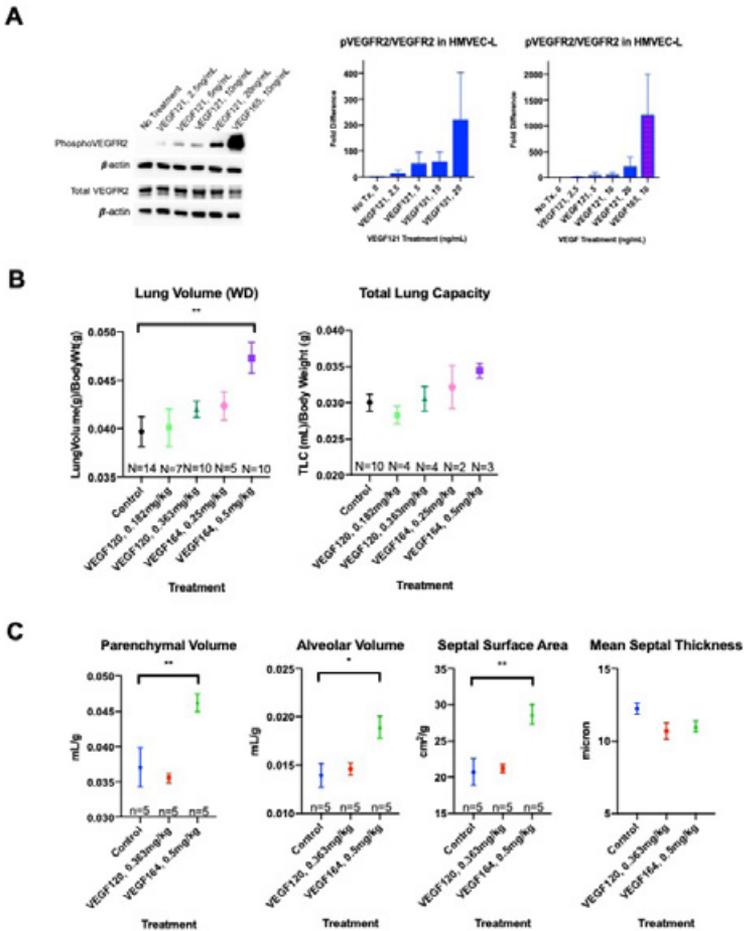


Figure 1. The heparin-binding domain of VEGF is required for accelerated compensatory lung growth after left pneumonectomy.

A. VEGF121 stimulates activation of VEGFR2 in human lung microvascular endothelial cells (HMVEC-L) in a dose dependent manner, but less potently than VEGF165. **B.** VEGF120 and VEGF164 stimulate increased lung volume and total lung capacity after left pneumonectomy in a dose dependent manner, although only lung volume with treatment of 0.5mg/kg VEGF164 reached statistical significance. **C.** Morphometric analysis demonstrates that treatment with 0.5mg/kg VEGF164 significantly increased parenchymal volume, alveolar volume and septal surface area, without changing mean septal thickness, compared to controls. These effects were not observed with VEGF120 treatment. Results are expressed as mean \pm SEM. * p \leq 0.05; ** p \leq 0.01

POSTERS

P9

FIRST REPORT OF THE LONG TERM SURVIVAL OF A FETAL LAMB WITH MYELOMENINGOCELE REPAIRED IN UTERO WITH PLACENTAL MESENCHYMAL STROMAL CELLS

Laura A. Galganski, MD, **Kaeli Yamashiro, DO**, Sarah C. Stokes, MD, Christina M. Theodorou, MD, Priyadarsini Kumar, PhD, Christopher D. Pivetti, MS, Aijun Wang, PhD, Diana L. Farmer, MD

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Purpose: The long term outcomes of the in utero myelomeningocele (MMC) repair augmented with placental mesenchymal stromal cells (PMSCs) in the ovine MMC model are unknown largely due to difficulty maintaining MMC lambs after birth. This study aimed to survive a lamb with MMC repaired in utero with PMSCs for 6 months to determine the long term motor, bowel and bladder function outcomes.

Methods: The MMC lamb underwent in utero MMC repair with PMSCs, was survived for 6 months with bracing and physical therapy, and compared to age-matched normal lambs as untreated MMC lambs cannot survive long term. Motor, bowel and bladder assessments occurred weekly for 2 months, then bi-weekly until 6 months, which consisted of sheep locomotor rating (SLR), Bristol Stool Scale characterization, post-void residual (PVR) per kg and posturing while voiding. Comparison of rectal cross-sectional areas occurred monthly with barium enemas. Data were analyzed with a two-way analysis of variance comparing 1 MMC lamb to 4 normal lambs up to 3 months, then to 1 normal lamb from 3 months to 6 months because 3 of the normal lambs are only 3 months old.

Results: There was no difference between the MMC lamb and normal lambs' motor function, with all scoring 15 on the SLR at each timepoint ($p>0.99$). The MMC lamb and normal lambs had no difference in bowel function with the same Bristol Stool Scale characterization ($p>0.99$) and similar rectal cross-sectional areas at each timepoint ($p=0.61$). There was no difference between the groups' bladder function with similar PVR per kg ($p=0.21$, Figure 1) and all lambs postured while voiding at each timepoint ($p>0.99$).

Conclusion: For the first time, an MMC lamb repaired in utero with PMSCs was survived for 6 months. Motor, bowel and bladder function in the MMC lamb is not different than age-matched normal lambs up to 6 months.

POSTERS

P9 (continued)

Post Void Residual per Kilogram

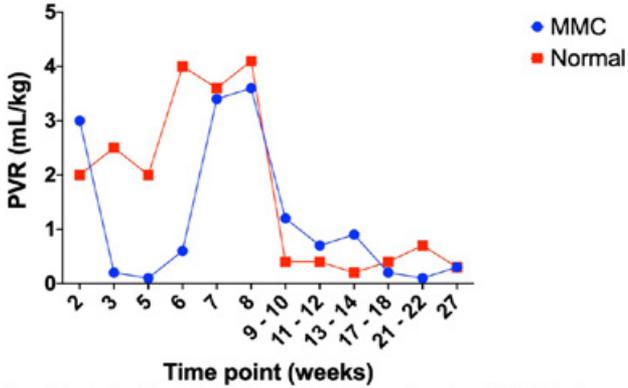


Figure 1. Post void residual (PVR) per kilogram (kg) of the myelomeningocele (MMC) and normal lambs. There were no differences in the MMC and normal lambs' PVR per kg over the 6 month period.

POSTERS

P10

A CHRONOLOGICAL ANALYSIS OF THE INTESTINAL MICROBIOME FOLLOWING MASSIVE SMALL BOWEL RESECTION

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Background: Intestinal microbiota play an important role in short bowel syndrome, contributing to serious complications including bacterial overgrowth and inflammation with increased risk of liver failure and sepsis. To evaluate how the amount of residual intestine affects dysbiosis, we performed a chronological analysis of the intestinal microbiome following massive small bowel resection (SBR).

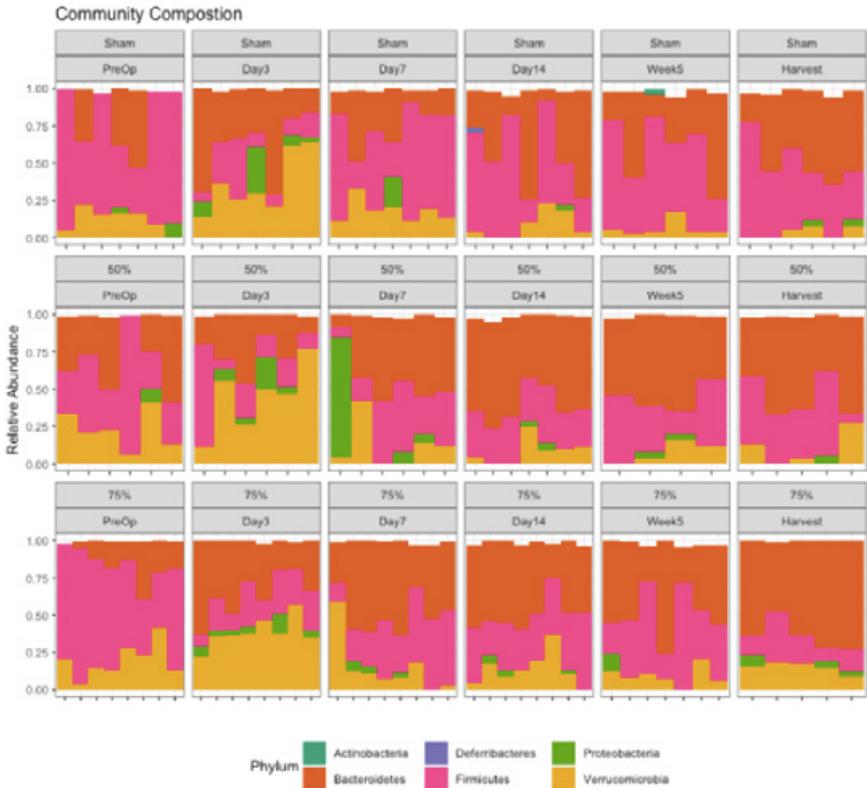
Methods: B6 mice underwent 50% or 75% proximal SBR or sham operation and were maintained on a liquid diet for 10 weeks and housed individually to eliminate cage effects. Fecal samples were collected preoperatively and on post-operative days 3, 7, 14, and weeks 5 and 10. Bacterial DNA was extracted from fecal pellets and 16S rRNA gene PCR amplification was performed using the Illumina MiSeq platform. Amplicon sequence variants (ASV) were selected using dada2. Alpha diversity (richness and Shannon index) and differential abundance were evaluated.

Results: At all time periods, the richness (number of taxa) remained stable with a mean greater than 200 with no significant difference between all 3 cohorts. Shannon diversity was only statistically significant between sham operation and 75% SBR (Kruskal-Wallis ANOVA, $p = 0.028$) at day 7. Samples with greater than $1e+3$ ASVs were selected for differential abundance testing ($n = 6-9/\text{group}$). Relative abundance plots demonstrated an increase in the phyla Bacteroidetes and Verrucromicobia and a decrease in Firmicutes in both SBR groups compared to sham at day 14. However, there were no significant differences between the 50% and 75% SBR groups (Fig 1).

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P10 (continued)

Conclusions: Following massive SBR, alterations in the diversity and bacterial abundance predominantly occur at early post-operative time points (days 7 and 14). There was no significant microbial differences observed between the 50% compared to the 75% SBR. This may emphasize the importance of the presence ileocecal valve in dysbiosis as well as the utility of intraluminal samples compared to fecal samples.



POSTERS

P12

HEPARIN IMPAIRS PULMONARY FUNCTION FOLLOWING UNILATERAL PNEUMONECTOMY

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Introduction: Newborns with severe hypoplastic lung disease often require extracorporeal membrane oxygenation (ECMO) and systemic anticoagulation, usually with heparin. Previous work in our lab has demonstrated that heparin inhibits compensatory lung growth (CLG) after left pneumonectomy. This inhibition was only partially rescued with VEGF, which has previously demonstrated to accelerate CLG. We investigate the role of heparin on pulmonary function and whether inhibition of CLG by heparin is able to be rescued with FG-4592, a prolyl hydroxylase inhibitor demonstrated to accelerate CLG.

Methods: Eight-week old mice underwent left pneumonectomy followed by twice daily intraperitoneal injections of normal saline (controls) or heparin. They also received twice daily gavage of a control vehicle or FG-4592. Exercise tolerance tests were performed two days prior to pneumonectomy and treatment (baseline) and on post-operative day four. Pulmonary function tests were also performed on post-operative day four. Following euthanization, the lungs were harvested for lung volume measurements.

Results: Compared to controls, heparin administration significantly decreased the percent change in time spent exercising (-54.5% vs. -16.9%, $P = 0.02$) and distance run (-66.0 vs. 19.8%, $P = 0.01$) after unilateral pneumonectomy from baseline. Heparin administration decreased lung volume determined by the water displacement method, although not significantly, compared to controls. FG-4592 treatment significantly and reliably increased lung volume (55.51 vs. 42.81 $\mu\text{L/g}$, $P = 0.01$) and inspiratory capacity (28.7 vs. 23.7 $\mu\text{L/g}$, $P = 0.008$) compared to heparin administration alone. However, attempted rescue therapy with FG-4592 was unable to salvage CLG from the inhibitory effects of heparin for either lung volume or inspiratory capacity.

Conclusions: Heparin administration significantly impairs pulmonary function following pneumonectomy. This inhibition is unable to be salvaged with FG-4592 therapy. As heparin is commonly used as systemic anticoagulation for newborns with hypoplastic lung disease on ECMO, it may be time to reconsider heparin as the first-line anticoagulant.

POSTERS

P12 (continued)

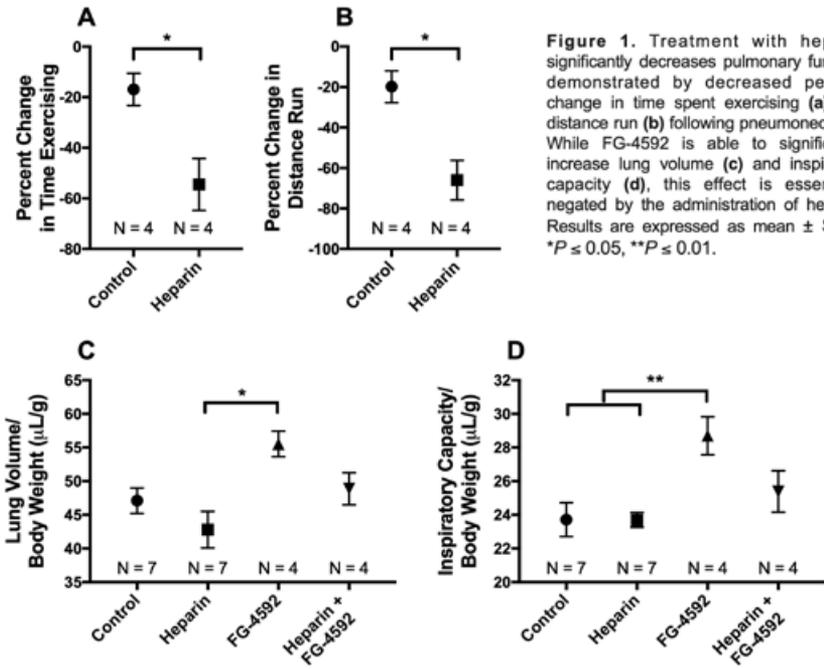


Figure 1. Treatment with heparin significantly decreases pulmonary function demonstrated by decreased percent change in time spent exercising (a) and distance run (b) following pneumectomy. While FG-4592 is able to significantly increase lung volume (c) and inspiratory capacity (d), this effect is essentially negated by the administration of heparin. Results are expressed as mean ± SEM. * $P \leq 0.05$, ** $P \leq 0.01$.

POSTERS

P13

ENTERAL ANTIBIOTICS PROMOTE PROLONGED SMALL INTESTINAL MUCOSAL GROWTH IN MICE**Matthew P. Shaughnessy, MD¹**, Lily H. McCarthy², Robert A. Cowles, MD³¹*Yale University School of Medicine, New Haven, CT, USA*, ²*Yale University, New Haven, CT, USA*, ³*Yale School of Medicine, Department of Pediatric Surgery, New Haven, CT, USA*

Purpose: Previous work demonstrated enhanced enterocyte proliferation and mucosal growth in gnotobiotic mice with a limited microbiome, and treatment of conventional flora (CF) mice with broad-spectrum enteral antibiotics results in near germ-free (NGF) conditions. We hypothesized that creating NGF conditions with enteral antibiotics would result in reversible small intestinal mucosal growth in mice.

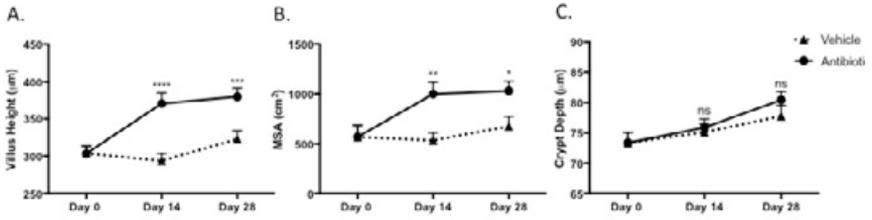
Methods: C57BL/6J mice with CF were allowed ad libitum access to either an antibiotic solution (Ampicillin, Ciprofloxacin, Metronidazole, Vancomycin, Meropenem) mixed in artificial sweetener (n=9) or artificial sweetener alone (n=6). After 14 days of treatment, approximately half of each group (n=4,3) was euthanized for evaluation of the intestinal mucosa. At this point, antibiotics were discontinued, and all remaining mice received sweetener alone for an additional 14 days. Untreated CF mice were utilized as day 0 controls (n=2). Segments from the proximal, middle, and distal small intestine were harvested, fixed, sectioned and stained with H&E. Villus height (VH) and crypt depth (CD) were measured and mucosal surface area (MSA) was calculated. Data were analyzed with Student's t-test and significance assumed for $p < 0.05$.

Results: Antibiotic-treated CF mice (Abx) had taller villi in the proximal ($p < 0.0001$), middle ($p < 0.0001$), and distal small intestine ($p = 0.01$) when compared to vehicle-treated CF mice at day 14. Combined VH and overall MSA were also greater at day 14. These effects persisted at day 28 even after all antibiotic therapy had ceased (Figure 1A,B). Crypts were deeper in Abx mice at both 14 and 28 days, although this did not reach statistical significance (Figure 1C).

Conclusion: Enteral administration of broad-spectrum antibiotics stimulates small intestinal mucosal growth, resulting in taller villi and greater overall MSA. Interestingly, this effect does not immediately reverse but persists even after discontinuation of antibiotics. While further studies are needed, manipulation of the intestinal microbiome is potentially a novel strategy for treatment of patients with malabsorptive disorders.

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P13 (continued)



POSTERS

P15

SPRING-MEDIATED INTESTINAL LENGTHENING IN A SHORT-GUT MODEL

Genia Dubrovsky, **Lauren S. Wood, MD**¹, Shant Shekherdimian, MD, MPH², Michael Lewis³, Matthias Stelzner³, Martin Martin², James C.Y Dunn, MD, PhD¹

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Introduction: Spring-mediated distraction enterogenesis has been shown to increase the length of an intestinal segment in animal models. However, this method of intestinal growth has not been studied in a large animal disease model. The goal of this study is to study the feasibility and cellular effects of spring lengthening in a short-gut animal model.

Methods: Juvenile mini-Yucatan pigs underwent a series of 2 surgeries. In the first operation, a short-gut model was created by resecting 70-75% of the jejunum and ileum. A month later, the pigs underwent a second operation to place a nitinol spring inside the jejunum and to collect a small amount of intestine for histologic examination. Another month later the intestine was re-examined for gross and histologic changes, as well as change in RNA expression of various genes.

Results: After bowel resection, pigs had symptoms of diarrhea and slow weight-gain for 1 week before showing signs of adaptation. 1 month after resection, histology showed a significant increase in the muscularis propria width and crypt depth. Spring placement resulted in a 2-fold increase in length of a jejunal segment from 2 to 4 cm. This segment also showed further adaptation with an increase in crypt depth (Figure). 2 months after bowel resection, evaluation of RNA expression levels showed a significant increase in the expression of LGR5 (stem-cell gene) and ALPI (brush-border gene), but a decrease in LYZ (Paneth cell gene) in spring-lengthened segments, while non-lengthened segments showed an increase in LGR5, but a decrease in both ALP1 and LYZ.

Conclusions: Massive bowel resection results in significant cellular adaptive changes in the intestine. Spring placement can increase intestinal length and can further expand on these changes. It may therefore be useful in increasing the absorptive capacity of the intestine in patients suffering from short-bowel syndrome.

POSTERS

P15 (continued)

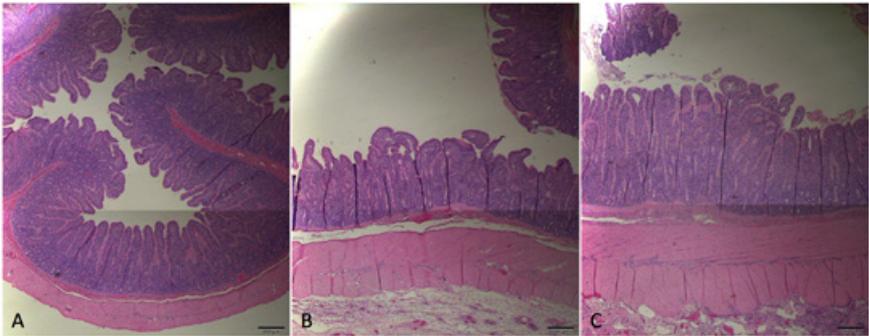


FIGURE. Bright-field microscopy at 4x magnification showing hematoxylin and eosin stained sections of A) normal jejunum prior to intervention, B) jejunum 2 months after massive small bowel resection WITHOUT spring-mediated lengthening, and C) jejunum 2 months after massive small bowel resection WITH spring-mediated lengthening.

POSTERS

P16

EFFECT OF HEPATIC PROGENITOR CELL PROMININ-1 EXPRESSION ON FIBROSIS

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Purpose: Despite surgical drainage, most infants with Biliary Atresia (BA) progress toward liver cirrhosis. We previously demonstrated expansion of Prominin-1 (Prom1)-expressing hepatic progenitor cells (HPCs) within areas of periportal fibrosis in BA and that Prom1 knockout is associated with decreased biliary ductular reactions and fibrosis. Therefore, we hypothesized that Prom1 directly modulates BA-associated fibrosis.

Methods: For in vitro gain-of-function, we established a stably transfected Prom1-overexpressing murine Methionine adenylyl transferase 1a (Mat1a)-/- HPC clone using Lipfectomine 3000®; plated clonal cells were then treated with 5 ng/mL recombinant Transforming Growth Factor- β (TGF β) to induce a fibrogenic response. For loss-of-function, cells were co-treated with either 0.05 μ mol X030, which inactivates HSP90 downstream of Prom1, 0.1mg/mL pirfenidone (PFD), which inhibits TGF β signaling, or Prom1-targeted small interfering (si)-RNA. Relative gene expression were analyzed using qPCR. Fluorescent Western Blot was used for protein expression. ANOVA with post-hoc Tukey test were performed ($p < 0.05$).

Results: Prom1-transfected HPCs had 13,996-fold greater Prom1 compared to nontransfected Mat1a cells; relative PROM1 protein levels were also increased. There was no difference in Collagen1 α 1 expression but decreased Integrin- β 6 with Prom1 overexpression (0.33 ± 0.04 , $p < 0.0001$). With TGF β -treatment, Prom1-overexpressing HPCs expressed 70.8-fold greater Collagen1 α 1 ($p < 0.0001$) vs 65.9-fold in parental Mat1a ($p = 0.0363$), and 2.4-fold ($p = 0.0039$) greater Integrin- β 6 (vs 1.12-fold in Mat1a, $p = 0.995$) compared to control. X030 treatment decreased Collagen1 α 1 (12.1 ± 2.7 , $p < 0.01$) expression, with no change in Integrin- β 6. PFD treatment also decreased Collagen1 α 1 (27.2 ± 1.6 vs 70.8 ± 17.4 , $p = 0.0013$), with no change in Integrin- β 6). Expression of Prom1 was significantly downregulated after siRNA-transfection (0.18 ± 0.03 vs 1.0 ± 0.05 , $p < 0.0001$), as well as decreased protein levels. In contrast to TGF β -treated Prom1-overexpressing HPCs, TGF β -treated Prom1-silenced HPCs showed no difference in Collagen1 α 1 (20.1 ± 9.1 vs 15.9 ± 3.9 , $p = 0.73$).

Conclusion: Prominin-1-expressing HPC do not contribute to TGF β -mediated fibrogenesis with Collagen deposition. We speculate that Prominin-1-expressing HPC likely induce a profibrogenic response in adjacent portal fibroblasts.

POSTERS

P17

CNP-MIR146A REDUCES INFLAMMATION IN LPS-INDUCED ACUTE LUNG INJURY

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Purpose: Acute respiratory distress syndrome (ARDS), the most severe form of acute lung injury, is highly prevalent in ICU admissions and carries devastating morbidity and mortality. It is often secondary to a systemic inflammatory response with sepsis as the leading cause of ARDS worldwide. We have previously shown that radical-scavenging cerium oxide nanoparticles (CNP) conjugated to the anti-inflammatory microRNA-146a (miR146a) can decrease the inflammatory response in bleomycin-injured lungs and improves pulmonary function. We hypothesized that CNP-miR146a will blunt the inflammatory response and decrease pro-fibrotic gene expression in lipopolysaccharide (LPS)-injured mice, a more clinically relevant model of sepsis and acute lung injury.

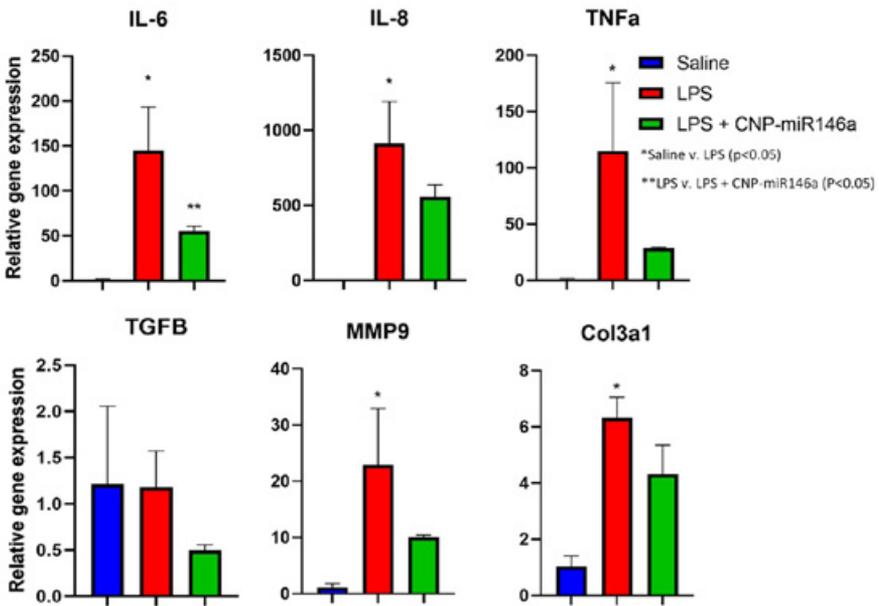
Methods: To test this hypothesis, 10-week old C57/Bl6 male mice were given 50µg of intratracheal LPS in 50µL PBS or 50µL saline as controls. Four hours following injury, mice were given an intratracheal administration of 100ng/50µL of CNP-miR146a. Lung tissue from each group was harvested 24 hours after the initial injury and processed for real-time PCR. Data was analyzed using the one-way ANOVA.

Results: We found that LPS-injured mice had a significant increase in the pro-inflammatory mediators IL-6, IL-8, and TNF α , as well as the pro-fibrosis mediators MMP9 and Col3 α 1 compared to controls ($p < 0.05$). Treatment with CNP-miR146a significantly reduced the relative gene expression of pro-inflammatory IL-6 ($p < 0.05$), with a trend toward decreasing IL-8, TNF α , Col3 α , TGF β , and MMP9.

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P17 (continued)

Conclusion: LPS-mediated lung injury results in a significant increase in pro-inflammatory and profibrotic gene expression. Treatment with CNP-miR146a reduces pro-inflammatory signaling in acute lung injury. Future studies examining the effects of this reduction on pulmonary mechanics and histologic structure will be important to evaluate the benefits of a reduced inflammatory insult in acute lung injury, and the potential of CNP-miR146a as a novel therapeutic in the treatment or prevention of ARDS.



POSTERS

P18

THE LUNGS IN CONGENITAL DIAPHRAGMATIC HERNIA ARE SEVERELY HYPOXIC AT BIRTH - INSIGHT TO PATHOGENESIS

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Purpose: In congenital diaphragmatic hernia (CDH), pathophysiologic pulmonary dysfunction occurs secondary to pulmonary hypertension and hypoplasia. Clinically, these processes often manifest as hypoxia. While clinically predictable, the underlying pulmonary cellular and molecular changes in CDH remain enigmatic, limiting our ability to measure efficacy in novel therapies. Our objective was to characterize the degree of hypoxia and hypoxia-inducible factor (HIF) expression in the nitrofen CDH model.

Methods: The rodent nitrofen model was used. Immediately postnatally, Hypoxyprobe, a hypoxia marker, was administered intraperitoneally to pups. Control pups were maintained in normoxia (21% O₂) or hypoxia (4% O₂). CDH pups were maintained in normoxia. Left lungs were collected at 1 hour of life. The extent of parenchymal hypoxia was assessed by immunofluorescence. The relative expression of HIF-1 α and HIF-2 α were measured by western blotting. Comparative statistics were performed using GraphPad Prism (ANOVA & t test).

Results: CDH pulmonary parenchyma showed a significantly increased degree of hypoxia at birth compared to controls. There was a 5x increase in Hypoxyprobe detection in 4% hypoxemic pups compared to control pups ($p < 0.01$); CDH pups had 20x more Hypoxyprobe intensity than controls ($p < 0.01$) (FIGURE). The relative expression of HIF-1 α was 4-fold higher in CDH pups ($p = 0.005$). HIF-2 α expression was also increased, with 2x greater expression in CDH lungs compared to controls ($p = 0.0012$).

Conclusions: We conclude that CDH pulmonary parenchyma shows profoundly increased levels of hypoxia compared to control lungs and lungs of pups exposed to severe hypoxia very early after delivery. Moreover, relative expression of HIF-1 α and HIF-2 α were increased in CDH lung tissue compared with controls, suggesting HIF stabilization, part of a physiologic and pathophysiologic signaling response. These data reveal mechanisms of cellular hypoxia signaling alterations which may be initiated prenatally and provide critical parameters for assessing response to therapies. Moreover, these observations represent critical early postnatal or prenatal therapeutic targets.

POSTERS

P18 (continued)

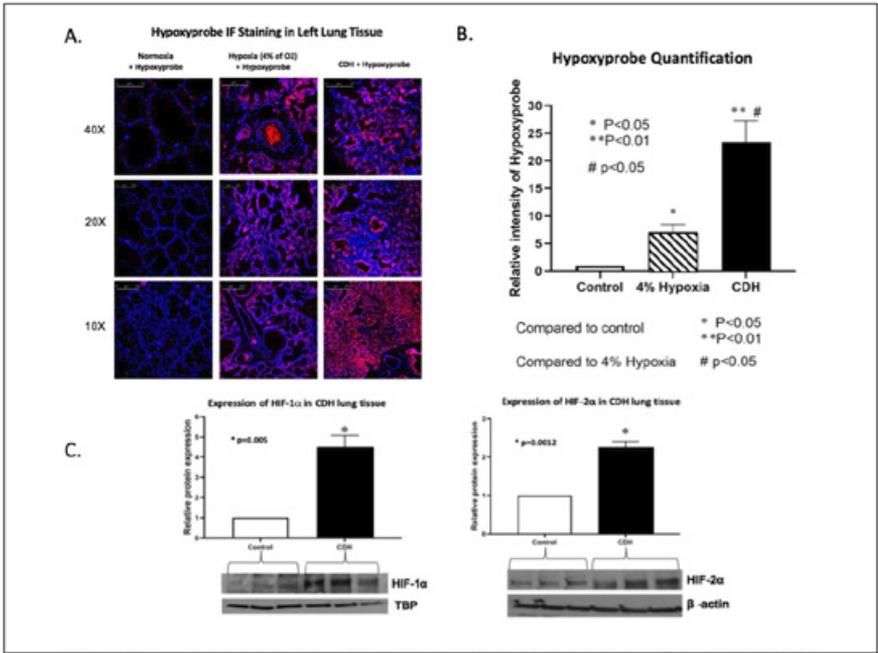


Figure 1: A) Magnified immunofluorescence staining of Hypoxyprobe in left lung tissue of control pups in room air, control pups in 4% O₂, and CDH pups in room air B) Bar graph showing significant differences in Hypoxyprobe intensity between groups C) Bar graphs and western blot images

POSTERS

P20

URINE EXTRACELLULAR VESICLE-DERIVED MIRNA PATTERNS IN INFANTS WITH NECROTIZING ENTEROCOLITIS

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Purpose: Specific biomarkers for the early diagnosis of necrotizing enterocolitis (NEC) do not currently exist, and the exact etiology of the disease is still uncertain. Our goal was to identify urine extracellular vesicle (EV)-derived miRNAs that can be used as biomarkers for the diagnosis of NEC, and to ascertain gene and molecular targets of the candidate miRNAs.

Methods: Urine samples were collected from premature infants (N=80) of 24-34 weeks gestational age with the following diagnoses: non-NEC sepsis, medical NEC (did not require surgery), surgical NEC (required surgery), and healthy age-matched premature controls. After isolation from urine, EV-derived miRNAs were sequenced and expression analyses performed. The Wald Test, with a false discovery rate p-value of 0.1, was utilized to identify candidate miRNA biomarkers. miRNAs with significantly altered expression levels in patients with NEC were then analyzed using Ingenuity Pathway Analysis (IPA) to identify regulatory pathways associated with NEC.

Results: Differential expression analysis of the miRNA transcriptome revealed multiple EV-derived miRNA candidates for use in the discrimination of NEC from septic (e.g. miR-376a) or from control (e.g. miR-604) infants. IPA indicated that NEC was significantly associated with multiple disease regulatory pathways when compared to healthy premature control infants, including inflammatory disease and response, gastrointestinal disease and organismal injury. Sepsis was significantly associated with disease regulatory pathways including organismal injury and hematological disease. IPA demonstrated that signal transduction molecules tumor protein 53 (TP53) and histone deacetylase 5 (HDAC5) may be associated with miRNA-mediated inflammatory mechanisms in NEC.

Conclusion: Urine extracellular vesicle-derived miRNA patterns from infants with necrotizing enterocolitis are altered in comparison to septic infants and premature healthy infants. These shifts in miRNA expression as a function of disease are associated with changes in regulatory pathways that may aid in the elucidation of mechanistic progression and resolution of NEC.

POSTERS

P21

INCREASING INTESTINAL REMNANT LENGTH DECREASES INTESTINAL INFLAMMATION IN A ZEBRAFISH MODEL OF SHORT BOWEL SYNDROME

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Purpose: Short bowel syndrome (SBS) is associated with a highly pro-inflammatory state in multiple organisms. We have previously found increased expression of inflammatory markers in the remaining intestine in a zebrafish model of SBS. We hypothesized that variation of remnant intestinal length would correlate to the amount of intestinal inflammation, with reduction as remaining length increased.

Methods: After IACUC approval, adult male zebrafish were allocated to 3 groups: sham (n=14), S1-SBS (jejunostomy equivalent, n=14), and S3-SBS (ileostomy equivalent, n=14). Sham fish had a laparotomy alone. S1-SBS fish had a laparotomy with intestinal ligation at S4 and creation of a stoma at S1, S3-SBS fish had a laparotomy with intestinal ligation at S4 and creation of a stoma at S3. Fish were weighed weekly and euthanized on POD14 with collection of proximal intestinal segments (S1). The expression of $\text{tnf}\alpha$, il6 , and $\text{il1-}\beta$ in the proximal intestine was evaluated with RT-qPCR. Intestinal inflammation was evaluated with immunofluorescent staining for myeloperoxidase, a neutrophil marker. Statistical analysis included one-way ANOVA with Prism software.

Results: At 14 days, S1-SBS zebrafish had significantly increased expression of $\text{tnf}\alpha$, il6 , and $\text{il1-}\beta$ compared to sham fish ($p=0.031$, $p=0.003$, $p=0.026$). S3-SBS fish had decreased expression of $\text{tnf}\alpha$, il6 , and $\text{il1-}\beta$ compared to S1-SBS fish ($p=0.04$, $p=0.002$, $p=0.043$) but no difference when compared to sham fish. S1-SBS fish had more MPX+ cells/intestinal section compared to both sham and S3-SBS fish (65.2 ± 20.3 v 4.25 ± 1.9 , $p=0.0004$; 65.2 ± 20.3 v 37.25 ± 13.2 , $p=0.01$).

Conclusions: Zebrafish with longer remnant intestine demonstrate decreased expression of inflammatory markers and decreased MPX staining. SBS results in a pro-inflammatory state and the extent of intestinal inflammation correlates to the amount of remaining intestine. Knowledge of the inflammatory state associated with the extent of remaining intestine might guide future therapies for patients with short bowel syndrome.

POSTERS

P23

ELEVATED PROBNP LEVELS ARE ASSOCIATED WITH DISEASE SEVERITY, CARDIAC DYSFUNCTION AND MORTALITY IN CDH

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Purpose: Cardiac dysfunction is emerging as a key culprit in the morbidity and mortality of congenital diaphragmatic hernia (CDH). N-terminal pro b-type natriuretic peptide (pBNP), a hormone released secondary to ventricular stretch, has been used as a prognosticator and biomarker of severity in heart failure and cardiomyopathy. We hypothesized that pBNP levels would be associated with cardiac dysfunction and high-risk disease in CDH.

Methods: All patients in the CDH Study Group (CDHSG) from 2015 to 2019 were included. Mean pBNP was used for patients with multiple values. Cardiac function was determined using echocardiograms from the first 72 hours of life. Statistical analyses were performed using Stata/IC 16 (College Station, TX).

Results: A total of 2,337 patients were identified. Of those, 212 (9%) had at least one pBNP value, ranging from 2.5 to 142,207.5 pg/mL. Of patients who had a pBNP measurement, 3 (1.5%) had CDHSG stage A defects, 58 (29.6%) B, 111 (56.6%) C, and 24 (12.2%) D. Patients with high-risk defects (Stage C/D) had significantly higher pBNP levels compared to patients with low-risk defects (Stage A/B) (14281 vs. 5025, $p=0.007$). pBNP was significantly elevated in patients who died (median 14100, IQR 4377–22900 vs 4911, IQR 1883–9810) ($p<0.001$). Patients with cardiac dysfunction on initial echocardiogram had higher pBNP than patients with normal cardiac function (8379 vs. 4778, $p=0.005$), but no pBNP cutoff value was highly sensitive and specific for cardiac dysfunction (AOC=0.61) (Figure).

Conclusion: We conclude that, among patients with congenital diaphragmatic hernia, elevated proBNP was associated with high-risk defects, cardiac dysfunction, and mortality. Although additional study is needed to optimize measurement timing and frequency, proBNP shows significant promise as a prognostic factor and biomarker in congenital diaphragmatic hernia-associated cardiac dysfunction.

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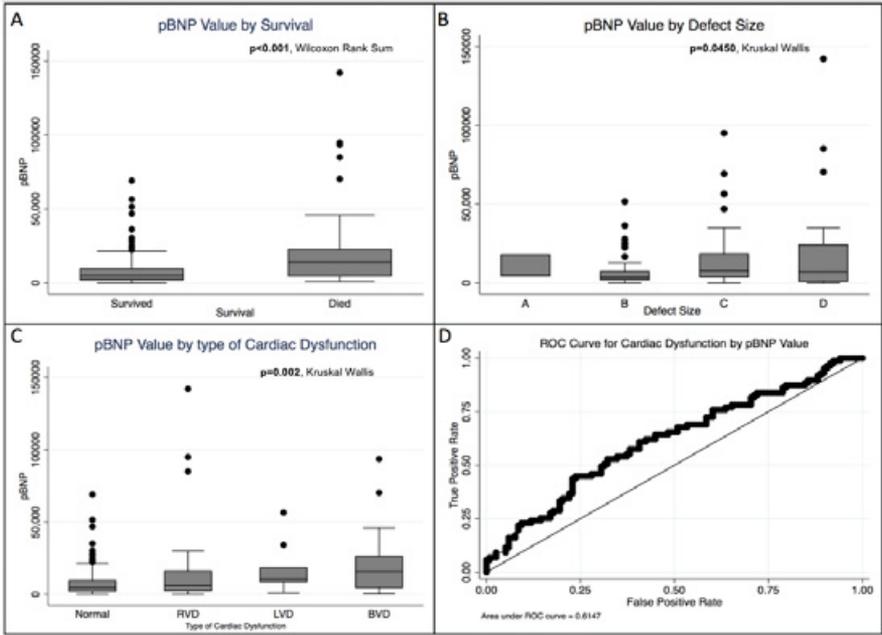


Figure 1: All boxplots are displayed as medians with IQR (grey boxes) with whiskers containing values $\pm 1.5 \times IQR$; pBNPs are recorded as pg/mL A) pBNP values for CDH patients based on survival B) pBNP values for CDH patients based on CDHSG staging system C) pBNP values for CDH patients with cardiac dysfunction RVD = right ventricular dysfunction only, LVD = Left ventricular dysfunction only, BVD = Biventricular dysfunction D) ROC Curve for likelihood of cardiac dysfunction based on pBNP value

POSTERS

P25

HIGH RATE VENTILATION AS PRIMARY RESCUE STRATEGY FOR PATIENTS WITH CONGENITAL DIAPHRAGMATIC HERNIA: A COMPARISON TO HIGH FREQUENCY OSCILLATORY VENTILATION

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Purpose: We describe high rate ventilation (HRV), pressure controlled ventilation delivering 100 breaths per minute with low positive end-expiratory pressure, as a rescue ventilation strategy, and compare it to the more widely used high frequency oscillatory ventilation (HFOV) in the treatment of critically ill congenital diaphragmatic hernia (CDH) patients.

Methods: We conducted a retrospective review of all patients diagnosed with CDH who required rescue mechanical ventilation at our institution from January 2005 until September 2019. Patients requiring HRV (n=47), HFOV (n=32) or both HRV/HFOV (n=45) were included. Fisher's Exact Test was used to compare categorical variables and Kruskal-Wallis test for continuous variables among the 3 groups. Single and multivariable analysis using cox regression, logistic regression and linear regression was performed.

Results: A total of 124 patients were studied. More severe lung to head ratio (LHR) and need for patch repair significantly correlated with HFOV (p=0.016, p=0.003). These confounding variables were thus used to control for severity of illness. When comparing outcomes for patients treated with HFOV versus a combination of both HFOV and HRV, there was no significant difference between groups in regard need for ECMO (p=0.154), inhaled nitric oxide (p=0.404), and total time on mechanical ventilation (p=0.351). Similarly, the need for oxygen at discharge and need for pulmonary hypertension medications at discharge were not significantly different between groups. Finally, patients in the HR/HFOV group underwent repair on average 2 days earlier than those in the HFOV group (p<0.001).

Conclusion: The use of HRV prior to HFOV results in comparable outcomes to those of patients escalated directly to HFOV. HRV can be used at institutions without access to HFOV, during inter-hospital transfer, does not need specialized respiratory specialists, and is less obtrusive during surgery. These findings support the use of HRV as an alternative initial rescue strategy.

POSTERS

P26

TRAINEE NON-COMPLIANCE WITH POST-OPERATIVE OPIOID PRESCRIBING GUIDELINES

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Purpose: Awareness of prescription variability after outpatient surgery at our institution prompted an assessment of actual opioid dose utilization, ascertained by post-operative telephone follow-up. We then created opioid prescribing guidelines after the common outpatient operations based on this utilization data. These guidelines were incorporated into the monthly orientation for rotating surgery residents. Our aim was to evaluate compliance rates and determine barriers to implementation.

Methods: We conducted a retrospective review 6 months after implementation of the guidelines from 3/1/19 to 8/31/19. Number of prescribed opioid doses was obtained and compared to the recommended doses for a given procedure. Individual follow-up interviews were conducted with prescribing providers. Statistical analysis was performed using Fisher's exact test and considered significant if $p < 0.05$.

Results: 85 of the 206 (41.3%) included cases demonstrated trainee non-compliance (Table). Non-compliance occurred after all categories of procedures except epigastric herniorrhaphy. 49 out of 80 pediatric surgery fellow prescriptions were non-compliant vs 36 out of 126 general surgery resident prescriptions (61.3% vs 28.6%, $p < 0.001$). Fellow responses addressing non-compliance focused on disbelief that small volumes of medication, e.g. < 5 ml, would adequately control pain or be filled by a non-pediatric pharmacy. Resident responses indicated lack of knowledge of the guidelines or forgetting to use them. Default prescription dosing in the electronic medical record that exceeded our guidelines was also identified as a reason for non-compliance.

Conclusion: Trainee non-compliance with post-operative opioid prescribing guidelines is common. Implementation barriers identified were multi-factorial and included lack of stakeholder buy-in and gaps in education. Targeted intervention based on trainee level may be beneficial as well as refining the default prescription doses in the medical record.

POSTERS

P27

JUST THE FACTS, MA'AM: DO GENDER FACTORS AND LETTERS OF RECOMMENDATION PREDICT SUCCESSFUL MATCH IN PEDIATRIC SURGERY?

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Purpose: This study evaluated predictors of a successful pediatric surgery fellowship (PSF) match, focusing on the effects of gender and letters of recommendation (LOR).

Methods: Applications submitted to a single PSF program from 2014-2018 were reviewed. Applicant characteristics were recorded. LOR were categorized by author characteristics and analyzed using the previously validated Linguistic Inquiry and Word Count program. The independent effects of gender and LOR attributes on match success were evaluated using multivariable regression modeling, accounting for repeated measures per applicant and adjusting for other applicant factors.

Results: There were 259 applicants (51% female) with 1,005 LOR. Of the LOR authors, 85% were male, 58% were full professors, and 8% were PSF program directors. Based on available match data, 120 applicants (47%) successfully matched (match rate 43% for females, 51% for males, $p=0.21$). LORs were significantly longer for matched vs. unmatched applicants (511 vs. 461 words, $p<0.01$). On multivariable regression modeling, applicant gender still had no effect ($p=0.16$). Instead, factors independently associated with match success were LOR length ($p=0.002$), use of "standout" words such as exceptional or outstanding in the LOR ($p=0.048$), highest ABSITE score ($p=0.01$), and traditional applicant status (i.e. those applying during PGY4 year, $p=0.02$). The LOR author gender, academic rank, program director status, and gender concordance with the applicant had no independent effect.

Conclusion: This study did not find evidence of gender bias in the PSF match. With respect to LOR effects on match success, our findings suggest that how well LOR authors know the applicant (as shown by a longer letter) and their strong endorsement (exemplified by use of "standout" words) matters more in the selection process than the academic rank, subspecialty, program director status, or gender of the LOR author. Pediatric surgery applicants should consider these factors when selecting recommendation letter authors.

POSTERS

P28

THE FELLOWSHIP EFFECT: DO SURGICAL SUBSPECIALTIES AFFECT PEDIATRIC SURGERY CASE NUMBERS

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Purpose: The Accreditation Council for Graduate Medical Education (ACGME) monitors case numbers from graduating residents and fellows. With evolving curriculums, minimum case requirements are continually reevaluated. Prior literature shows increasing pediatric surgery fellowships and decreasing general surgery residency case numbers in pediatric surgery. We hypothesize that an increase in pediatric surgical subspecialty fellowships, specifically pediatric otolaryngology and pediatric urology, would decrease overlapping case numbers in pediatric surgery fellowships.

Methods: A web-based review of the ACGME website for pediatric surgery, the SF Match website for pediatric otolaryngology, and the Societies for Pediatric Urology website was performed for the number of fellowship graduates. We analyzed only publicly available pediatric surgery case logs for overlapping cases including thyroidectomy, parathyroidectomy, branchial cleft cyst excision, thyroglossal duct cyst excision, major neck tumor excision, nephrectomy, orchidopexy, inguinal hernia, and testicular torsion. Analyzed data included average case number per pediatric surgery fellow and number of fellows each year. Simple linear regression analysis was performed.

Results: We identified a significant increase in pediatric surgery, pediatric otolaryngology, and pediatric urology fellowship graduates from 2003-2018 (all with $p < 0.006$). Within the overlapping cases, a majority of them showed little fluctuation over the years despite an increase in subspecialty fellowships. A decrease in tumor-related nephrectomies and open orchidopexies was identified ($p < 0.001$; $p < 0.004$). Though reaching significance, nephrectomy fluctuation was only between 2 and 4 cases during this time period. Similarly, we identified a significant rise in thyroidectomies ($p < 0.001$); however, the increase was from an average of 5 to 8 cases.

Conclusion: We have shown a significant increase in fellowships in pediatric surgery, pediatric otolaryngology, and pediatric urology over a 15-year time period. Despite identifying significant case relationships, there has been minimal negative effect on overall pediatric surgery case volume. Continuing to monitor these trends will help ensure adequate training for all.

POSTERS

P29

TRENDING DIVERSITY IN PEDIATRIC SURGERY: A FOUR-DECADE REVIEW OF GRADUATING FELLOWS

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Purpose: The Liaison Committee on Medical Education created diversity accreditation standards in an effort to increase the diversity among undergraduates entering medical school. These efforts continue even at the residency level. Recent reports have shown physician specialization is partly influenced by their mentors, which tend to be same sex or same ethnicity. In the academic surgery world, females and several racial groups remain underrepresented, potentially leading to a lack of mentorship within those groups. We hypothesize the lack of diversity in pediatric surgery has improved throughout the years.

Methods: A Genealogy of North American Pediatric Surgery was utilized to identify all graduating pediatric surgery fellows from 1981-2018. A web-based analysis of each graduate was then performed, noting their gender and race. Census categories were used, including White, Black, Asian, and Hispanic. A year-to-year and decade-to-decade comparison was completed.

Results: A total of 1217 pediatric surgery fellows graduated from accredited programs between 1981-2018. Twenty-four of these graduates were excluded as demographic data was lacking. When comparing the remaining graduates from the first and last decades, an increase from 16.8% to 39.5% for female graduates was observed. An increase in non-White graduates was seen for all races, with the greatest increase in Asian graduates (3.9% to 21.2%) (Figure 1). Notably, the percentage of Hispanic graduates nearly doubled each decade.

Conclusion: There is a significant increase in diversity in pediatric surgery fellowship graduates. Specifically, all non-White racial groups have more representation. The percentage of women graduates has more than doubled with the most recent year having a 50-50 split of graduating males and females. Diversity is improving among pediatric surgery graduates providing a positive perspective for the future.

POSTERS

P30

VIDEO AND SIMULATION BASED SURGICAL EDUCATION ON CENTRAL VENOUS CATHETER REPAIR

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Purpose: Central venous catheter (CVC) repair is an important component of pediatric surgical management. Variability in performance and post-repair guidance was noted in our institution prompting provider education. This study evaluates the utility of a combined video and simulation-based educational approach to management of CVC fractures.

Methods: Following IRB approval, surgical trainees and nurse practitioners received a video-based teaching module then performed a mid-fidelity simulation to demonstrate proficiency with CVC repair and care (Figure). A post-education survey was administered allowing 5-point Likert scale responses. Primary outcomes included provider experience and confidence with the procedure following simulation. Pre-education repairs of CVC's were compared to post-education repairs after a washout period to analyze secondary outcomes. These included appropriate antibiotic stewardship and accurate education of families regarding use and care of the repaired line. The Cochran-Mantel-Haenszel (CMH) test for linear trend was utilized to compare pre- and post-education outcomes.

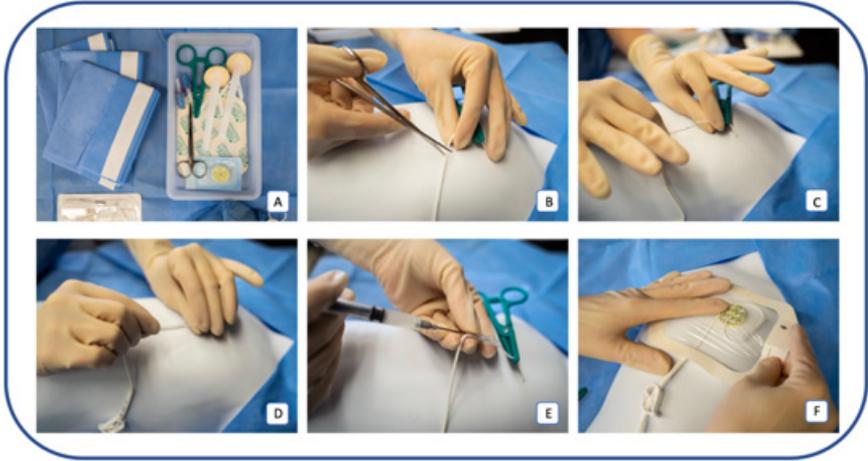
Results: Thirty-seven surgical residents and nurse practitioners received the tiered training. Of those trained, 34/37 (91.9%) agreed or strongly agreed that the video-based training developed knowledge, technical skills, and self-confidence in repair technique, while 36/37 providers (97.3%) gave the same rating for the simulation-based exercise. When comparing pre- and post-education outcomes, appropriate antibiotic stewardship improved from 84.4%(54/64) to 100.0%(51/51) of CVC repairs ($p<0.01$). Proper education of families regarding use and care of the CVC following repair also improved significantly from 20.3%(13/64) to 86.3%(44/51) of CVC repairs ($p<0.001$).

Conclusions: Surgical trainees and nurse practitioners experienced an enhanced learning experience by developing knowledge, technical skills and self-confidence through the use of a video and simulation-based training for central venous catheter repair. This combination of methods was also associated with improvement in patient management. A tiered, video and proficiency-based simulation teaching paradigm is effective in educating practitioners and can be a useful adjunct to traditional bedside training.

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P30 (continued)

Figure. Simulation-based training to repair fractured central venous catheters (CVC) in pediatric surgery. (A) Review of the CVC repair supply bundle (B) Removal of the damaged CVC segment 5cm proximal to the insertion site (C) Connection of the new central line (D) Sliding the splice sleeve over the repaired joint (E) Application of the medical adhesive (F) Application of sterile dressing



POSTERS

P31

WORKING TOWARDS EQUALITY: GENDER BIAS IN LETTERS OF RECOMMENDATION FOR PEDIATRIC SURGERY FELLOWSHIPS

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Background: Gender bias in letters of recommendation (LOR) has been reported for candidate selection in academic medicine, typically with females more frequently described in communal terms (e.g. helpful, kind, interpersonal) and males described in more agentic terms (e.g. assertive, intellectual, ambitious).

Purpose: This study examined the presence of gender bias in LOR for pediatric surgery fellowship.

Methods: LOR submitted to a single pediatric surgery fellowship program between 2014-2018 were retrospectively reviewed and analyzed using a previously validated Linguistic Inquiry and Word Count software program. Descriptive statistics and bivariate analysis were employed in our analysis.

Results: 1264 LOR from 326 applicants (51% female) were analyzed. Of the letter writers, 83% were male, 57% were professors, and 7.6% were Pediatrics Surgery Fellowship Program Directors. The overall average word count was 530 words, with no significant difference in LOR word count between genders. Compared to male applicants, female applicants were more likely to be described with grindstone words ($p=0.02$), achievement ($p=0.02$), and clout ($p=0.0005$). Male applicants were described with more authentic words ($p=0.0006$) and informal speech with non-fluencies ($p=0.02$). There were no significant differences in the use of agentic and communal words between genders.

Conclusion: While there are differences in recommendation letters for candidates in the pediatric surgery match based on gender, previously described overt gender bias was not seen in this study. Interestingly, male candidates were described as more personal and humble, while females were described more based on achievement, confidence, and leadership; a significant reversal of previously described gender bias in academic medicine. These findings may be due to the unique interpersonal and multidisciplinary skills required in pediatric surgery and may represent a unique form of bias that warrants further study.

POSTERS

P32

LEFT VENTRICULAR CARDIAC DYSFUNCTION IS SEEN IN THE FETUS IN AN OVINE DIAPHRAGMATIC HERNIA MODEL IN THE EXTRAUTERINE ENVIRONMENT FOR NEONATAL DEVELOPMENT

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Purpose: Little is known about cardiac function in fetuses with diaphragmatic hernias while fetal physiology is still in effect. Here we demonstrate that left ventricular dysfunction can be seen even during fetal development in a lamb model of severe diaphragmatic hernia (DH).

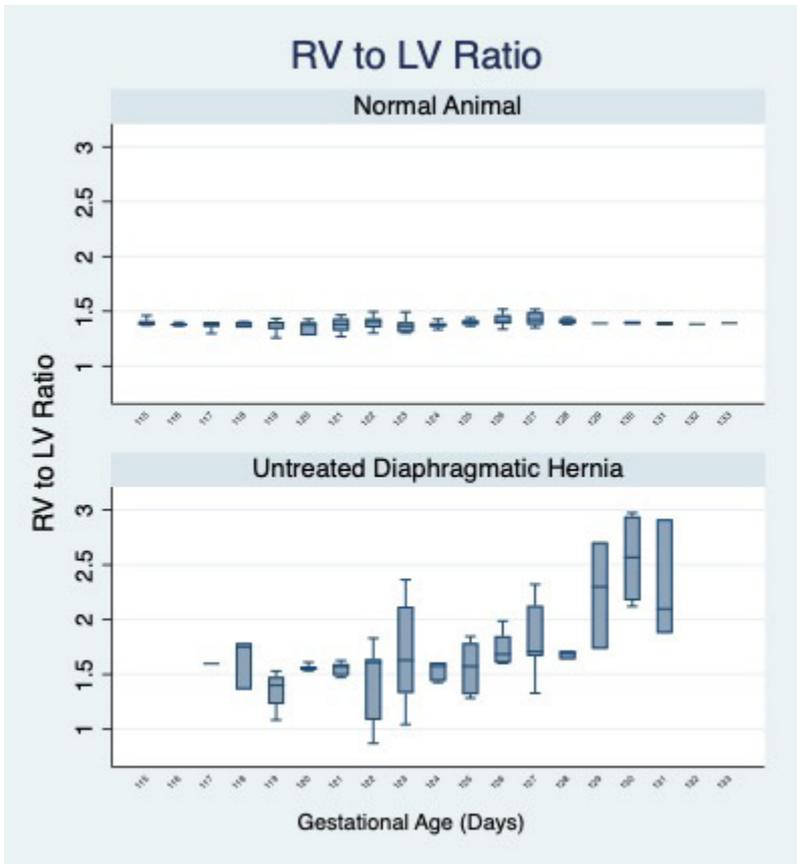
Methods: Diaphragmatic hernias (DH) were surgically created in fetal sheep at gestational age 70-76 days. Fetuses were cesarean delivered at ~120 days gestational age, cannulated via the umbilical vein and arteries, and placed in the Extrauterine Environment for Neonatal Development (EXTEND). There were two experimental groups supported by EXTEND: a DH group (DH, n=5), and a Normal group - age-matched controls without DH (Normal, n=11). All groups were supported on the EXTEND system for 1-28 days (average = 15.0 days). Echocardiography was performed every 12-24 hours with a Philips iE33 Ultrasound.

Results: In the normal animal group, the Mean RV to LV Ratio was 1.41 (Std Err 0.0098, 95% CI 1.39-1.43) on day 0 of the run. DH Animals had a mildly elevated RV to LV from Day 0, at 1.47 (Std Err 0.28, 95% CI 1.08-1.82). The DH Animals' RV to LV ratio increased to 2.08 (Std Err 0.07, 95% CI 1.93-2.22) by Day 11 of the study, while the Normal Animals' RV to LV Ratio remained stable at 1.39 (Std Err 0.01, 95% CI 1.93-2.22). Combined cardiac output was lower in the DH group. RVCO was equivalent in both groups; the decreased RV to LV ratio can be explained by a decreased LVCO. While LVCO remained constant in the Normal group, it dropped rapidly in the DH group. The LVCO drop was a result of a decreased LVSV.

Conclusion: Left ventricle dysfunction, previously seen only in neonates, exists even when fetal cardiac physiology is intact, as shown in this diaphragmatic hernia animal model.

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CONGENITAL DIAPHRAGMATIC HERNIA AS A POTENTIAL TARGET FOR TRANSAMNIOTIC STEM CELL THERAPY: COMPREHENSIVE DONOR CELL HOMING AND PULMONARY MORPHOMETRIC ANALYSES

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Purpose: Transamniotic stem cell therapy (TRASCET) can impact select processes of pulmonary development in experimental congenital diaphragmatic hernia (CDH), particularly in the lung vasculature. We sought to examine pulmonary morphometrics and donor cell kinetics after TRASCET in experimental CDH.

Methods: Following IACUC approval, forty-three pregnant dams received Nitrofen (2,4-dichlorophenyl p-nitrophenyl-ether) orally on gestational day 9.5 (E9; term=22 days) to induce fetal CDH. Fetuses were divided into four groups: untreated animals undergoing no further manipulations (n=59) and three groups receiving volume-matched intra-amniotic injections on E17 of either saline (n=103), a suspension of amniotic fluid-derived mesenchymal stem cells (afMSCs) labeled with luciferase (TRASCET; n=231), or an acellular suspension of recombinant luciferase (n=141). Normal fetuses (n=16) served as additional controls. Infused afMSCs consisted of syngeneic rat cells phenotyped by flow cytometry. Animals were euthanized at term for either pulmonary morphometry, or screening for labeled afMSC presence at twelve anatomical sites. Statistical comparisons were by Wald test (two-tailed $p < 0.05$) and nested ANOVA (Bonferroni-adjusted $p < 0.008$).

Results: Among 103 survivors with CDH, morphometric and homing analyses were performed in 56 and 47 fetuses, respectively. TRASCET led to a significant decrease in arteriole wall thickness compared to the untreated group ($p < 0.001$; table), but this did not reach significance against the saline group with the number of subjects available ($p = 0.180$; table). There were no significant differences in any of the five parameters of alveolarization compared between untreated and both treatment groups (table). Donor afMSCs were identified selectively in the bone marrow and umbilical cord ($p = 0.035$ and 0.015 , respectively, vs. plain luciferase controls).

Conclusions: The effects of transamniotic stem cell therapy in experimental congenital diaphragmatic hernia appear to be centered on the pulmonary vasculature and to derive from circulating donor cells. Further scrutiny into the impact of this therapy on pulmonary arterial pressures and function is warranted.

POSTERS

P35

FETAL RESUSCITATION DURING OPEN FETAL MYELOMENINGOCELE REPAIR

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Background: Little data exists regarding outcomes of intraoperative fetal resuscitation during fetal surgery. In this study, we assess the outcomes of fetal resuscitation during open fetal myelomeningocele (fMMC) repair.

Methods: We retrospectively reviewed all fMMC repairs between January 2011 and May 2019 at our institution. Preoperative, intraoperative, and postnatal data were collected.

Results: 6 fetuses (4 male, 2 female) out of 260 cases (2%) underwent resuscitation during fMMC repair for severe fetal bradycardia or asystole. Average fetal weight by ultrasound was 559g and 2 patients (33%) had posterior placentas. Surgery was performed at an average gestational age of 23w5d. All patients were successfully resuscitated with medications (epinephrine, atropine, calcium gluconate) given via the umbilical vein, 5 required chest compressions, and 2 received transfusions (Table 1). Sterile intraoperative fetal echocardiography documented both effective cardiac compressions and recovery. Average total resuscitation time was 8.8 minutes (7-11 minutes). All 6 delivered liveborn infants at a median of 32w5d with intact fMMC repairs. One delivered at 24w4d gestation due to premature rupture of membranes and the family elected for palliative care. The 5 infants had average birthweight of 2.40 kg and normal Apgar scores. Neonatal brain MRIs showed no evidence of ischemic injury or hemorrhage. At birth, leg movement was normal in 4 and decreased in 1 patient. 4 patients have completed 12month follow up to date. All 4 were able to sit up unassisted and 2 pulled up to furniture.

Conclusions: Fetal resuscitation during fMMC repair is effective, does not necessitate immediate delivery, and does not appear to impact surgical outcomes. We speculate that issues related to deep maternal-fetal general anesthesia, increased uterine tone, or umbilical cord compression lead to the need for resuscitation.

POSTERS

P38

THE IMPACT OF DAILY PROBIOTICS ON NECROTIZING ENTEROCOLITIS IN VERY LOW BIRTH WEIGHT INFANTS

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Purpose: Necrotizing enterocolitis remains a leading cause of morbidity and mortality in premature infants. The role of prophylactic probiotics for prevention is unclear. This study evaluates the routine use of probiotics on the incidence and severity of necrotizing enterocolitis (NEC) in very low birth weight (VLBW) infants in the neonatal intensive care unit (NICU).

Methods: A retrospective review of VLBW infants cared for at a single institution two years prior to (2014-2016) and two years following (2016-2018) the introduction of probiotics (Bifidobacterium and Lactobacillus) was conducted. Babies received probiotics daily until 35 weeks corrected gestational age. Those with known gastrointestinal pathology were excluded. 665 infants were reviewed (310 who received probiotics and 355 who did not). Baseline characteristics, antibiotic use, suspected and confirmed NEC as well as infectious and nutritional outcomes were compared between groups. Welch's t-test and chi square test were performed to compare variables with p-values <0.05.

Results: The two groups did not differ significantly with regard to gestational age, birth weight, sex, comorbidities, type of enteral feed, time to full enteral nutrition or length of stay. The overall incidence of NEC was similar (23.7% vs. 24.2%, p=0.87) as was the incidence of NEC > stage 2 (3.9% vs. 5.8%, p=0.36). In addition, there were no significant differences in all cause-mortality (7.0% vs. 10.7%, p=0.10) or NEC-related mortality (0.6% vs. 0.7%, p=0.89). Significantly fewer infants receiving probiotics developed infections (26.8% vs. 31.3%, p=0.046) with respiratory, bloodstream and urinary tract being the most common. There was also a significant decrease in antibiotic use in the probiotic group (24.6% vs. 33.1%, p=0.019).

Conclusions: The routine use of Bifidobacterium and Lactobacillus probiotics in very low birth weight infants did not significantly impact the incidence and severity of necrotizing enterocolitis. However, it was associated with fewer overall infections and less antibiotic use.

POSTERS

P39

IMPACT OF SURGICAL TREATMENT ON NEURODEVELOPMENTAL DISABILITY AND HOME HEALTHCARE NEEDS IN EXTREMELY LOW BIRTH WEIGHT SURVIVORS OF SURGICAL NECROTIZING ENTEROCOLITIS: A MULTICENTER COHORT ANALYSIS

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Purpose: To date, randomized controlled trials have demonstrated no definitive difference in mortality between laparotomy (LAP) and primary peritoneal drainage (PPD) for surgical necrotizing enterocolitis (NEC). Therefore, this study sought to determine if choice of treatment affected longer term outcomes among extremely low birth weight (ELBW) survivors of surgical NEC.

Methods: Data were prospectively collected on ELBW infants born 2006-2016 and enrolled in the Vermont Oxford Network follow-up project. Surgical NEC was defined by predetermined clinical criteria and surgical coding. Follow-up occurred at 16-26 months corrected age. Outcomes were assessed using an intention to treat analysis (LAP=laparotomy only, PPD=Any PPD, including PPD alone or PPD plus laparotomy). Severe disability was specifically defined, and included significant audiovisual or motor impairments, cerebral palsy and/or any Bayley Scales of Infant Development domain score <70. Evaluated home healthcare needs included respiratory assistance or tube feeding. Adjusted risk ratios with 95% confidence intervals were calculated using generalized estimating equations controlling for clustering of infants within hospitals.

Results: 733 ELBW infants with surgical NEC survived to discharge. Of these, 295 (174 LAP, 121 PPD) underwent follow-up evaluation. Characteristics of evaluated and non-evaluated infants were similar. Compared to LAP, PPD infants had lower median birth weight (LAP 798 grams vs PPD 675 grams) and higher rates of neonatal comorbidities (Table 1). At follow-up, the two groups had similarly high rates of severe disability (LAP 37.7%, PPD 37.5%; ARR: 0.97 (0.68, 1.38)) and home healthcare needs (LAP 73.0%, PPD 75.0%; ARR: 1.00 (0.84, 1.23)).

Conclusions: These data demonstrate the high rates of longer term morbidity in ELBW survivors of surgical NEC. Infants who underwent any PPD had similar rates of severe disability and home healthcare needs compared to infants who underwent laparotomy alone. Interestingly, this occurred despite PPD infants having lower birth weights and higher rates of neonatal comorbidities.

POSTERS

P40

OUTCOMES IN GASTROSCHISIS: EXPECTATIONS IN THE POST-NATAL PERIOD

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Background: Despite the overall increasing incidence of gastroschisis, morbidity and mortality have decreased. However, these patients can experience a wide range of complications leading to a prolonged hospital stay, causing significant distress to families. To better understand this, we aim to provide generalizable estimates for expected outcomes of patients with gastroschisis from a large multi-institutional cohort.

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Methods: A retrospective study of neonates with gastroschisis at 11 children's hospitals from 2013-2016 was performed. Outcomes of complex and simple gastroschisis are reported.

Results: Among 394 neonates with gastroschisis, 315 (80%) were classified as simple gastroschisis with normal-appearing bowel in 80% and mild-severe matting in 20%. Median EGA was 36 weeks [IQR 35,37] and median birth weight was 2.4kg [IQR 2.1,2.8]. Seventy-two (23%) underwent primary closure while 243 (77%) underwent delayed closure. A late diagnosis of atresia was found in 2%. Of the entire cohort, 79 (20%) were classified as complex gastroschisis with atresia in 8%, perforation in 7%, necrosis in 6%, and volvulus in 3%. Of the complex group, mild-severe matting was found in 44%, atresia in 41%, perforation in 34%, necrosis in 29%, and volvulus in 11%. Median EGA was 35 weeks [IQR 34,37] and median birth weight was 2.3kg [IQR 2,2.7]. Twenty (25%) underwent primary closure while 59 (75%) underwent delayed closure. A late diagnosis of atresia was found in 23%. Outcomes are reported in Table 1 showing increased time from birth to closure, time from closure to goal feeds, ventilator use, surgical site infections, NEC, TPN use, LOS (105 vs 33 days), and mortality (11% vs 0%) for complex patients.

Conclusion: As expected, neonates with complex gastroschisis have significantly worse in-hospital outcomes and carry a mortality rate >10%. This study provides generalizable estimates for expected outcomes of patients with gastroschisis that can be utilized during prenatal and postnatal counseling.

POSTERS

P41

ORGAN PROLAPSE IS ASSOCIATED WITH SIMPLE GASTROSCHISIS AND IMPROVED OUTCOMES IN A MULTI-INSTITUTIONAL COHORT

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Introduction: Gastroschisis is associated with variable postnatal outcomes that are largely dependent on whether it is simple or complex. Complex gastroschisis is defined as any associated necrosis, perforation, atresia, or volvulus. Prior single-center data suggests that the presence of prolapsed organs besides bowel (e.g. stomach, bladder, reproductive organs) is associated with simple gastroschisis and improved patient outcomes. This study sought to reassess these findings in a larger, multi-institutional cohort and compare prenatal ultrasound documentation of prolapsed organs to findings at neonatal abdominal closure.

Methods: A retrospective review of all inborn neonates with gastroschisis was performed at five large-volume tertiary care children's hospitals from 1/2002-6/2017. Data collected included maternal characteristics, prenatal ultrasound findings, and neonatal outcomes. The primary outcome of complex gastroschisis and other standard postnatal outcomes were stratified against the presence or absence of prolapsed organs.

Results: Five-hundred-and-two patients were included, with 23.7% having at least one prolapsed organ present at first abdominal coverage. The most commonly prolapsed organs were stomach (58%), gonads (55%), and bladder (23%). Organ prolapse was associated with simple gastroschisis ($p=0.002$), ability to perform primary closure ($p<0.001$), and improved postnatal outcomes including decreased rates of sepsis ($p=0.008$) and need for mechanical ventilation ($p=0.035$) (Table 1). In the last three years of the study period when prenatal records were reliably available, 90.6% of mothers

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had a documented prenatal ultrasound (96/106). During this same period only 19% (5/26) of neonates with prolapsed organs at abdominal closure were identified prenatally.

Conclusions: The presence of prolapsed organs is predictive of simple gastroschisis. This finding is also associated with improved postnatal outcomes including decreased time to definitive closure, sepsis rates, and need for mechanical ventilation. Screening for prolapsed organs should be incorporated into prenatal ultrasonography and counseling and these findings should be validated prospectively.

POSTERS

P42

CHILD SELF-REPORTED QUALITY OF LIFE IN PEDIATRIC INTESTINAL FAILURE

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Purpose: Recent studies have focused on parent-reported health-related quality of life (HRQOL) in children with intestinal failure (IF). However, HRQOL from the perspective of the child with IF has not been evaluated. The aim of this study was to measure self-reported HRQOL in children with IF and to compare these data to parent-reported surveys and reference populations.

Methods: A prospective, longitudinal study of HRQOL was performed in a regional intestinal rehabilitation program from 2015-2019. The PedsQL 4.0 Generic Core Scales were administered annually to children with IF ages five years and above along with their parents. Survey data was stratified by age and compared with parent-proxy scores and reference populations of healthy and chronically ill children. Linear mixed-effect models were constructed to identify associations with child self-reported HRQOL.

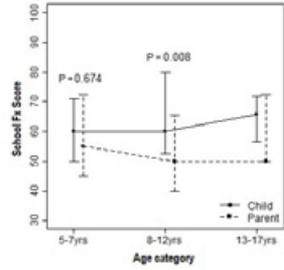
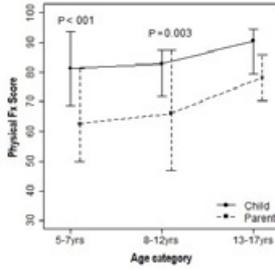
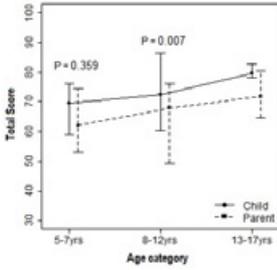
Results: A total of 172 surveys were completed in 84 families. Median child age at survey was 8 (IQR 6-10) years and remnant bowel length was 31 (19-54) cm. Child self-reported HRQOL scores increased from the 5-7 year to 8-12 year age groups ($p=0.07$). Children reported higher HRQOL scores compared to parent-proxy data at all ages with a significant difference in the 8-12 year cohort ($p<0.01$). The largest differences between child and parent scores were in the Physical Functioning and School dimensions ($p<0.01$, Figure 1). Children with IF had lower HRQOL scores than healthy children in all survey dimensions ($p<0.001$) and children with chronic illness in the School and Social Functioning dimensions ($p<0.05$). In an adjusted analysis, longer remnant bowel length was independently associated with decreased HRQOL scores in children ($p<0.05$).

Conclusions: Children with IF reported better HRQOL compared to parent-proxy data. While these HRQOL scores improved with age, they were significantly lower than healthy and chronically ill peers. The association between bowel length and HRQOL deserves further investigation.

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Child and Parent HRQOL Scores



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P43

WHEN TO TAKE IT OUT? OPTIMAL TIMING OF INTERVAL APPENDECTOMY IN 500 CONSECUTIVE CHILDREN

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Purpose: Interval appendectomy following antibiotic management of perforated appendicitis remains common and is often advised to occur 6-8 weeks after presentation. We explore the optimal time to interval appendectomy.

Methods: Our electronic medical record was queried for interval appendectomies from 2006-2019. Data extracted included demographics, pathology findings, abscess drainage, length of stay, readmissions, operative time, and time to interval appendectomy.

Results: 519 consecutive children were intended to undergo elective interval appendectomy. Nineteen were excluded: 10 recurrent appendicitis treated with urgent appendectomy, 2 bowel obstructions, 1 failed non-operative management, 2 missing pathology, 2 combined procedures, and 2 immune suppressed patients. The remaining 500 patients comprised the study cohort. Mean age was 9.9 years, 47% were female, and time to interval appendectomy averaged 12.7 weeks from initial presentation. Operating before 6 weeks was associated with longer mean operative time and more chronic inflammation on pathology (Table 1). Beyond 6 weeks, operative times, lengths of stay and pathology findings were similar. Even when performed after 18 weeks, the percentage of specimens with chronic and acute inflammation were unchanged. Only 11% of appendices had an occluded lumen and 17% had an appendicolith. Appendiceal carcinoid tumors were identified in 6 patients (1.2%). Initial abscess drainage and longer length of initial stay were associated with prolonged time to interval appendectomy. 19.2% were readmitted at least once prior to their appendectomy. Of 10 patients with recurrent appendicitis (2%), 2 occurred before 6 weeks, 8 after 6 weeks, and of those, 2 after 12 weeks.

Conclusion: Interval appendectomy prior to 6 weeks might prove technically difficult. Beyond 6 weeks the procedure may be performed when convenient with similar pathology findings, operative time and length of stay. The risk for recurrent appendicitis while waiting appears to be low. Appendiceal carcinoids are similarly unusual.

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SURGICAL TREATMENT OF SEVERE IDIOPATHIC CONSTIPATION - COMPARISON OF TWO DIFFERENT SURGICAL TECHNIQUES

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Purpose: To compare the outcome of patients suffering from severe idiopathic constipation with megarectosigmoid (SICMRS) subjected to two different operative techniques.

Methods: A retrospective, descriptive and observational study, was performed with the approval of the IRB. The medical records of patients with SICMRS operated from January 2014 to April 2019 were reviewed. The patients received two different operations: (Group A) Trans-abdominal sigmoidectomy with preservation of the rectum and (Group B) transanal proximal rectosigmoidectomy, where the resection starts 5cm proximal to the pectinate line. Postoperative evaluation included the presence or absence of voluntary bowel movements (VBM), as a manifestation of bowel control and the magnitude of reduction of laxative dosage. Statistical analysis was performed using SPSS 25.0.

Results: 34 patients were included. 17 had a transabdominal sigmoidectomy (Group A), and seventeen underwent a transanal rectosigmoidectomy (Group B). VBM occurred in 9 patients of Group A and 16 of Group B postoperatively. Postoperative reduction or discontinuation of laxative dosage happened in Group A in 9 patients; 7 required enemas and one underwent an ileostomy creation. In Group B the reduction or discontinuation of laxatives was successful in 13 patients, one remained on the same dosage, three used enemas. The mean follow up in Group A was 43 months and in Group B 15 months. Postoperative recurrent fecal impaction occurred in 12 patients of Group A and one patient of Group B. Preoperative and postoperative milligrams of Senna differed statistically significant (p -value = 0.007) in Group B.

Conclusion: Both surgical techniques improve the problematic SICMRS. However, the transanal proximal rectosigmoidectomy resulted in a higher rate of bowel control, enhanced prevention of fecal impaction and a significant reduction of the laxative dosage.

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P45

ASSOCIATION OF OPERATIVE APPROACH WITH POSTOPERATIVE OUTCOMES IN NEONATES UNDERGOING SURGICAL REPAIR OF ESOPHAGEAL ATRESIA OR CONGENITAL DIAPHRAGMATIC HERNIA

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Purpose: Minimally invasive surgery (MIS) has gained traction as a first-line approach to repair congenital anomalies, including tracheoesophageal fistula (TEF) and congenital diaphragmatic hernia (CDH). Data comparing outcomes between MIS and open approaches for these operations have been limited to case series, so we sought to evaluate outcomes using a national database.

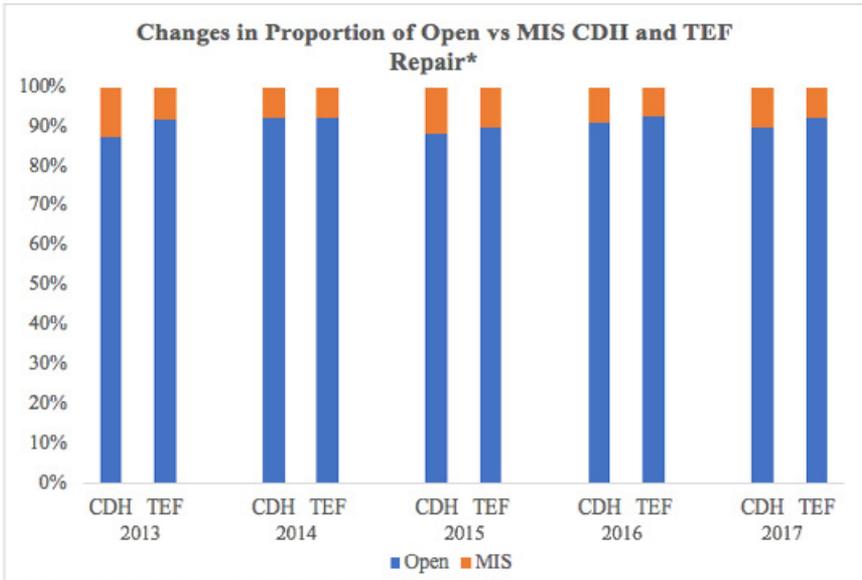
Methods: Neonates undergoing TEF or CDH repair in 2013-2017 were identified using the National Surgical Quality Improvement Project-Pediatric (NSQIP-P) database. Operative times, proportion of postoperative lengths of stay (LOS) exceeding 30 days, and composite morbidity were compared between MIS and open groups, using Chi-square and Wilcoxon rank sum testing. Multivariable logistic regression was used to adjust for comorbidities. Proportions of open versus MIS cases were compared over time.

Results: We identified 2,179 neonates who underwent TEF (n=1,053) or CDH (n=1,126) repair. Median operative time for open was shorter than MIS for TEF (167 vs 196 minutes, p<0.001) and CDH (117 vs 140 minutes, p<0.001). Open repair patients were more likely to have ASA class >3 for TEF (42.9% vs 27.6%, p=0.03) and CDH (73.6% vs 57.7%, p<0.001) and postoperative LOS exceeding 30 days (45% vs 23.1%, p<0.001) with a similar trend for TEF (40.8% vs 29.9%, p=0.06). After adjustment for comorbidities, neither risk of morbidity nor prolonged postoperative LOS were increased for open repair compared to MIS. The proportion of MIS cases has not increased significantly over time (Figure).

Conclusion: Despite increasing interest in minimally invasive surgery for complex congenital anomalies the trend seen from 2013-2017 shows no significant increase in minimally invasive repair and no improvement in outcomes compared to open surgery after adjusting for comorbidities. It is important to explore surgeon preferences and continue to track outcomes after minimally invasive repair of these congenital anomalies to confirm the safety of broad adoption of this approach.

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*CDH, $p=0.772$; TEF, $p=0.522$ for Cochran Armitage

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P46

PREVALENCE AND SURGICAL MANAGEMENT OF BILIARY DISEASE IN PEDIATRIC INTESTINAL FAILURE

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Purpose: The aim of the study was to describe the burden of biliary disease and its associated surgical management in children with intestinal failure (IF).

Methods: We retrospectively analyzed patients with severe IF [requiring parenteral nutrition (PN) for ≥ 90 days] and followed by our multidisciplinary intestinal rehabilitation center between 2009-2018. Biliary disease was defined as the presence of gallbladder sludge or cholelithiasis on standard abdominal ultrasound obtained annually. Kaplan-Meier curve analysis was conducted to analyze timing of surgery. Patients undergoing cholecystectomy during transplantation were excluded. Percent bowel length was adjusted for post-conceptual age. Fisher's exact and Wilcoxon rank sum tests were applied to compare patients receiving cholecystectomy while on and off PN.

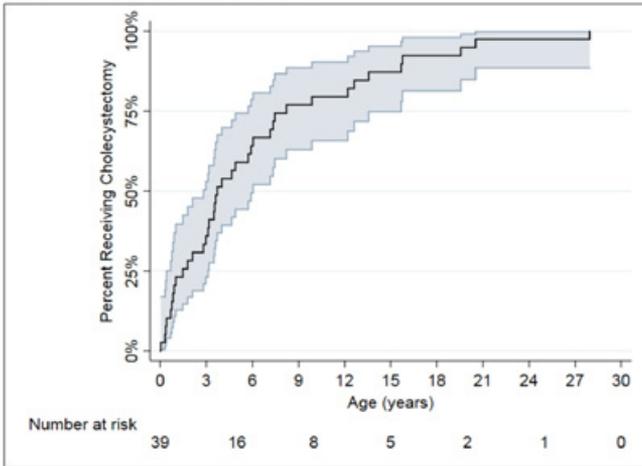
Results: Of 505 IF patients, 124 (24.6%) were diagnosed with biliary disease. Seventy-six (61.3%) received ursodiol and 39/124 (31.5%) of patients underwent cholecystectomy. Of the cholecystectomy group, 13 (33.3%) had cholelithiasis with biliary colic, 10 (25.6%) had prophylactic surgery in association with planned laparotomy, 9 (23.1%) had cholecystitis, and 7 (18.0%) choledocholithiasis. The median (IQR) age was 3.5 (1.3, 7.8) years at the time of surgery and is further described in the figure. Patients remaining on PN at the time of surgery (76.9%) were more likely to receive cholecystectomy earlier than patients who had achieved enteral autonomy [3 years (1, 7) vs. 7 years (3, 14), $p=0.022$] and had lower percent bowel length [13% (9, 29) vs 34% (28, 68), $p=0.007$].

Conclusions: Biliary disease remains a frequent concomitant of intestinal failure with almost one-third of those diagnosed receiving cholecystectomy. These operations are done at a young age, primarily for symptoms. In patients with intestinal failure, vigilance for complications of biliary disease is warranted, particularly in those remaining on parenteral nutrition.

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Figure. Kaplan-Meier curve demonstrating the age upon receiving cholecystectomy in patients with biliary disease. Median (IQR) age for the cohort was 3.5 (1.3, 7.8) years at the time of surgery, with 31 of 39 (79.5%) receiving surgery before 10 years of age.



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OUTCOMES IN CHILDREN AND ADOLESCENTS UNDERGOING CHOLECYSTECTOMIES WITH A HIGH EJECTION FRACTION

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Background: Cholecystectomy is commonly performed electively for symptomatic cholelithiasis and biliary hypokinesia with an ejection fraction (EF) less than 35%. Recent literature has shown that cholecystectomy in adults for biliary hyperkinesia (EF>65%) can provide resolution of symptoms (primarily pain) for the majority of patients. We seek to determine whether cholecystectomy is efficacious in the treatment of symptomatic biliary hyperkinesia in the pediatric population.

Method: The charts of 105 patients aged 10 to 18 from 2008 to 2018 who underwent cholecystectomy were reviewed to determine ejection fraction, BMI, race, pain with CCK-HIDA, complications, and resolution of symptoms (pain, vomiting, steatorrhea, diarrhea) post operatively. Analyses of surgical outcomes were performed between two groups, low/normal EF and high EF, which were stratified and compared.

Results: A total of 79 patients had low/normal EF (EF ≤65%), and 26 had high EF (EF>65%). Mann-Whitney, Chi-square, & Fisher's exact tests differentiated between groups. The resolution of symptoms rate was similar between groups with no statistical difference: low/normal EF (75%) vs. high EF (69%), p=0.497. Pain with HIDA scan appeared higher in the high EF group (p=0.047), refer to Table 1. No difference was shown between groups for gender, race, age, BMI, and follow-up rates. No surgical complications were seen in either group.

Conclusion: Pediatric patients with symptomatic biliary hyperkinesia experience a similar rate of resolution of their symptoms when compared to similarly matched patients who underwent cholecystectomy for biliary hypokinesia.

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P48

ROUTINE UPPER GASTROINTESTINAL SERIES BEFORE GASTROSTOMY TUBE PLACEMENT: IS IT NECESSARY?

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Background: Gastrostomy tube placement is a common procedure performed by pediatric surgeons, with approximately 9,000 performed annually in the United States. An upper gastrointestinal (UGI) series is routinely obtained preoperatively to define the patient's anatomy. We hypothesized that the incidence of significant anatomic abnormalities is low and that routine UGI may not be justified before feeding gastrostomy.

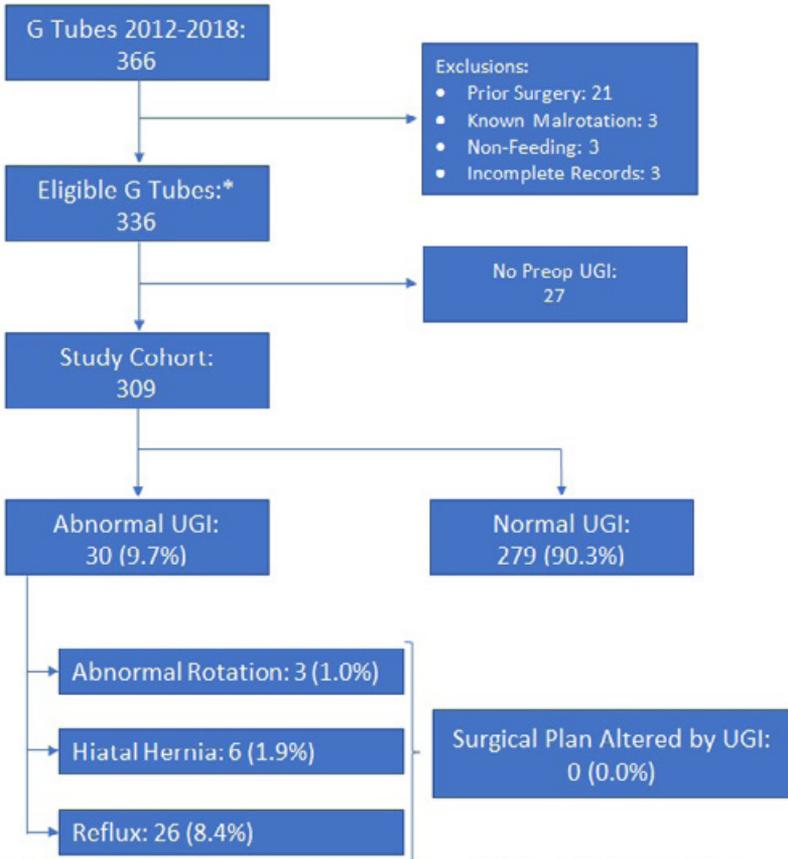
Methods: Patients <18 years of age undergoing feeding gastrostomy between 2012 and 2018 were retrospectively reviewed. Demographics, comorbidities, and preoperative UGI results were recorded.

Results: 366 patients underwent gastrostomy of which 336 were eligible for study inclusion. Exclusions included prior abdominal surgery (21), known malrotation (3), gastrostomy for purposes other than feeding (3), or incomplete records (3). 309 (92.0%) eligible patients had a preoperative UGI and subsequently underwent gastrostomy alone (176) or gastrostomy with Nissen fundoplication (133). Associated anomalies were chromosomal or metabolic in 34.0%, cardiac in 27.5%, craniofacial in 7.1%, GI in 0.6%, and neurologic impairment in 43.7%. There were 30 (9.7%) abnormal UGIs, including abnormal rotation in 3 (1.0%), gastroesophageal reflux in 26 (8.4%), and hiatal hernia in 6 (1.9%). In 2 cases of suspected malrotation on UGI, laparoscopy confirmed normal anatomy. The third had a rotational variant deemed not to require Ladd's procedure due to a wide mesenteric base and absence of Ladd's bands. Four of the 6 patients with hiatal hernias required repair. However, all 4 cases were scheduled for Nissen fundoplication based on clinical reflux symptoms, so the hernias could have been identified intraoperatively irrespective of the UGI findings.

Conclusion: Our study did not identify any patients that required additional procedures based solely on UGI findings, suggesting that the routine use of UGI before gastrostomy may not be warranted.

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*Eligible G tube means a primary gastrostomy tube placed for the purpose of feeding in a patient without an exclusion including: known malrotation or an anomaly known to be associated with it (eg gastroschisis), prior intraabdominal surgery, or tubes placed for a purpose other than feeding (eg gastropexy following gastric volvulus).

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POST-OPERATIVE COMPLICATIONS IN CHILDREN UNDERGOING APPENDECTOMY WITH A SYNCHRONOUS ONCOLOGIC DIAGNOSIS

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Tweet it! Appendectomy in children with active oncologic diagnoses is safe. #APSA2020

Purpose: To determine if (a) synchronous cancer diagnosis confers increased risks for post-operative complications in children undergoing appendectomy and (b) neutropenia accounts for any increased risk.

Methods: Retrospective cohort study using NSQIP, Pediatric (2012-2017). We included patients ≤ 18 years undergoing appendectomy. Patient variables included age, gender, pre-operative white blood cell count (WBC), whether or not currently undergoing chemotherapy, laparoscopic vs open appendectomy and perforated vs non-perforated appendicitis. Outcomes were 30-day post-operative superficial (SSI) and organ space infections, and hospital readmissions. Chi-squared testing was used to compare outcomes in a univariate analysis and multivariable logistic regression was used to calculate risks of complication.

Results: We identified 28,219 patients who had undergone an appendectomy; 25,055 (88.8%) had pre-operative WBC counts recorded and 95 (0.3%) had a synchronous cancer diagnosis and/or undergoing chemotherapy. Patients were also grouped based on leukocyte count preoperatively (Table). Patients with WBC $\leq 4,000$ were much more likely to be undergoing chemotherapy than those with WBC $>4,000$ (15.5% vs 0.2%, $p < 0.001$). Patients undergoing chemotherapy had a lower perforation rate than those not (16.3% vs 26.3%, $p=0.04$). When comparing patients with or without a cancer diagnosis on univariate analysis, there was no difference in 30-day rates of surgical site infection or abscess. Hospital readmission rates were markedly higher in those with a cancer diagnosis (22.1% vs 3.5%, $p < 0.001$), although specific reasons for readmission were not recorded. On multivariable logistic regression, cancer diagnosis was an independent risk factor for hospital readmission (OR 6.3, 95% C.I. 3.3-11.9, $p < 0.001$) but not for post-operative SSI or abscess. WBC $< 1,000$ was similarly found to be an independent risk factor for 30-day hospital readmission (OR 5.2, 95% C.I. 1.4-18.7, $p=0.01$).

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Conclusion: A synchronous cancer diagnosis and preoperative leukopenia are both independent risk factors for 30-day hospital readmission, but not perioperative complications in children undergoing appendectomy.

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ADULT ANXIETY AND PEDIATRIC TRAUMA ARE ASSOCIATED WITH INCREASED PERIOPERATIVE PAIN REPORTING FOR YOUNG PATIENTS

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Purpose: While anxiety has been noted to influence pain perception, there has been limited research demonstrating the impact of parental anxiety on pediatric pain perception for children undergoing low risk surgery. We hypothesized that higher adult anxiety would be associated with increased adult reporting of pediatric pain.

Methods: We recruited the parents of 73 patients aged 0-6 years preparing for elective operations between 2018-2019. Parents reported on their personal anxiety, the amount of pain they believed their child was experiencing, and if their child had experienced any adverse events or trauma. Demographic data and perioperative conditions were recorded. Anxiety was assessed with the State-Trait Anxiety Inventory (STAI), and pain was assessed with a visual analog scale, which were both collected at three standard visits: pre-operative appointment (T1), day of surgery (T2), and post-operative follow-up (T3). The primary outcome was to determine the relationship between adult anxiety and perception of pediatric pain. Analysis was completed with multivariate regression using step-wise selection and student's t-test.

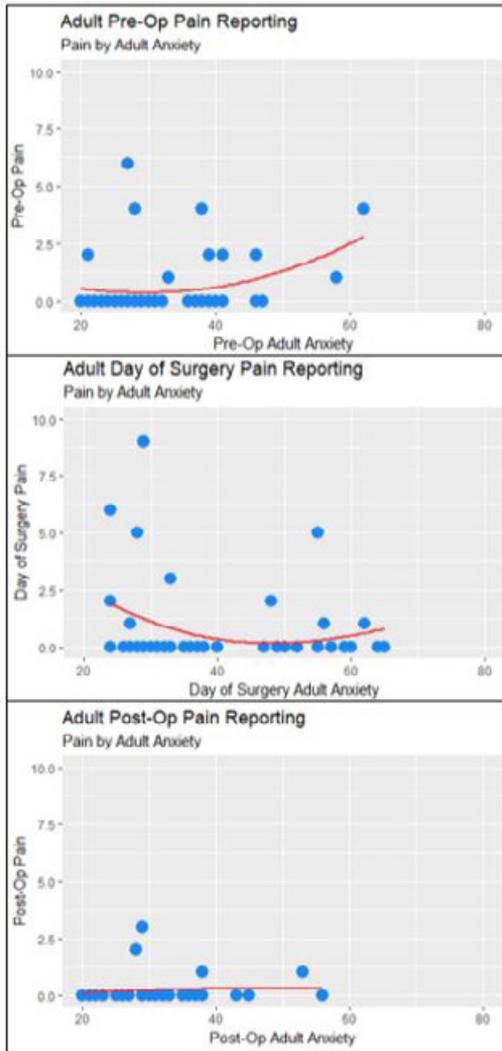
Results: Parents reported their children were in significantly more pain at T1 if the parent exhibited higher trait anxiety, if the child had a history of an adverse childhood events, and with one participating surgeon ($p=0.003$, $R^2=0.23$). At T3, parents reported higher pain for children with a history of adverse childhood events ($p=0.01$, $R^2=0.16$). There was no association between the independent variables and pain.

Conclusions: Parents are more likely to report their child is experiencing increased pain if the parent reports high trait anxiety, as well as if the child has a history of an adverse childhood event. This data suggests that pain perception in pediatric surgery is significantly influenced by psychosocial factors. As parents often direct the pain management of young children, these findings may identify a unique target for improved pain management and patient outcomes in pediatric surgery.

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Figure 1: Adult anxiety and perception of pediatric pain



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IMPACT OF INSERTION SITE ON COMPLICATIONS OF CENTRAL VENOUS ACCESS DEVICES IN PEDIATRIC ONCOLOGY PATIENTS

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Purpose: There is still debate over the safest route of placement of long-term central venous access devices. The aim of this study is to review a large, single-institution experience to determine impact of access location on peri-operative complications.

Methods: The records of patients undergoing subcutaneous port (SQP) and tunneled catheter (TC) insertion from January 2010 through December 2016 were reviewed. Patient demographics, subclavian (SCV) versus internal jugular (IJ) vein, image-guidance, and 30-day complications were included. Surgical complications were defined as pneumothorax, hemothorax, arrhythmia requiring intervention, malpositioning or malfunctioning requiring additional surgery. Infections were included if there was a positive blood culture within 30 days of insertion. Position was confirmed by fluoroscopy.

Results: A total of 1,309 patients were included (618 SQP, 691 TC). The location for insertion was SCV (909, 69.4%) and IJ (400, 30.6%). There were 117 complications (89 SCV, 28 IJ) including: malpositioning/malfunctioning (SCV 77, 8.5% and IJ 24, 6.0%), pneumothorax (SCV 4, 0.4% and IJ 1, 0.3%), hemothorax (SCV 1, 0.1% and IJ 1, 0.3%), arrhythmia (SCV 2, 0.2%, and IJ 0), wound dehiscence (SCV 3, 0.3% and IJ 1 0.3%), and arterial puncture (SCV 2, 0.2% and IJ 1, 0.3%). The complication rates were not different based on site. Ultrasound was used for 334 (83.5%) of IJ, and 10 (1.1%) of SCV insertions and was associated with lower complication than without (6.2% vs 9.9%, $p=0.036$). Table 1 lists patient demographics and complication rates based on location. There were no significant differences between the groups. Subgroup analysis demonstrated a higher surgical complication rate for SQP (24, 3%) versus TC (3, 0.4%) ($p<0.001$).

Conclusion: There is no difference in 30-day complication rates when using subclavian versus internal jugular vein as the site for long-term central venous access. When cannulating the IJ, ultrasound guidance is recommended to decrease complications.

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DETERMINING THE NEED FOR PRE-OPERATIVE PROPHYLACTIC ANTIBIOTICS IN PEDIATRIC PATIENTS RECEIVING ANTIBIOTICS FOR ACUTE INTRA-ABDOMINAL INFECTION

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Purpose: Administration of antibiotics within an hour of incision is a common quality metric for reduction of surgical site infections (SSI). Many pediatric patients who undergo surgery for an acute intra-abdominal infection are started on systemic antibiotic treatment upon diagnosis. For these patients, we hypothesized that additional prophylactic antibiotic coverage within an hour of incision would not decrease rates of SSI.

Methods: A single institution retrospective review of patients <18 years undergoing appendectomy or cholecystectomy from July 2014 to July 2019 was performed. Only patients receiving systemic antibiotics in the 24 hours before surgery were included. Patients were categorized based on receipt of an antibiotic to cover gram positive bacteria within an hour of incision (no prophylaxis vs. prophylaxis). The primary outcome was SSI within 30 days. Secondary outcomes were *Clostridium difficile* colitis, anaphylactic reaction in the operating room and readmission within 30 days due to infection. Outcomes were compared with chi-square test and Fisher's exact test.

Results: A total of 363 patients were evaluated, with 271 (75%) receiving antibiotics to cover gram positive bacteria within an hour of incision. There was no significant difference in rate of perforated appendicitis between groups (28.2% no prophylaxis vs. 28.4% prophylaxis, $p>0.999$). There was no significant difference in rates of organ space SSI (4.3% no prophylaxis vs. 4.4% prophylaxis, $p=0.97$), superficial SSI (1.1% no prophylaxis vs. 0.7% prophylaxis, $p>0.999$), anaphylaxis in the OR (2.2% no prophylaxis vs. 0.7% prophylaxis, $p=0.26$) or readmission (0% no prophylaxis vs. 1.8% prophylaxis, $p=0.19$). One patient who received prophylactic antibiotics within an hour of incision was readmitted on post-operative day 29 with *Clostridium difficile* colitis.

Conclusion: For pediatric patients receiving systemic antibiotics for acute intra-abdominal infection, additional prophylactic antibiotics within an hour of incision may not be necessary to prevent surgical site infections.

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SPLENECTOMY IN CHILDREN YOUNGER THAN 2 YEARS OLD: IS IT SAFE OR STILL TOO RISKY?

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Introduction: Splenectomy is a procedure that is sporadically performed in children who have hematological disorders such as hereditary spherocytosis or sickle cell anemia. This procedure has not been universally accepted in younger children due to increased risk and concern of post-splenectomy sepsis. Children with SSD occasionally are referred to surgery under 2 years of age after life-threatening episodes of splenic sequestration. We sought to better understand the risks of postoperative complications and post-splenectomy sepsis in this population.

Methods: We included all pediatric patients (<18 years old) who underwent laparoscopic or open splenectomy from 2013 to 2017 in the pediatric ACS-NSQIP database. Demographic, preoperative, postoperative and follow up data were extracted.

Results: A total of 1038 children underwent splenectomy in the study period. The median age was 9.1 years old [IQR 5.1-13.7] with 550 males (53%) and 558 white (53.8%). Splenectomy was performed laparoscopically in 925 children (89.1%). The most common cause for splenectomy was hereditary spherocytosis followed by non-classified splenomegaly and sickle cell disease. From this population, 52 children (5%) were younger than 2 years old. When comparing both groups there was no difference in gender, but younger children were more likely to be African/American (65% vs 32% $p<0.05$) and have an open repair (20% vs 10%, $p=0.06$). The most common cause of splenectomy in this group was sickle cell disease. Children younger than two years old tend to have a higher ASA score (ASA 4 11% vs 2%, $p<0.05$) and more preoperative transfusions (42% vs 20%, $p<0.05$). There was no difference in terms of length of stay, re-admission, mortality or postoperative complications (Table 1)

Conclusion: The benefits of early splenectomy may outweigh the risks of chronic transfusion and multiple hospitalizations in this vulnerable population. Further studies are needed to clarify any long-term implications of this procedure.

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COLLABORATION IMPROVES OUTCOMES FOR CHILDREN FOLLOWING THYROIDECTOMY

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Purpose: Pediatric thyroid disease requiring surgical intervention has an overall rare incidence but includes a breadth of diagnoses, both benign and malignant. Multiple surgical specialties receive training in pediatric thyroidectomy, and current evidence suggests that a multidisciplinary approach reduces complication rates. While previous literature has quantified the complication rate in multidisciplinary thyroidectomies, there does not currently exist a direct comparison to thyroidectomies performed by individual surgeons. The aim of this study is to quantify the complication rate of surgeons operating independently and compare it to that of a multidisciplinary approach. We hypothesize that multidisciplinary surgeries improve outcomes in pediatric thyroidectomies.

Methods: A retrospective study including two children's hospitals was performed. Patients between 0-20 years of age who underwent complete or hemithyroidectomy over a 12-year period were included in data collection. Patient demographics, diagnoses, surgical data and hospital outcomes were examined. Standard statistical analysis was performed, using chi-square analysis to compare categorical variables and student's T-test to compare continuous variables.

Results: 107 patients were included in the study, 51 of which were operated on by single surgeons and 56 by surgeons from multiple specialties. The average age was 13.9 years old (SD=3.52) and 75 of the 107 patients were female. Patients who were operated on by single surgeons were significantly more likely to require admission to the PICU compared to those who were operated on by surgeons from multiple specialties ($p=0.044$). They were also more likely to have a drain placed ($p=0.00008$) and experience post-operative hoarseness ($p=0.037$). Overall complication rate was significantly higher in single-surgeon thyroidectomies ($p=0.0012$), as was duration of hospital stay ($p=0.000016$).

Conclusions: Multi-disciplinary surgical care decreased complications and hospital resources in children undergoing thyroidectomy. Collaboration among surgeons that perform pediatric thyroidectomy in a single institution may improve outcomes for this rare disease.

POSTERS

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THE LEFT-SIDED REPAIR: AN ALTERNATIVE APPROACH FOR DIFFICULT ESOPHAGEAL ATRESIA REPAIR

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Purpose: Esophageal atresia (EA) repair is generally performed through the right chest; however, select cases may benefit from a left chest approach, including those with a leftward upper pouch, where placement in the right chest may lead to airway distortion, tracheomalacia exacerbation or recurrent laryngeal nerve injury, or those with numerous prior right-sided operations, especially if complicated by empyema. We describe our left-sided approach for these patients as an alternative to the right sided repair.

Methods: A retrospective review of all patients who underwent EA repair via traction induced growth (Foker procedure [FP]) from 2014-2019 was performed. Left sided repairs were considered for patients with a leftward upper esophageal pouch and minimal to no tracheomalacia on bronchoscopy. Outcomes were compared between groups (right vs left sided FP).

Results: Forty-seven patients (55% male) were included, with 17 in the left-sided group. Only one patient in the left sided group had a right aortic arch. Fewer left-sided FP patients underwent concurrent airway surgery (35.3% vs 50%, $p=0.34$); hence, they were more likely to undergo minimally invasive procedures (41% vs 7%, $p=0.004$). Though median days on traction was similar (11 vs 14, $p=0.7$), days of paralysis (8 vs 18, $p=0.003$), intubation (17 vs 25.5, $p=0.04$), and hospital stay (59 vs 75, $p=0.03$) were significantly less in the left FP group. Complication rates (including leak and stricture resection) were similar; however, a significantly greater percentage of right-sided FP patients required subsequent airway work (33.3% vs 5.9%, $p=0.035$). There were no differences in feeding outcomes, with 25% fully orally fed, and another 30% predominantly orally fed in each group at one year follow-up.

Conclusion: Select EA patients may benefit from a left thoracic approach in order to decrease potential for airway distortion or exacerbation of tracheomalacia, or as salvage pathway after failed right chest approach.

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MANAGEMENT OF PEDIATRIC SOLID BREAST MASSES: WHEN IS OBSERVATION APPROPRIATE?

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Purpose: Pediatric solid breast masses are common and almost always benign. Management remains variable as there are no standardized guidelines. The evidence supports observation for lesions smaller than 5cm. We sought to evaluate our experience to determine when observation is an appropriate option.

Methods: IRB approved, retrospective review of female pediatric solid breast masses treated at a single institution between 2016-2019. Size, imaging, management, and pathology were reviewed. Parametric and non-parametric tests were used for analysis.

Results: Of 233 patients, the median age was 16 years (Range: 10 – 17.9 years). Ultrasound was obtained in 64%. Excision was performed in 73% (171/233); 68% (117/171) were < 5cm in diameter, 27% (47/171) 5-10cm, 4% (7/171) > 10cm, and 40% (69/171) were symptomatic. There were no malignant lesions and 93% were fibroadenomas. Indication for excision was most commonly patient preference (61%), large size (19%), surgeon preference (11%), and growth (8%). Percutaneous needle biopsy was performed in 9 patients (4%), which only changed management to observation in one case. Of 116 masses < 5cm on ultrasound, the majority were excised (68% vs. observed 32%; $p = 0.002$). Indication for excision was patient preference in 75%. Of 75 masses initially observed, 17% went on to excision due to patient preference (77%) or growth > 50% (23%). The remaining 62 masses (83%) that were observed without resection had median diameter 1.7 cm. Follow-up data was available for 68% (42/62). All masses were either stable at one year (76%) or resolved (24%).

Conclusion: Although all pediatric solid breast masses in our series were benign, excision was common for lesions of all sizes and was most commonly driven by patient preference. Observation without biopsy is likely safe for small, asymptomatic lesions that remain stable in size. An evidence-based guideline would be helpful to standardize management and counsel families.

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LAXATIVE VERSUS ENEMA USE IN PEDIATRIC FECAL INCONTINENCE

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Purpose: Severe fecal incontinence (FI) is a common phenomenon in pediatric patients with and without congenital colorectal malformations. There is a paucity of data describing successful, long-term management strategies for FI, further contributing to the significant burden on patients and their families.

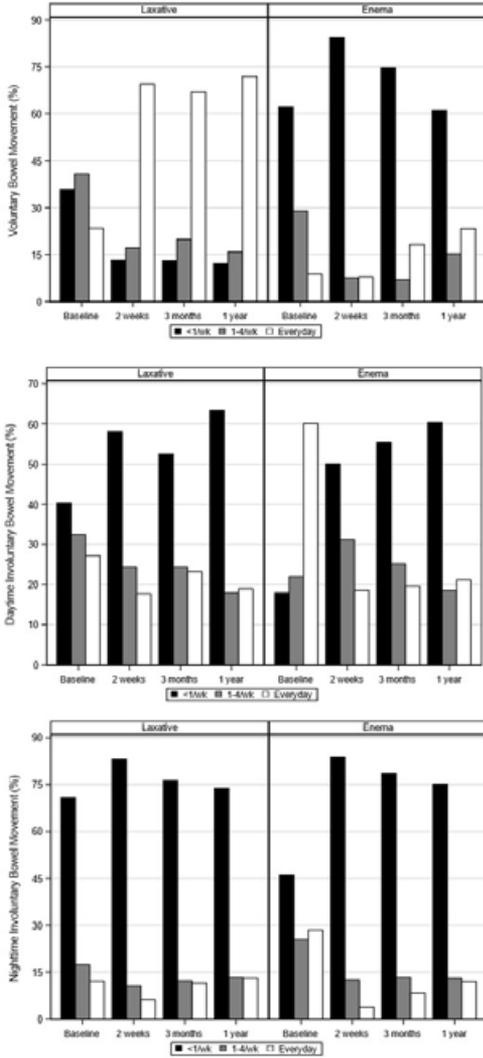
Methods: 342 patients aged 3 to 12 years were enrolled over a 3-year period into a bowel management program. Patients were assessed by a multidisciplinary team and begun on either a laxative or enema regimen. FI severity was measured prospectively over the course of one year using an internally created clinical score calculated from surveys obtained in person and electronically. Key measurements include frequency of voluntary (VBM) and involuntary bowel movements (IVBM) (daily, 1-4 times per week or less than 1 per week).

Results: There were no differences in gender and race when choosing enema or laxative therapy. Younger patients and those with anorectal malformation, Hirschsprung's disease and congenital spine issues were more likely to be placed on enemas ($p < 0.05$). At baseline, almost twice as many patients reported daily VBMs in the laxative group compared to the enema group. Similarly, twice as many in the enema group reported daily daytime IVBM compared to those on laxatives. Within two weeks of bowel management, however, marked improvements in VBM, daytime and nighttime IVBM frequency were observed ($p < 0.05$, Figure). Despite differences at baseline, both groups showed improvement with ongoing bowel management using their respective methods. These improvements were sustained after one-year. There were no differences in daytime or nighttime IVBM improvement with either enema versus laxative methods ($p = 0.14$).

Conclusion: Laxatives or enemas, when used consistently in a systematic fashion as in a bowel management program, can result in significant and sustained improvement in pediatric fecal incontinence. Patients and caregivers must work together to determine the appropriate diagnosis, and thus therapy, to facilitate success.

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LONGTERM OUTCOMES AFTER PARTIAL SPLENECTOMY

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Introduction: Partial, or subtotal, splenectomy has become an accepted alternative to total splenectomy for management of hematologic disorders in children who would otherwise be left susceptible to over-whelming post-splenectomy sepsis (OPSS), at the expense of potential subsequent reoperation for total splenectomy or cholecystectomy. Here, we present our experience of patients undergoing partial splenectomy, to determine the rate of reoperation and if any factors affected this return.

Methods: All patients who underwent partial splenectomy at a single large children's hospital were retrospectively reviewed from 2002 through 2019 after IRB approval.

Results: 28 patients had partial splenectomy, at median age 6.0 years (IQR 4.0-7.5), and were followed over 8.1 years (IQR 3.4-10.3). 25% (n= 7) of patients required completion splenectomy. There was no significant difference in age at index operation (p=0.84), spleen volume (p=0.14), mean preoperative and post-operative hemoglobin (p= 0.19 and 0.88, respectively), mean preoperative and post-operative reticulocyte count (p= 0.98 and 0.31, respectively), or transfusion requirements after index operation (p=0.42) when comparing patients who did not require completion splenectomy to those who did. 32% (n= 9) of patients had a cholecystectomy with partial splenectomy, and of those who did not, 26% (n= 5) required a cholecystectomy later on. Among those who did not undergo concomitant cholecystectomy, the presence of gallstones on preoperative ultrasound was not associated with the rate of subsequent cholecystectomy (p=1.00). Median time to completion splenectomy was 2.9 years (IQR 1.5-7.2), and to delayed cholecystectomy was 3.8 years (IQR 2.8-6.8). There were no cases of OPSS or deaths.

Conclusion: Partial splenectomy is a safe alternative to total splenectomy in children with hematologic disease with decreased susceptibility to OPSS, however, families must be counseled that there is a 25% chance of reoperation to total splenectomy, and 26% chance of subsequent cholecystectomy if not completed at index operation, regardless of other physiologic variables.

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IMPROVING APPENDIX VISUALIZATION RATES FOR CHILDREN PRESENTING WITH ABDOMINAL PAIN TO A COMMUNITY HOSPITAL

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Purpose: Ultrasound is frequently used in the diagnostic workup of abdominal pain in pediatric patients. Unfortunately, visualization of the appendix can be difficult and ultrasound is operator dependent. The purpose of this study was to determine if a brief educational intervention and standardized checklists for abdominal ultrasounds could improve the rate of diagnosis or exclusion of acute appendicitis and thus reduce the number of CT scans in pediatric patients with acute abdominal pain.

Methods: A new scanning protocol for sonographers was developed for evaluating acute appendicitis. In October 2018, our pediatric radiologist provided sonographers with education, including a worksheet containing a checklist of anatomic findings to identify. A new dictation template was created to include findings listed on the sonographer worksheet. We analyzed 1139 pediatric patients presenting with abdominal pain who underwent ultrasound from Jan 2016-Sept 2018 before the checklist initiation and 448 patients after the intervention from Oct 2018 – Aug 2019. We compared rates of appendix visualization, CT scans, admissions, and surgery.

Results: The results from before and after the intervention are demonstrated in Table 1. There was no significant difference in patient age using two sample T-test. Pearson chi-squared tests were performed and demonstrated no significant difference in gender, admission rates, or surgery. There was a statistically significant decrease appendix non-visualization rate (83% vs. 74%, $P < 0.0001$) and in patients undergoing CT scan (23% vs 13%, $p < 0.0001$).

Conclusion: Providing sonographers with education and a standardized checklist for acute appendicitis can improve the visualization rate of the appendix and reduce the number of CT scans performed in children who present to the emergency department with acute abdominal pain.

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PREDICTIVE VALUE OF ACR TI-RADS SCORING IN CHILDREN WITH THYROID NODULES

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Purpose: To test the ability of the American College of Radiology (ACR) Thyroid Imaging Reporting and Data System (TI-RADS) classification to predict thyroid nodule malignancy in the pediatric population.

Methods: Retrospective review of head and neck ultrasounds performed at a free standing children's hospital in patients age 18 years and younger between January 2014 and August 2019. Among ultrasounds performed for (or identifying) thyroid nodules, we collected demographic data, nodule TI-RADS scores, disposition (observation, biopsy or surgical excision) and final pathology results. Predictive values of TI-RADS scores vis-à-vis nodule malignancy were determined and compared to published adult data.

Results: Among 2,451 ultrasounds of the thyroid 106 patients with one or more nodules were identified; of these, 31 had biopsy results available. In patients who underwent surgical resection, final specimen pathology was recorded. In others, we recorded results of fine needle aspirate or core biopsy cytopathology. The prevalence of malignancy for TI-RADS scores 2, 3, 4, and 5 were 0%, 0%, 36% and 31%, respectively. These results are somewhat lower than published adult data. Negative predictive value, positive predictive value, sensitivity and specificity of TI-RADS 5 vs <5 were 78%, 31%, 50% and 61%, respectively. When using a cutoff of TI-RADS 4 or 5 vs <4, those results were 100%, 33%, 100% and 30%, respectively.

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Conclusion: These preliminary data suggest that TI-RADS scores may be less predictive of thyroid nodule pathology in pediatric patients than in adults. Using a cutoff of TI-RADS 4 or 5 may be most helpful in optimizing test sensitivity, although the specificity of these tests remains suboptimal. TI-RADS is a relatively new classification system and therefore prospective multi-center studies may yield more accurate information regarding its utility in the pediatric population.

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POINT-OF-CARE ULTRASOUND IN THE DETECTION OF SOFT TISSUE FOREIGN BODIES IN THE OUTPATIENT PEDIATRIC POPULATION

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Purpose: To evaluate the utility of point-of-care ultrasound (POCUS) in the identification of soft tissue foreign bodies in the pediatric surgery clinic.

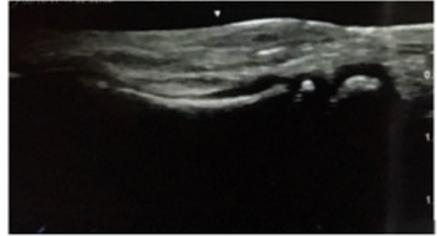
Methods: All patients with a CPT code for foreign body removal by the pediatric surgery service between April 1, 2012 and June 1, 2019 were included. POCUS became available April 1, 2016. Pearson's chi-squared test ($\alpha=0.05$) was used to compare the number of radiologic tests ordered before and after the availability of POCUS.

Results: 168 patients met inclusion criteria. Mean age was 9.04 years (SD 5.26). Foreign bodies were most common in the foot ($n=79$, 47.0%) and face/scalp ($n=25$, 14.9%). The most common foreign body materials were metal ($n=52$, 32.1%), wood ($n=48$, 29.6%), and glass ($n=41$, 25.3%). 112 patients were referred to the Pediatric Surgery clinic by their Primary Care Physician ($n=54$, 47.0%) or the Emergency Department ($n=58$, 50.4%) and sometimes presented with x-rays ($n=80$, 65.0%) or formal ultrasounds ($n=21$, 17.1%) prior to consultation. Prior to the availability of POCUS, additional imaging was ordered by the pediatric surgery service for 33 patients (33.7%) compared to 13 patients (23.2%) once POCUS became available ($p=0.17$), including 9 formal ultrasounds ($n=69.2\%$). Once available, POCUS was used in 24 cases (42.9%), most often of the foot ($n=13$, 54.2%), and successfully identified a foreign body on 20 occasions (83.3%). Two of six surgeons accounted for 79.2% ($n=19$) of POCUS use. All patients (100.0%) underwent wound exploration with foreign body removal and only three (1.8%) required re-exploration for retained foreign body. Prior to re-exploration, one patient underwent formal ultrasound (33.3%), one underwent MRI (33.3%), and the other had no imaging (33.3%).

Conclusion: Point-of-care ultrasound is an effective modality for identifying soft tissue foreign bodies in the pediatric surgery clinic and resulted in a trend towards fewer formal radiologic studies, potentially reducing cost to patients.

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THE HIDDEN MORTALITY OF CONGENITAL ANOMALIES IN UGANDA

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Purpose: The true incidence of congenital anomalies in sub-Saharan Africa is unknown. Existing data estimates rely upon patient presentation to health facilities. This project aims to examine perceptions of congenital anomalies in Uganda that may alter surgical care-seeking behavior and subsequent estimate of disease burden.

Methods: Interviews regarding beliefs surrounding congenital anomalies were conducted with 198 Ugandans between September 2018 and May 2019. Of these, 91 were family members of a child with a congenital anomaly. Responses from community members versus affected family members were compared using Fisher's exact, Cochran-Mantel-Haenszel, and t-tests. $P < 0.05$ was considered significant.

Results: 18 tribes and 40 districts were represented. Of all respondents, 100% (n=198) assumed that seeking surgical care for an anomaly would send a family into poverty, 43% (n=84) believed fathers would abandon the child, and 26% (n=51) thought the child should be left to die. Causes of anomalies were believed to be contraceptive methods (48%, n=95), witchcraft (17%, n=34) or drugs and alcohol (10%, n=19). Of participants who had a child with an anomaly, 32 (35%) were advised to seek care from traditional healers, 25 (28%) were advised to allow the child to die, and the median distance traveled to the hospital was 95 kilometers (Q1=65km, Q3=300km). Compared to community members, families with affected children were more likely to have a lower income ($p < 0.001$) and believe anomalies could be successfully treated ($p = 0.007$), but also thought that allowing the child to die was best for the family (32% versus 9%, $p < 0.0001$).

Conclusion: Misconceptions regarding congenital anomalies are common in Uganda, and families face significant financial and social pressures when deciding to seek surgical care. These data suggest that many patients with congenital anomalies may die and never reach a health facility to be counted, thus contributing to the hidden mortality.

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LENGTHENING OF MULTIPLE INTESTINAL SEGMENTS IN-CONTINUITY USING BIODEGRADABLE SPRING DEVICE

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Purpose: To demonstrate the feasibility and analyse challenges of mechanical lengthening of multiple intestinal segments in-continuity using biodegradable spring device.

Methods: Spring device was produced from polycaprolactone – a biodegradable polymer used for sutures and various medical devices. Compressed spring length was 25 mm, relaxed spring was 60 mm long. The use of all animals was authorised by a Laboratory Animal Control Commission. Six female pigs aging 2 months each underwent placement of three biodegradable compressed springs into the jejunum in-continuity. Intestinal plication using dissolvable sutures was performed for narrowing intestinal lumen around each compressed spring to secure them. Spring physical parameters were chosen according to published data by several labs worldwide. Animals were observed for the mean period of three weeks (1-4). By the end of observation the animals were euthanized, intestine was examined for lengthening. Regular staining and immunohistochemistry were used to analyze histological changes according to different observational periods to compare the effect.

Results: Four pigs tolerated liquid diet followed by regular feeds with no sign of bowel obstruction and no weight loss. Two pigs died from early surgical complications. Most intestinal segments demonstrated up to 2,5-fold lengthening. Three springs migrated from the place of implantation. Long follow-up animals demonstrated natural passage of the springs with the stool after 3 weeks of observation. Morphological examination revealed significant increase of villi height, crypt depth and muscularis propria thickness as well as neoangiogenesis.

Conclusion: Distraction enterogenesis is a promising alternative for the surgical management of short bowel syndrome. Using biodegradable spring device allows to lengthen multiple intestinal segments in-continuity with no need for repeated procedure to extract the device. Better fixation method needs to be applied to prevent migration of the springs during lengthening. Further studies of distraction enterogenesis are needed for its implementation in the clinical practice.

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SUMMER TRAUMA EXPERIENCE PROGRAM FOR STUDENTS (STEPS): AN INNOVATIVE COMMUNITY OUTREACH CURRICULUM

Christina M. Bence, MD¹, Afua Amoabin, BS², Kristin Braun, RN, MS³, Tiffany Christensen⁴, Jennifer Doerr, MSN, RN⁵, Alyssa Graffy, MHA⁶, Sabina M. Siddiqui, MD⁷

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Background: Confronting community violence with a multi-disciplinary public health model is the gold standard for healthcare advocacy in trauma. The impact of this multi-disciplinary approach is strengthened by increased diversity of involved healthcare providers, as well as exposure to and engagement in the community they serve. To employ a public health approach to violence prevention in our community, we developed a youth outreach program that addressed community violence and racial/ethnic disparities in healthcare through engagement, education, and empowerment.

Methods: The Summer Trauma Experience Program for Students (STEPS) was an innovative two-day curriculum that introduced minority youth to a broad spectrum of healthcare careers and addressed community violence through hands-on, experiential learning techniques. Our Level-1 pediatric trauma center partnered with a local minority youth outreach program to develop the curriculum, which included a panel discussion with healthcare professionals, "Stop the Bleed" course, and interactive dialogues regarding personal experiences with violence. Day two introduced an immersive trauma "shadow-simulation" in which youth paired with healthcare providers actively engaged in a simulation scenario that began at scene of injury and progressed through patient transport, resuscitation in the ED, and culminated in a debriefing exercise.

Results: Twenty-two youth participated with a mean age of 14 years and even gender representation. The majority were Black/African American and first-generation Middle-Eastern American. Twenty-one healthcare professionals with diverse genders, ethnicities, and backgrounds were involved, including a pediatric surgeon, surgical residents, medical students, trauma nurses, first-responders, social workers, and psychologists. The response to the program from engaged community members was overwhelmingly positive.

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Conclusion: Our experience with STEPS demonstrates that a directed, immersive public health approach to community outreach and violence prevention is feasible and invited by community members and stakeholders. Further, the concept of “shadow-simulation” adapts complex medical concepts and skills to the level of the learner, allowing for engagement and empowerment of community youth.



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HEALTH MINDSET RELATES TO QUALITY OF LIFE FOR ADOLESCENT RENAL TRANSPLANT PATIENTS

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Purpose: Mindset theory has long played a major role within school settings and has now been linked to health and behavioral outcomes within chronic medical conditions. Specifically, a growth mindset, in which health is viewed as improvable through effort, has been associated with better health outcomes than a fixed mindset, in which health is defined as unchangeable. In this study, we examine health mindsets within a pediatric surgical population of adolescent renal transplant patients to assess their link to post-transplant health and quality-of-life (QOL) outcomes.

Methods: Upon IRB approval, 43 adolescents completed a set of questionnaires at routine outpatient visits. Patients were given the Health Mindset Scale and QOL measures. Objective surgical outcomes were recorded through chart reviews.

Results: In terms of self-reported QOL measures, patients with a growth mindset of health reported significantly more confidence in their medications and treatments than those with a fixed mindset ($p < .05$). Furthermore, there was a trend toward improved provider-reported adherence for patients with a growth mindset. Although trends were noted for lower rates of rejection and overall infections in the growth-mindset patients, no significant differences were identified in these health outcomes.

Conclusions: Although limited by sample size, we were able to demonstrate a link between health mindsets and QOL measures within a surgical population of adolescent renal transplant survivors. Specifically, a growth mindset, in which health is viewed as malleable and subject to improvement, is associated with a more positive outlook than a fixed mindset. These findings support the notion that health mindset may play a valuable role in the psychological wellbeing of pediatric surgical patients. Next steps include the development of multi-institutional studies to better understand the role of health mindset within other surgical patients as well as the creation of interventions to promote growth mindsets of health.

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COMPARATIVE OUTCOMES FOLLOWING LAPAROSCOPIC SLEEVE GASTRECTOMY IN ADOLESCENTS WITH AND WITHOUT PARENTS WHO HAVE UNDERGONE BARIATRIC SURGERY

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Purpose: Adolescents undergoing bariatric surgery with a parent who has also undergone surgery likely have a genetic component to their disease, but potentially greater perioperative home support. To further elucidate the role of nature or nurture we compared outcomes following laparoscopic sleeve gastrectomy between adolescents with and without parents who have undergone bariatric surgery.

Methods: A retrospective review of a prospective database containing all patients undergoing laparoscopic sleeve gastrectomy between January 2010 and May 2019 at a single institution was performed. Preoperative measures included age, weight, body mass index (BMI), and presence of a parent with a history of bariatric surgery. Primary end points were percent excess weight loss (%EWL) and percent excess BMI loss (%EBMIL). Continuous data were compared using Student's t-test.

Results: In total, 308 patients were reviewed. Seventy (22.7%) patients had a parent with previous bariatric surgery (PBS) and 238 (77.3%) did not (NBS). PBS patients were younger at time of operation (16.5+/-2.1 vs. 17.2+/-2.4, p=0.03) with higher initial weight (145.4+/-33.3 kg vs. 136.9+/-26.9 kg, p=0.03) and BMI (51.7+/-11.1 vs. 49.4+/-8.1, p=0.07). Six months post surgery, the NBS group had higher %EWL (43+/-15 vs. 38+/-12, p=0.05) and %EBMIL (52+/-20 vs. 45+/-15, p=0.04). However, both measurements were similar between the two groups at all later points. Mean %EWL at one year was 45+/-16 in the PBS group compared to 49+/-21, (p=0.38) in the NBS group. Similarly, mean %BMIL was 54+/-21 in the PBS group compared to 59+/-26, (p=0.31) in the NBS group.

Conclusion: Adolescents with a parent with previous bariatric surgery present for surgery at a younger age and heavier weight and BMI. They have less initial weight loss, but have similar long-term outcomes compared to those without a parent who has undergone surgery. The data indicate that home environment may play a role in postoperative outcomes and warrants further focused study.

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THE BUSINESS OF EXTRACORPOREAL MEMBRANE OXYGENATION IN CONGENITAL DIAPHRAGMATIC HERNIA: COST CONTRIBUTORS AND REIMBURSEMENT PATTERNS IN PROFESSIONAL AND HOSPITAL BILLING**Alejandra M. Casar Berazaluze, MD¹**, Jason S. Frischer, MD²*¹Cincinnati Children's Hospital Medical Center, University of Texas Health Science Center at San Antonio, Cincinnati, OH, USA, ²Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA*

Purpose: CDH is one of the costliest diagnoses in pediatric surgery. ECMO is utilized in its management, with evident increment in costs without significant change in survival. We aimed to identify the main cost contributors to these bills and analyze their patterns of reimbursement.

Methods: A retrospective review was performed for 2015-2017. Itemized hospital and professional bills were retrieved. Descriptive statistics were obtained, and reimbursement rates were calculated. Per payor differences were analyzed with t-tests. Hospital charges were ranked in all bills; the three highest cost contributors were present in all accounts. Professional ECMO charges and payments were summarized.

Results: Twelve patients were identified. The median length of ECMO was 15 days, with length of stay of 87 days and 58% mortality. The top three contributors to hospital bills were NICU room rate (26%), nitric oxide (26%), and ventilator day charges (5%). Mean reimbursement was 57% for hospital (Medicaid=41%, Private=78%, $p=0.008$) and 30% for professional bills (Medicaid=10%, Private=59%, $p=0.0006$). Professional charges accounted for 10% of total charges. Pediatric Surgeon charges were 50% of professional charges.

Conclusion: The top three cost contributors to ECMO were NICU room rate, nitric oxide, and ventilator day charges. Reimbursement averaged 57% for hospital and 30% for professional bills, showing lowest reimbursement from Medicaid. Pediatric surgeon fees accounted for 5% of total charges. Although ECMO is an expensive bridging therapy in CDH, the main drivers of cost are unrelated to ECMO supplies, surgery, monitoring, or blood products. Adjusting our guidelines with high quality evidence to support their use can make a significant difference in healthcare expenditure. Further research is warranted to define the role of nitric oxide in ECMO/CDH given its high cost and limited evidence of support from current literature, as its use has become widespread without improvements in mortality or ECMO utilization.

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CHANGES IN GEOGRAPHIC DISTRIBUTION OF PEDIATRIC SURGEONS BETWEEN 2005-2015

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Purpose: Recognized impediments to quality health care for children include time, cost, distance. In 2010, more than 10 million children lived greater than 60 miles from a pediatric surgeon, and disparities in distance-to-care were demonstrated across race, ethnicity, and state. While the number of pediatric surgery fellowship training positions has increased over that time period, it is not known how this affected geographic distribution of trained pediatric surgeons within the continental United States. The aim of this study was to evaluate the change, if any, in distances-to-care between children living in the continental United States and pediatric surgeons across the years 2005 to 2015.

Methods: The 2005-2015 American Pediatric Surgical Association member file and the 2010 Decennial Census were used to calculate straight-line distances between pediatric surgeons' zip code centroids and census block centroids.

Results: There were 399 practicing pediatric surgeons across 238 locations in 2005 compared to 837 practicing across 406 locations in 2015. In 2005 and 2015, across the continental United States, the median (IQR) miles to the nearest pediatric surgeon was 16.3 (7.5,46.1) and 13.1 (6.1,35.5) respectively.

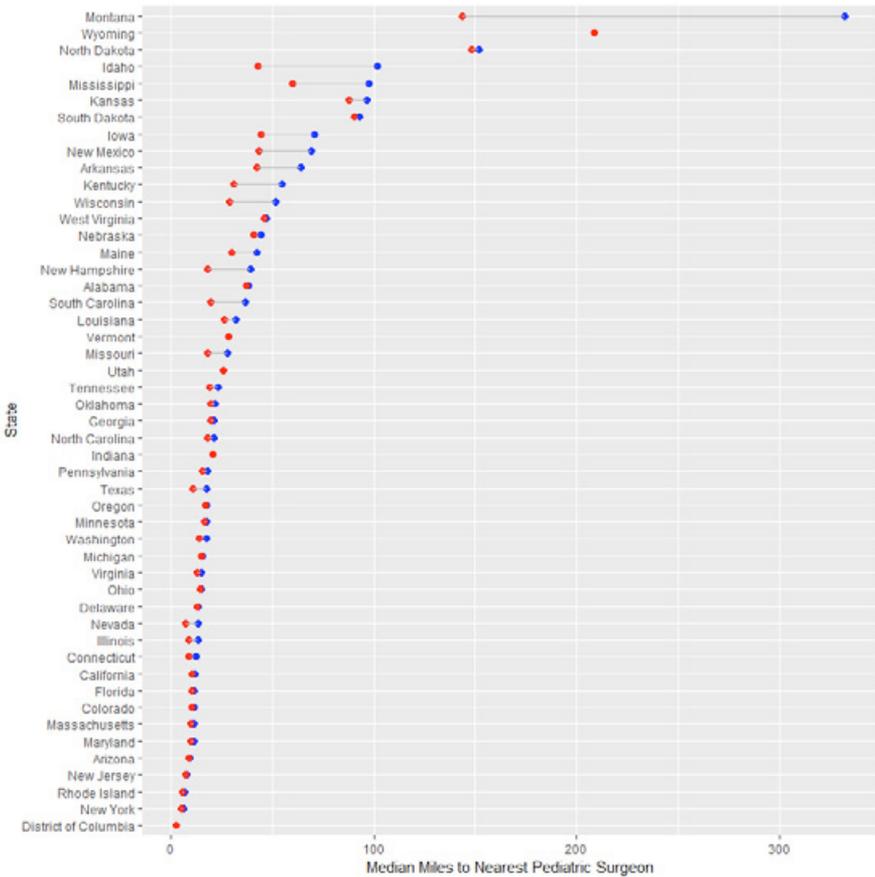
Conclusions: Disparities in proximity to pediatric surgeons were present and persistent across states between 2005 and 2015. While there was decrease in median distance-to-care nationally and across most states, this improvement was significant in only a small number of states. This method is feasible to evaluate distance-to-care with the upcoming 2020 Decennial Census and is a valuable tool as future geographic allocation of pediatric surgeons is discussed.

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Figure 1. Change in median distance to nearest pediatric surgery between 2005 and 2015 by state

Figure Legend: Red dot represents median distance to nearest pediatric surgeon in 2015 while blue dot represents median distance to nearest pediatric surgeon in 2005.



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FIRST YEAR EXPERIENCE WITH A COLLABORATIVE HYBRID OPERATING ROOM AT A QUATERNARY CHILDREN'S HOSPITAL

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Purpose: Hybrid operating rooms (HOR) are valuable assets for cardiothoracic, neurosurgical, vascular, and trauma interventions in adult hospitals. Limited experience exists for their use in pediatric surgery. Our institution debuted a multi-purpose collaborative HOR in February 2018 designed to combine the skills of interventional radiologists and pediatric surgical subspecialists to improve surgical care of pediatric patients. We sought to review our one-year utilization to identify areas of opportunity for improvement.

Methods: All HOR cases between February 2018 and February 2019 were retrospectively reviewed. Descriptive statistical analyses were performed.

Results: A total of 186 cases were identified. The HOR was used 124 days –49% of working days, 34% of calendar days– with an average of $2\pm 1(1-5)$ cases per day. It was in use for 539 hours within an 8-hour open block during 253 working days, representing 27% room utilization. The breakdown of cases included 84(45%) hybrid, 41(22%) c-arm, 41(22%) OR overflow, and 20(11%) IR overflow cases. For hybrid cases, 213 procedures were performed –a mean of $3\pm 1(1-6)$ per case. Two or more specialties were involved in 98% of cases, three or more in 25%. Average case duration was $4\pm 2(1-13)$. There were $2\pm 1(0-4)$ imaging modalities used per case –69% using two or more, 20% using three or more.

Conclusion: This early experience with our HOR demonstrates that multiple procedures can be performed as a single event, indicating potential cost and time savings and reduction in risks associated with repeated anesthetic use. The room was utilized as a multi-specialty collaboration in most cases, representing more integrative patient care and improved provider communication. High interventional radiology involvement and the use of image guidance speaks to more targeted interventions that are safer and less invasive. A mixed practice use in our collaborative HOR nearly doubled room utilization during this early adoption phase, strengthening the business model for this innovative suite.

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THE IMPACT OF GENERAL SURGEONS ON PEDIATRIC SURGICAL PRACTICE: THE NORTH CAROLINA EXPERIENCE

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Introduction: The adequacy of the United States pediatric surgical workforce is widely debated. Fellowships for pediatric surgeons (PS) have increased, and index cases at recertification are low. The role of general surgeons (GS) in pediatric surgical care is unknown.

Methods: A retrospective review of the 2013-2015 North Carolina Hospital Inpatient Discharge Database was performed. Pediatric patients (less than or equal 18 years) undergoing common general surgery procedures were included. Bivariate analysis by surgical provider (PS, GS, other surgical specialty [OSS], and unassigned surgeons [US]) was performed. Logistic regression with multiple imputation to impute US data was performed to identify predictors of surgical intervention by PS versus GS.

Results: Of the 9385 examined procedures, 5147 (54.8%), 2570 (27.4%), 574 (6.1%), and 1094 (11.7%) patients were operated on by PS, GS, OSS, and US, respectively. PS patients were younger (5.8 years, SD 6.1) than GS patients (11.7 years, SD 5.7), $p < 0.001$. More patients undergoing surgery by GS ($n = 1647$, 64.1%) were emergent compared to 45.2% ($n = 2324$) by PS, $p < 0.001$. Patients traveled a median of 22.2 (IQR 9.6–40.0) and 9.7 (IQR 4.1–18.3) miles for an operation by PS and GS, respectively, $p < 0.001$. After regression, patients had higher odds of undergoing operations by GS compared to PS if they were older (OR 1.10, 95%CI 1.09–1.11, $p < 0.001$), admitted for emergent surgery (OR 1.59, 95% CI 1.41–1.78, $p < 0.001$), or had government insurance (OR 1.74, 95% CI 1.57–1.92, $p < 0.001$).

Conclusion: Pediatric surgeons are more likely to operate on younger patients undergoing elective operations, and less likely to operate on patients with emergent admissions with federal government insurance. General surgeons continue to perform a large percentage of emergent surgery for pediatric patients. These data demonstrate the importance of working with general surgeons to augment in-training pediatric surgery exposure in order to provide access to optimal surgical care for pediatric patients.

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INFECTION PREVENTION PRACTICES AND SURGICAL SITE INFECTION RATES VARY SIGNIFICANTLY BETWEEN CENTERS: A MULTI-CENTER COHORT STUDY OF INFANTS UNDERGOING GASTROINTESTINAL SURGERY

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Purpose: Surgical site infections (SSIs) remain the leading cause of postoperative morbidity in infants. Best practices for SSI prevention remain elusive. We aimed to determine SSI rates within a large cohort of infants undergoing gastrointestinal surgery and describe the utilization of various infection prevention strategies by different centers.

Methods: Data were collected on all infants (age <1) who underwent gastrointestinal surgery at 16 children's hospitals between 8/1/2017-1/31/2018. Infants who underwent non-emergent procedures and survived ≥48 hours after surgery were included in the analysis. Gastrointestinal surgeries included tracheoesophageal fistula repairs, gastrostomy tube (GT) placements or closures, funduplications, intestinal procedures, gastroschisis/omphalocele repairs, exploratory laparotomies, and anorectal malformation repairs. The primary outcome, SSI, included superficial, deep and organ/space infections. Descriptive statistics and univariate analyses were utilized, with $p < 0.05$ considered significant.

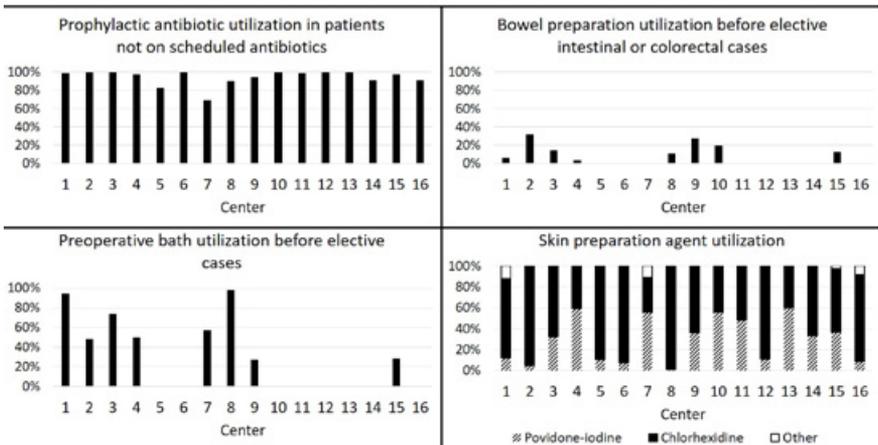
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Results: SSI occurred in 46 of 915 operations (5%), but SSI rate varied by procedure: 18% of tracheoesophageal fistula repairs, 7% of intestinal procedures, 6% of combined GT/funduplications, 3% of GTs, and 2% of gastroschisis/omphalocele repairs. Centers performed a median of 42.5 eligible cases during the study period (range 5-128), and the median institutional SSI rate was 4% (range 0-19%). Utilization of surgical prophylactic antibiotics, bowel preparation, and preoperative baths varied significantly between centers, while selection of surgical skin preparation agents varied both between and within centers (Figure). Perioperative normothermia was maintained in only 68% of cases overall, with individual centers ranging from 48-100%. Other SSI prevention measures were rarely documented as having been utilized, such as changing gowns (n=2), gloves (n=7), drapes (n=1), or instruments (n=2) prior to closure.

Conclusion: Surgical site infection rates varied significantly between centers. High inter- and intra-institutional variation was observed in the utilization of various infection prevention strategies. Practice standardization and increased utilization of recommended infection prevention practices may improve outcomes in this population.

Figure: Between-Center Variation in Utilization of Various Surgical Site Infection Prevention Strategies



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VALIDATING AN OPIOID PRESCRIBING ALGORITHM IN POST-OPERATIVE PEDIATRIC SURGICAL ONCOLOGY PATIENTS

Sara A. Mansfield, MS, MD, Amy Kimble, MS, NP-C, Lynn Wynn, MSN, CPNP, Doralina Anghelescu, MD, Andrew J. Murphy, Andrew M. Davidoff, MD

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Purpose: Postoperative opioid prescribing patterns are variable, and often excessive. We developed an algorithm to decrease opioid prescriptions at discharge based on a retrospective analysis. The aim of this study was to prospectively test the algorithm in pediatric oncology patients.

Methods: Patients undergoing abdominal or thoracic surgery for tumor resection at a single institution were included. Patients taking pre-operative opioids were excluded. Prospectively collected data included: operative details, inpatient opioid use 24 and 8 hours prior to discharge, oral morphine equivalents (OME) per kilogram prescribed, amount used, and patient satisfaction. Figure 1 details the prescribing algorithm. Total home dose prescribed was equal to that used in the 8 or 24 hours prior to discharge divided into 2-3 doses.

Results: A total of 148 patients underwent thoracoscopy (n=27), thoracotomy (n=20), laparoscopy (n=45), or laparotomy (n=56) from July 2018 through September 2019. The algorithm precisely anticipated outpatient opioid requirements for 112 patients (75.7%). For 26 (17.6%) the algorithm over-estimated opioid need by an average 0.42 OME/Kg. Those who stayed 4 days after open surgery were supposed to not get opioids at discharge but 10 patients (6.8%) did because of continued inpatient usage up to the time of discharge. These patients were significantly older (11.48 vs 6.7 yrs, $p=0.008$) than patients where the algorithm was accurate. Using this algorithm, we decreased overall opioid prescriptions from 6.17 to 0.50 OME/Kg ($p<0.001$). All patients/parents reported being "very satisfied without any pain" or "satisfied with minor pain that does not impact normal activities". There were no readmissions or unplanned visits.

Conclusion: Using an algorithm based on inpatient opioid use, outpatient opioid needs can be accurately predicted, thereby, reducing excess opioid prescriptions without detriment to patient satisfaction. Older patients with continued opioid requirements up to discharge at day 4 may require a prescription for out-patient opioids.

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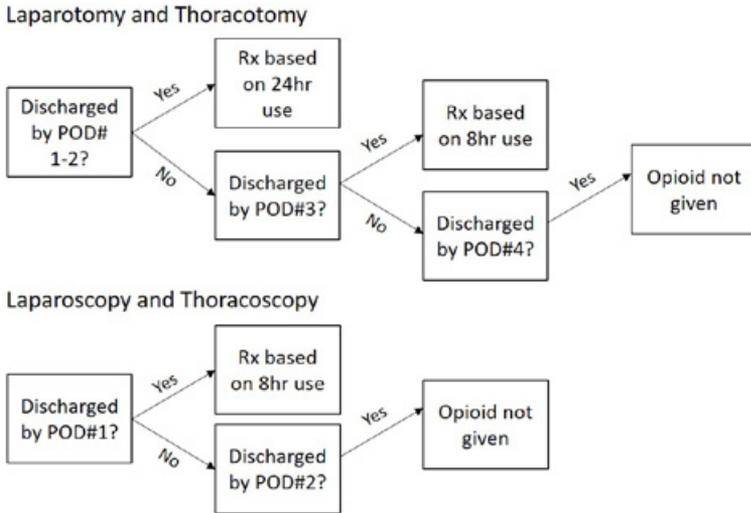


Figure 1. Post-operative opioid prescribing algorithm. (POD = post-operative day)

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TRANSFORMING SURGICAL MORBIDITY AND MORTALITY CONFERENCE INTO STRUCTURED CASE REVIEW

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Background/Purpose: The surgical morbidity and mortality (M&M) conferences at a regional children's hospital achieved the goals of case by case peer review and education for trainees but provided limited data for trending and analysis. In 2019, an institution-wide effort was initiated to create an electronic case review system with the goals of improving event capture and real-time practice performance feedback. Surgical M&M was migrated to this structured case review format to provide a platform for surgical performance improvement.

Methods: An online secure database was created with a 3-step classification system based on Clavien-Dindo severity score, peer review, and causality fishbone analysis. The data entered were available in an interactive dashboard. Retrospective tabulation of the 2018 M&M data was collected from the paper system used previously.

Results: For the first half of 2019, the division of pediatric surgery captured and categorized 88 complications in the case review system. The capture rate was 50 per 1,000 surgical procedures. For a similar time frame in 2018, the capture rate was 35 per 1,000 surgical procedures. The dashboard provided run charts of the incidence and types of complications by procedure and by surgeon. Similar trend data were not available in 2018. The dashboard output has made possible the creation of (non- risk adjusted) individual surgeon performance reports. The output has been used to direct process improvement projects and educational content.

Conclusion: Creation of an online database with interactive dashboard has allowed surgical M&M to evolve into a systematic case review that greatly facilitates quality improvement efforts. This system increased the event capture rate and provides novel practice performance feedback, resulting in process improvement projects and educational objectives predicated on the trending data. These electronic reporting tools are now available to all surgical divisions and represent a transformative approach to surgical case review.

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DOES COMPLIANCE WITH COLORECTAL BUNDLE COMPONENTS AFFECT PEDIATRIC SURGICAL OUTCOMES?

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Purpose: Colorectal procedures have the highest rate of surgical site infections (SSI) amongst children. Colorectal bundles (CRB) have decreased the SSI after adult colorectal surgery, but their benefit has not been demonstrated for children. This study investigated whether an association exists between SSI and compliance with CRB elements.

Methods: The charts of 276 children aged 1 month to 18 years undergoing colorectal procedures from 2008 to 2018 were reviewed. Data were analyzed using descriptive statistics and multivariate analyses; significance was defined at $p < 0.05$. CRB components included oral antibiotic prep, pre-precision and intraoperative antibiotic dosing, temperature maintenance, and use of clean-closure equipment. SSIs were defined using published CDC guidelines.

Results: Forty-four percent of patients were under one year, 30% 1-13yrs, and 26% 14-18yrs of age (median 7.4 years). Overall SSI rate was 14.5%. There were 16 superficial incisional, 2 deep incisional, and 14 organ/space SSI, and 5 anastomotic disruptions. Bundle elements were inconsistently utilized: 86% of patients received IV antibiotics, but only 8.3% received clean closure equipment. No-, partial- or full CRB compliance was not associated with a difference in SSI; this was consistent across age groups. Emergency status nearly tripled the infection rate ($p=0.0066$). Emergency cases had a higher contaminant class (2.15 vs 2.41, $p=0.027$) and higher ASA score (2.04 vs 2.27 $p=0.038$). There was a tendency to fail to re-dose antibiotics during longer emergency cases (47% vs 27%, $p=0.19$). These patients were more likely on stress dose steroids (6% vs 17%, $p=0.012$) and had higher pre-operative blood glucose levels (101 vs 136, $p=0.013$).

Conclusions: In the presence of a relatively low SSI rate, adherence to a Colorectal Bundle in pediatric colorectal surgery was not associated with further rate reduction. Attention to emergency cases may present the greatest opportunity for improvement.

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COMPLICATIONS AND RADIATION EXPOSURE ASSOCIATED WITH TUNNELED CENTRAL VENOUS LINE PLACEMENT: IMPLICATIONS FOR QUALITY AND PROCESS IMPROVEMENT EFFORTS

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Purpose: The purpose of this study was to characterize adverse event rates and radiation exposure associated with tunneled central venous line placement (tCVL), and to assess the utility of these measures for establishing quality improvement priorities and discriminating surgeon-level performance.

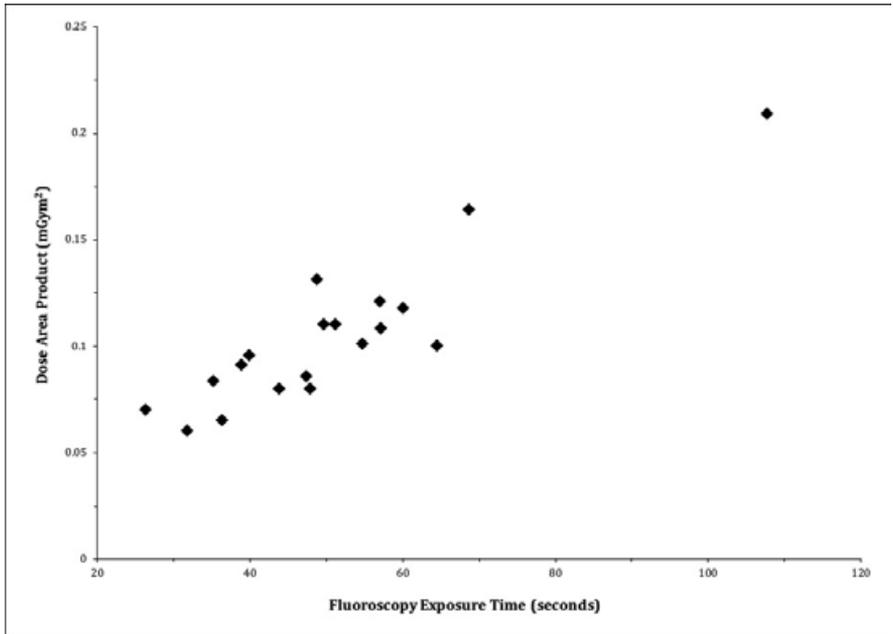
Methods: This was a retrospective study of children undergoing elective tCVL placement at a single children's hospital over a three-year period (6/2016–5/2019). Complications audited included pneumothorax, hemothorax, and reoperation within 30 postoperative days for catheter malposition or central line-associated blood stream infection (CLABSI). Measures of radiation exposure included fluoroscopy exposure time and dose area product (DAP). Generalized linear mixed models were used to estimate physician-level performance adjusted for patient characteristics, procedure indication, tCVL type (port or Broviac), and history of previous tCVL placement. Complications were modeled using logistic regression and radiation measures were modeled using a gamma distribution and a log link.

Results: 707 tCVL placements were performed by 19 surgeons (median: 35/surgeon [IQR:29–43]). The overall complication rate was 4.5% (Pneumothorax: 0.5%; Hemothorax: 0.3%; Reoperation: 2.0% for malposition and 1.7% CLABSI). Adjusted complication rates were not significantly different among surgeons (range: 3.9-5.3%, $p=0.35$). Overall mean fluoroscopy exposure time was 49 seconds and adjusted mean fluoroscopy exposure time varied more than four-fold across surgeons (range: 26-107 seconds, $p<0.01$, Figure). Overall mean DAP was 0.10 mGym² and adjusted mean radiation exposure dose varied more than three-fold across surgeons (range: 0.06-0.21 mGym², $p<0.01$, Figure).

Conclusion: Complications associated with tunneled CVL placement are relatively rare and may have limited utility as meaningful QI targets and for discriminating surgeon performance. Great variation exists in radiation exposure among surgeons, however, even after adjusting for patient and procedure-level factors. Identification and dissemination of best practices among surgeons to facilitate radiation stewardship should be considered a high-priority strategy to improve care in this cohort of children.

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P81

DEVELOPMENT OF A PROCEDURE TARGETED MODEL FOR GASTROINTESTINAL SURGERY IN ACS NSQIP PEDIATRIC

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Introduction: The American College of Surgeons (ACS) National Surgical Quality Improvement Program-Pediatric (NSQIP-Pediatric) provides risk adjusted models for inter-institutional comparisons to promote quality improvement (QI) efforts. The abdominal surgery model (ASM) is one of the standard comparisons but its utility is hampered by inclusion of a broad range of procedures from multiple specialties. Given the higher rate of morbidities such as surgical site infection found in gastrointestinal surgeries, we developed a gastrointestinal surgery model (GSM) to increase specificity and facilitate identification of institution-specific QI targets.

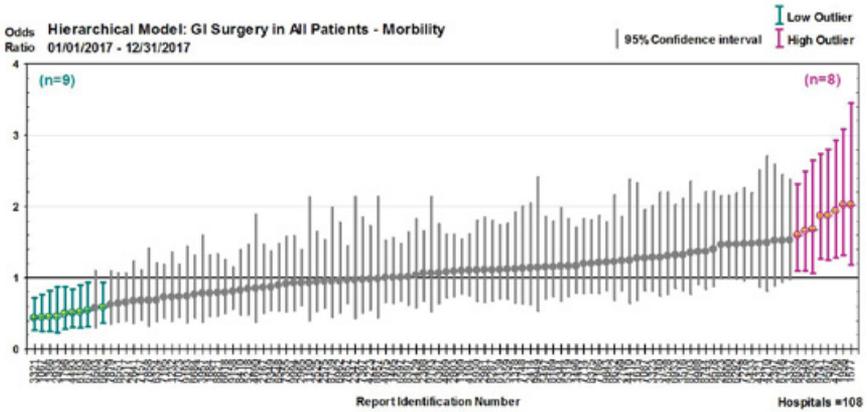
Methods: A GSM was developed using the July 2018 Semi-Annual Report data for a subset of Current Procedural Terminology (CPT) codes included in the existing ASM and thoracic surgery models for pediatric and neonatal patients. The inter-institutional odds ratios (OR) were calculated based on the ASM and GSM for overall mortality, morbidity, and surgical site infections. The results of the ASM and the GSM were compared with regard to ability to discriminate outcomes among institutions.

Results: A total of 16,231 cases representing 174 CPT codes were included. Neither the ASM nor GSM portrayed significant variation in mortality among institutions. The GSM identified nine institutions with significantly better (low outlier) and eight with significantly worse (high outlier) than expected risk-adjusted morbidity; the pediatric ASM model identified ten low and thirteen high outliers. The GSM identified one low and nine high outliers for surgical site infections (SSIs); pediatric ASM identified five low and fourteen high outliers. The GSM was able to identify ten high outliers for superficial SSIs and three outliers for organ space SSIs.

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Conclusions: The GSM had slightly fewer outliers than the ASM but maintained excellent discrimination among hospitals and has the advantage of being focused on gastrointestinal surgery. The GSM provides institutions with actionable data on performance and helps identify high-performers for the dissemination of best practices.



POSTERS

P82

DURING INFANT LAPAROSCOPIC GASTROSTOMY, CEREBRAL AND RENAL OXYGEN EXTRACTION AND SLEEP-WAKE CYCLES REMAIN STABLE

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Purpose: Conventional monitoring may not detect all episodes of tissue hypoxia/ischemia. Cerebral (cFTOE) and renal (rFTOE) oxygen extraction ratios indicate whether oxygen delivery meets tissue need. Inadequate delivery is associated with seizure activity and altered sleep-wake cycling. We hypothesized infants undergoing laparoscopic gastrostomy would demonstrate altered cFTOE and rFTOE when compared to preoperative baseline.

Methods: After IRB approval, between February 2018 and June 2019, infants 0-3 months corrected gestational age (GA), undergoing laparoscopic gastrostomy, were included. Strict exclusion criteria allowed for anesthesia standardization. Near-infrared spectroscopy (NIRS), conventional monitors and amplitude-integrated electroencephalography (aEEG) were applied. Monitoring was divided into pre, intra and post-operative time-periods. Fractional tissue oxygen extraction (FTOE) was calculated using arterial (SpO₂) and tissue oxygen saturation (rSO₂): $(\text{SpO}_2 - \text{rSO}_2) / (\text{SpO}_2) \times 100$. Data were averaged into one-minute epochs using the Moberg CNS Reader and JupyterLab with Python software. The one-hour pre, intra, and post-operative FTOE means were compared with one-way ANOVA.

Results: Sixteen infants were studied, 50% males, born at a median GA of 34.2 weeks (range: 23.0-40.6 weeks). At surgery, the median corrected GA was 42.9 weeks (range: 40.1-46.3 weeks), weight was 4.0 kg (range: 2.6-6.7 kg). The median pre, intra, and post-operative monitoring periods were 1135, 69, and 732 minutes (ranges: 620-1468, 44-120, and 664-922 minutes). None had seizure activity or altered sleep-wake cycles. Although FTOE extraction tended to increase in the latter half of the intra-operative period, this was not statistically significant ($p=0.10$) (Figure 1). Mean arterial blood pressure, SpO₂, cerebral and renal rSO₂ and FTOE extraction remained stable during pre and post-operative time-periods.

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Conclusion: During a short infant laparoscopic procedure, no significant alteration in cerebral or renal oxygen extraction was observed. None had seizures. All had normal sleep cycles for gestational age. These findings may have implications for the safety of laparoscopy and anesthesia in infants and warrant further study.

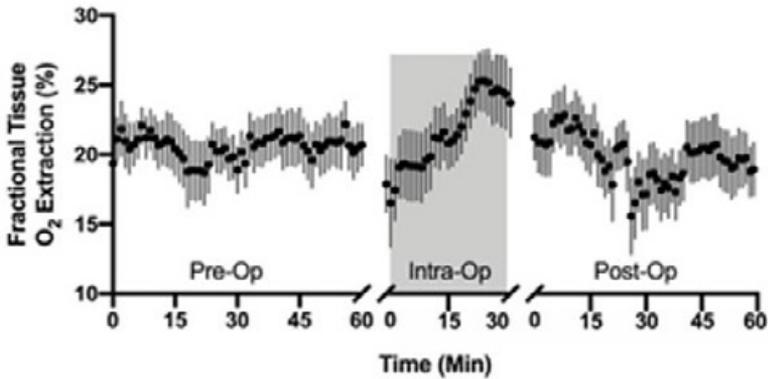


Figure 1: Cerebral FTOT for the cohort 1hr pre-operative, intra-operatively, and 1hr postoperatively.

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IATROGENIC POSTOPERATIVE OPIOID WITHDRAWAL (IPOW) IN INFANTS WITH SURGICAL NECROTIZING ENTEROCOLITIS

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Purpose: Necrotizing enterocolitis (NEC) requiring surgical intervention is the most common emergent surgery in preterm infants. Opioids are frequently prescribed after surgery and transition to methadone may be necessary for infants receiving opioids for prolonged periods. The incidence and outcomes from iatrogenic postoperative opioid withdrawal (IPOW) for infants with surgical NEC are unknown.

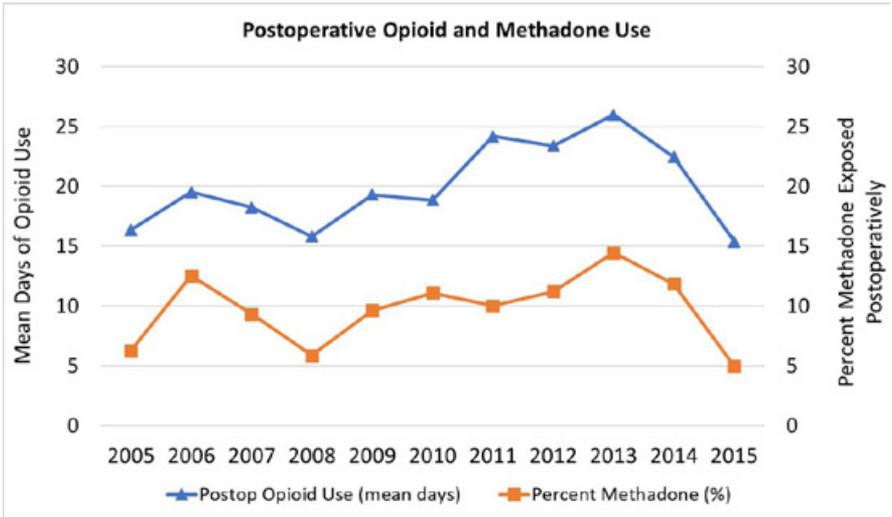
Methods: A retrospective cohort study using the Pediatric Health Information System® (PHIS) database was conducted from 1/2005-10/2015. Neonates who underwent surgery for NEC were identified. Infants exposed to methadone preoperatively, <7 days at time of surgery, with significant cardiac abnormalities or who expired within 90 days of their first NEC surgery were excluded. IPOW was defined as any postoperative administration of methadone. Differences in total ventilator days, postoperative length of stay (pLOS), total parental nutrition (TPN) days between those exposed and unexposed to methadone were measured. Multivariable logistic regression and linear regression with mixed effects modeling was performed, adjusting for patient and hospital characteristics.

Results: Overall, 5,242 infants with surgical NEC were identified and 391 (7.4%) received methadone postoperatively. The median first day of postoperative methadone use was day 22 (IQR 11-55), and was continued for 20 days (IQR 10-50). As the mean total days an infant received opioids postoperatively increased, the incidence of methadone use similarly increased (Figure 1). Compared to infants that received <6 days of opioids postoperatively, infants with >16 days postoperative opioid use were significantly more likely to receive methadone (OR 6.41, 95% CI 2.76-14.84). Each additional day of methadone use was associated with 0.56 (95% CI 0.36-0.77) additional ventilator days and a 0.65 day increase in pLOS (95% CI 0.54-0.76). Any methadone use was associated with 11.84 (95% CI 6.19-17.50) additional TPN days.

Conclusion: IPOW is associated with prolonged ventilation, postoperative length of stay, and TPN dependence in neonates who require surgery for NEC.

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PRESCRIPTION DRUG MONITORING PROGRAM MANDATE ASSOCIATED WITH DECREASED POST-OPERATIVE OPIOID PRESCRIPTIONS IN PEDIATRIC SURGICAL PATIENTS

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Purpose: To aid efforts to reduce opioid prescriptions in surgical patients, most states have established prescription drug monitoring programs (PDMPs), yet there is no data on the efficacy of these programs in pediatric patients. California instituted a PDMP in October of 2018 and we hypothesized that this would result in a decrease in post-operative opioid prescriptions in pediatric patients.

Methods: All patients < 18 years old undergoing hernia repair, orchiopexy, orchiectomy, appendectomy, or cholecystectomy with post-operative length of stay \leq 24 hours at a tertiary children's hospital were included. The study time period included 10 months before the PDMP mandate and 10 months after. The primary endpoint was prescription of an opioid on discharge. Secondary endpoints included phone calls, clinic or emergency department (ED) visits due to pain, and readmissions.

Results: There were 181 patients in the pre-PDMP group and 240 patients in the post-PDMP group. Opioid prescription rates decreased from 30.94% to 15.00% of patients ($p = 0.00009$). On sub-group analysis, this decrease was only significant in elective surgical patients (43.97% of patients pre-PDMP, 18.84% post-PDMP, $p < 0.0001$) with no change in acute surgical patients (7.69% pre-PDMP, 9.80% post-PDMP, $p = 0.64$). There were no significant increases in phone calls for pain (7.18% pre, 9.58% post, $p = 0.38$), clinic visits for pain (1.66% pre, 0.83% post, $p = 0.44$), ED visits for pain (1.66% pre, 2.50% post, $p = 0.55$), or readmissions (1.66% pre, 0.42% post, $p = 0.19$).

Conclusion: Mandatory prescription drug monitoring program consultation in California was associated with a decrease in opioid prescriptions following common pediatric surgical procedures. This reduction in opioid prescriptions was only significant in patients undergoing elective surgery, not acute surgery. There was no increase in clinical encounters for poor pain control despite fewer opioid prescriptions.

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A QUALITY IMPROVEMENT INITIATIVE TO ELIMINATE OPIOID PRESCRIPTIONS FOLLOWING PEDIATRIC HERNIA REPAIR

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Purpose: A practice change was implemented at two hospitals to reduce opioid prescribing following common pediatric surgical procedures. Effective May 1, 2019, children < 10 years old who underwent laparoscopic or open inguinal, umbilical, or epigastric hernia repair were not prescribed opioids. Those ≥10 years old received prescriptions at discretion of their surgeon. The purpose of this study was to evaluate efficacy of this initiative in reducing prescriptions while maintaining appropriate analgesia.

Methods: Medical records of hernia repair patients aged 6 months to 17 years at both institutions from January 1, 2019 to July 31, 2019 were reviewed to determine their analgesic regimen and outcomes including unplanned phone calls, emergency department visits, and pain control at telephone or office follow-up. Standard univariate statistical methods were used to compare prescriptions and outcomes before and after practice change.

Results: Of 111 children with median age of 5 years, 68 (61%) underwent hernia repair before the practice change and 43 (39%) after. There was no difference in age, procedure, or prescription of acetaminophen or NSAIDs between cohorts (all $p > .05$). Opioid prescriptions were reduced from 44% (n=30) before implementation to 12% (n=5) after ($p < .001$). Compliance was 97%, as only one patient < 10 years old (3%) received an opioid prescription after implementation (vs 44% before, $p < .001$). Unplanned phone calls (25 vs 16%, $p = .27$) and ED visits (4 vs 0%, $p = .99$) were stable. At follow-up nearly all patients reported adequate pain control (97 vs 92%, $p = .38$) and none reported obtaining opioids from other providers.

Conclusion: Opioid prescribing was significantly reduced in pediatric hernia repair and eliminated for children <10 years old in a short period of time through a quality improvement initiative. This practice change reduced opioid exposure for children and availability of opioids in the community for diversion without compromising pain control.

POSTERS

P87

20 YEARS OF SELECTIVE USE OF STERNAL ELEVATION DURING THE NUSS PROCEDURE AT A SINGLE INSTITUTION

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Purpose: Controversy exists about the routine use of sternal elevation (SE) before creating a sub-sternal tunnel during the Nuss procedure. The effects of SE on cardiac injury prevention and surgical site infection are unknown. We report our institution's experience with this surgical adjunct.

Methods: An IRB-approved (01-05-EX-0175-HOSP), single institution, retrospective review was performed (1/1/1997-11/20/2017). Primary and Re-do Nuss repairs are included. Incidence of SE use, techniques of SE, cardiac injury, and surgical site infections are reported. Chi square and Fisher's exact test (FE) was used (critical p-value 0.05).

Results: 2037 patients (80% male; mean age 15.2 years (SD=4.4); mean Haller index (HI) 5.3 (SD=5.7)) underwent Nuss repair. SE was used before creating the sub-sternal tunnel in 171(8.4%); 160(8.2%) of 1949 Primary and 11(12.5%) of 88 Re-do repairs ($\chi^2(1)=2.11$, $p=.156$). SE use increased significantly ($\chi^2(2)=118.93$; $p<.001$) over time and with increasing HI ($\chi^2(3) = 59.9$; $p<.001$). (Table) Techniques of SE included: Parasternal crane (39.2%); Vacuum bell (VB) (38.6%); Sub-xiphoid retraction (23.4%); Limited Sternotomy (1.2%). No cardiac injuries occurred in Primary repairs with or without SE. Two cardiac injuries occurred in patients with previous sternotomy, one with and one without SE. Infection rates were not statistically different between cases with (2.9%) and without SE (1.8%) ($\chi^2(1) = 1.14$; $p=.285$). Specifically, infection rates were not different using a VB sterilized with gas plasma (1.5%) (Without SE (1.8%, FE, $p=1.0$); Other SE techniques (3.8%, FE, $p=.65$)).

Conclusion: Sternal elevation can be a useful surgical adjunct to maintain a safe avascular plane anterior to the pericardium during the Nuss procedure. Our use of SE increased significantly over time and in patients with elevated HI with no cardiac injuries in Primary Nuss repairs. SE may not prevent cardiac injury in patients with a previous sternotomy. SE was not associated with an increased risk of surgical site infections, specifically when using a VB sterilized with our protocol.

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(F)UTILITY OF PULMONARY FUNCTION TESTING IN PECTUS EXCAVATUM

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Purpose: The use of pulmonary function testing (PFT) in pectus excavatum (PE) has been subject to debate. Although some evidence shows improvement from preoperative to postoperative values, the significance is uncertain, as other measures like exercise tolerance and symptomatic improvement may provide a more valuable functional assessment for patient-centered care. A high failure-to-complete rate for PFT (48%) was identified in our large institutional cohort. We sought to evaluate if other measures of PE severity or cardiopulmonary function could explain this non-completion.

Methods: Presenting symptoms, past medical history, and results from cardiac MRI, PFT, and cardiopulmonary exercise tests were reviewed in 281 patients evaluated preoperatively between 2015 and 2018. Regression modeling was used to measure associations between PFT completion and cardiopulmonary function, adjusting for pectus indices and other covariates.

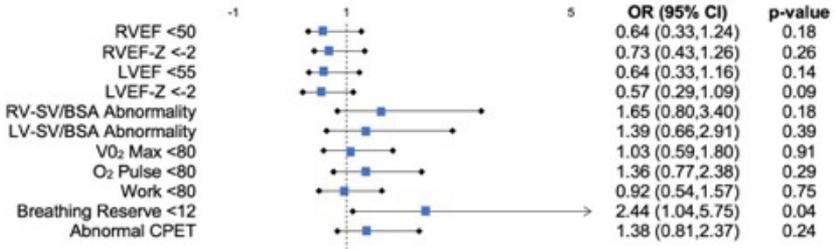
Results: PFT completers (n=147) had similar age group (p=0.65/0.20/0.48), sex (p=0.06), and racial (p=0.59) distribution as non-completers (n=134). They were equally symptomatic (72% vs 77%, p=0.23) – presenting with similar rates of chest pain (41% vs 40%, p=0.88), shortness of breath (62% vs 62%, p=0.99), palpitations (12% vs 14%, p=0.57), exercise intolerance (64% vs 63%, p=0.92), and history of connective tissue disorders (10% vs 8%, p=0.69). There was no significant difference in Haller (4.8 vs 4.8, p=0.94), depression (0.61 vs 0.65, p=0.24), correction (33.9 vs 34.0, p=0.93), cardiac compression (2.86 vs 2.71, p=0.18), and cardiac asymmetry (1.67 vs 1.63, p=0.51) indices or sternal torsion (14.9 vs 14.2, p=0.55). In adjusted regression analyses, PFT completers were more likely to have an abnormal breathing reserve (OR 2.44, p=0.04), higher RVEF (p=0.03) and LVEF (p=0.03), and lower RV-ESV/BSA (p=0.02) and LV-ESV/BSA (p=0.02).

Conclusions: We found that PFT completers were not significantly different from non-completers in most structural and functional measures of pectus deformity and cardiopulmonary function. Inability to complete PFT is not an indicator of pectus severity.

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Adjusted Relationships of Cardiopulmonary Function and PFT Completion (Completer vs Non-Completer [REF])



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P89

DOES AGE MATTER? CARDIOPULMONARY PROFILES OF ADOLESCENTS VERSUS ADULTS WITH PECTUS EXCAVATUM PRESENTING FOR SURGICAL EVALUATION

Alejandra M. Casar Berazaluze, MD¹, Todd M. Jenkins, PhD, MPH², William D. Hardie, MD², Karla E. Foster, MS², Justin T. Tretter, MD², Tarek Alsaied, MD², Ryan A. Moore, MD², Aaron P. Garrison, MD², Víctor F. Garcia, MD², Rebeccah L. Brown, MD²

¹Cincinnati Children's Hospital Medical Center, University of Texas Health Science Center at San Antonio, Cincinnati, OH, USA, ²Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA

Purpose: Our chest wall center manages a large volume of patients with pectus excavatum (PE). We sought to analyze differences in presentation and cardiopulmonary compromise between those referred for surgical consultation as adolescents (11-17 yrs.) versus adults (18+ yrs.).

Methods: Presenting symptoms, past medical history, and results from cardiac MRI, pulmonary function testing (PFT), and cardiopulmonary exercise testing (CPET) were reviewed in 329 patients evaluated preoperatively between 2015 and 2018. Adjusted regression modeling was used to measure associations between pectus indices and clinical endpoints of cardiopulmonary function.

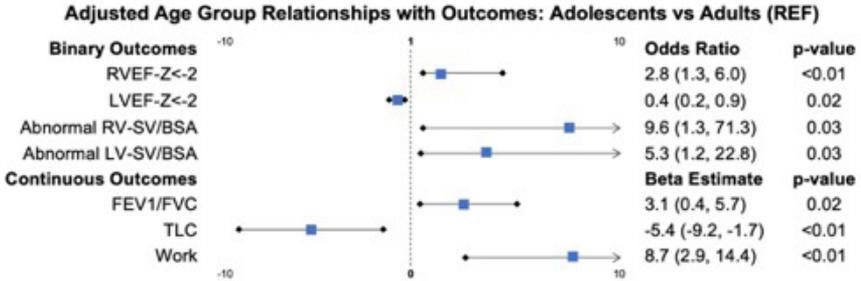
Results: Our sample included 276 adolescents and 53 adults. The majority were white (98% vs 100%, $p=0.6$) and male (85% vs 72%, $p=0.04$). Adults presented more frequently with chest pain (57% vs 38%, $p=0.01$), shortness of breath (76% vs 59%, $p=0.02$), palpitations (21% vs 11%, $p=0.04$), exercise intolerance (76% vs 59%, $p=0.02$), and connective tissue disorders (28% vs 14%, $p=0.01$). Their Haller (5.2[4.2,7.0] vs 4.7[4.0,5.7], $p=0.05$) and cardiac asymmetry (1.8[0.5] vs 1.6[0.5], $p=0.02$) indices were also higher. In continuous outcome analysis, adolescents had lower total lung capacity (TLC) with higher FEV1/FVC on PFT and higher work on CPET ($p<0.01$). In adjusted regression analysis, adolescents were more likely to have abnormal right ventricular ejection fraction (RVEF) z-scores (OR 2.8, $p=0.01$), adjusted right ventricular stroke volume (RV-SV/BSA) (OR 9.6, $p=0.03$), and adjusted left ventricular stroke volume (LV-SV/BSA) (OR 5.3, $p=0.03$) and less likely to have abnormal left ventricular ejection fraction (LVEF) z-scores (OR 0.4, $p=0.02$).

Conclusions: Adult patients with pectus excavatum were more symptomatic than adolescents and more frequently had a history of connective tissue disorders. Despite better functional exercise capacity represented by higher work and FEV1/FVC, adolescents had overall lower cardiac stroke volume,

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ejection fraction, and TLC. The etiology of these findings and their effect on age of presentation is uncertain. Further research is warranted to evaluate postoperative outcomes.



POSTERS

P90

A NEW RISK STRATIFICATION BY FETAL MRI FOR PREDICTION OF THE NEED OF PATCH CLOSURE IN ISOLATED CONGENITAL DIAPHRAGMATIC HERNIA: A MULTICENTER RETROSPECTIVE STUDY

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Aim: There have been no prenatal indicators that predict the need of patch closure for patients with congenital diaphragmatic hernia (CDH). The aim of this study was to determine the potential usefulness of the novel risk stratification using lung to liver signal intensity ratio (LLSIR) in fetal MRI.

Method: Eighty-one isolated CDH patients who were born and treated in the three children's hospitals during Jan. 2009 through Sep.2018 were involved. We stratified patients according to fetal T2-weighted MRI as Grade I, detectable ipsilateral lung at the apex; Grade II, undetectable ipsilateral lung at the apex and contralateral LLSR \geq 2.0; Grade III, undetectable ipsilateral lung at the apex and contralateral LLSR $<$ 2.0. To evaluate this stratification system, we analyzed survival and the need of patch repair, which were compared to o/e LHR severity: mild (o/e LHR 36-45% and liver down or o/e LHR \geq 46%), moderate (o/e LHR 26-35% or o/e LHR 36-45% with intrathoracic liver position), severe (o/e LHR 15-25%), extreme (o/e LHR $<$ 15%).

Results: For survival, 0/40 (0%) patients in Grade I, 6 / 32 (19%) patients in Grade II, and 6 / 9 (67%) patients in Grade III (OR, 4.68; 95%CI, 0.52-41.89), while 1/37 (2.7%) patients in mild, 2/25 (8 %) patients in moderate, 6/9 (50%) patients in severe and 3/3 (100 %) patients in extreme (OR, 6.69; 95%CI, 1.19-38.65) died. For Patch closure, only 1/40 (3%) patients in Grade I, 16/30 (53%) patients in Grade II, and all 5 (100%) patients in Grade III (OR, 56.30; 95%CI, 4.73-670.69), while 8/37(22%) patients in mild, 6/24 (25%) patients in moderate, 7/12 (58%) patients in severe and 1/1 (100%) patient in extreme (OR, 0.71; 95%CI, 0.26-1.95) required patch closure.

Conclusion: The risk stratification using LLSIR in fetal MRI has a potential advantage to predict the need of patch closure.

POSTERS

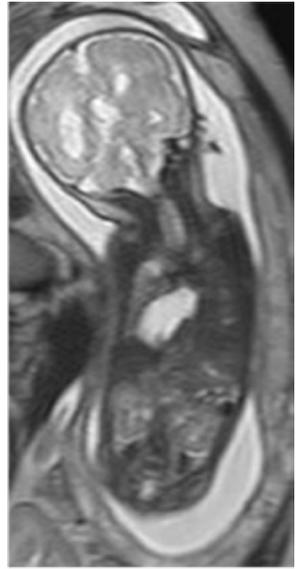
P90 (continued)



Grade I



Grade II



Grade III

POSTERS

P91

THE UTILITY OF ECHOCARDIOGRAPHY AND PULMONARY FUNCTION TESTING IN THE PREOPERATIVE EVALUATION OF PECTUS EXCAVATUM

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Purpose: Echocardiography (ECHO) and pulmonary function testing (PFT) are routinely performed during the preoperative evaluation of pectus excavatum (PE), but frequently do not influence operative decisions. We hypothesized that these investigations may be performed selectively based on patient symptoms and pectus severity.

Methods: A review of all PE patients (n=119) who underwent a Nuss procedure during a 15-year period (2004-2018) was conducted. Available preoperative ECHO (n=111; 93%) and PFT (n=90;76%) results were collected. PE severity on computed tomography was measured using the Haller (HI) and Correction indices (CI). Logistic and linear regression assessed the ability of symptoms and indices to predict abnormal cardiopulmonary test results.

Results: Of 116 patients with symptom documentation, 74 (64%) had one or more of the following: dyspnea 43 (37%), exercise intolerance 32 (28%), and chest pain 23 (20%). Mean + standard deviation HI and CI were 3.8 + 1.0 and 31.6 + 10.3, respectively. Fourteen ECHO exams (13%) were abnormal, the most common being mitral valve prolapse (n=4), dilated aortic root (n=3), and combined bicuspid aortic valve with dilated aortic root (n=2). None of these were clinically significant or influenced surgical correction; however, 12/14 (86%) required cardiology follow-up. Abnormal PFT results were present in 15/90 (17%), including 9 (11%) obstructive, 4 (5%) restrictive, and 2 (2%) mixed. The presence of symptoms did not predict abnormal ECHO or PFT, but each standard deviation increase in the CI was associated with abnormal PFT and ECHO by a factor of 2.2 and 2.0 respectively (Table 1). HI severity was only associated with ECHO.

Conclusion: The rates of abnormal ECHO and PFT testing in PE patients are low, and do not correlate with symptoms. Routine ECHO is still warranted to detect anomalies requiring follow-up. CI severity may be used to guide selective PFT testing.

POSTERS

P92

CHANGING LANDSCAPE: NATIONAL TRENDS FOR THE NUSS PROCEDURE OVER NEARLY TWO DECADES

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Purpose: The Nuss procedure is the most common procedure for operative correction of pectus excavatum, yet there has been no large-scale study of national changes since its adoption. We sought to describe trends in patient demographics, operative volume, and cost nationwide for the Nuss procedure.

Methods: We queried the Kids' Inpatient Database (KID) for all children undergoing the Nuss procedure between 1997 and 2016. Age, race, length of stay (LOS), hospital volume, and cost data were extracted. Low-volume centers were defined as those performing <10 Nuss procedures annually. Changes in hospital charges for laparoscopic appendectomy over the study period were used to determine a baseline surgical inflation rate. T-test and χ^2 were used for statistical analysis, with $p=0.05$ for significance.

Results: Between 1997 and 2016, the number of Nuss procedures performed annually increased 3.5-fold (848 to 2091). Mean age at operation increased significantly over the study period, from 10.8 to 15.3 ($p<0.01$). Historically, most patients were white with private insurance; recently, the number of non-white children and the number with public insurance increased significantly ($p<0.01$, $p<0.01$). The number of centers performing the Nuss procedure increased nearly 2.5-fold (128 to 305), with an increasing number of low-volume hospitals (97 to 223). In 2016, low-volume hospitals performed 73.1% of all Nuss procedures. The mean total hospital charges for the Nuss procedure increased by 329.1% over the study period, compared to a 290.4% increase for laparoscopic appendectomy, representing a 13.4% greater rate of increase ($p<0.01$). Post-operative LOS and anesthesia-associated CPT codes were unchanged over the study period, thus not accounting for the observed charge increases.

Conclusion: More Nuss procedures are being performed than ever before. There has been a proliferation of low-volume centers. Hospital charges for the Nuss procedure have increased at a greater rate than the baseline surgical inflation rate.

POSTERS

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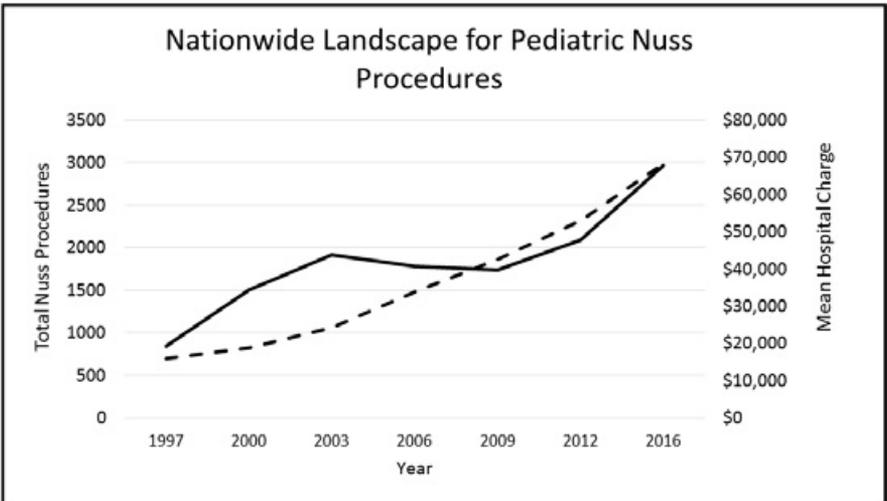


Figure 1. Total Nuss procedures (solid line) and mean hospital charge per procedure (dotted line) annually, 1997-2016.

POSTERS

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EFFECT OF CRYOANALGESIA ON POSTOPERATIVE OPIOID UTILIZATION IN MINIMALLY INVASIVE PECTUS EXCAVATUM REPAIR

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Tweet it! Use of cryoanalgesia in pectus excavatum repair is associated with decreased postoperative opioid utilization. @SArshiaArshad @UTH_CSTEP #APSA2020

Purpose: Post-operative pain control has traditionally been challenging after pectus excavatum repair. In 2016, we introduced cryoanalgesia as an adjunctive modality for post-operative pain management. We aimed to understand the impact of cryoanalgesia on opioid utilization and outcomes of pediatric patients undergoing minimally invasive pectus excavatum repair.

Methods: A single-center retrospective cohort study was conducted of all pediatric (<18 years) patients who underwent minimally invasive pectus excavatum repair (2011-2019). Patients who received cryoanalgesia were compared to those who did not (usual care). The primary outcome was total post-operative oral morphine equivalents per kilogram (OME/kg). Secondary outcomes included case length, length of stay (LOS), complications, and costs (adjusted for inflation). Univariate and multivariate analyses were performed, with $p < 0.05$ considered significant.

Results: Of 35 patients, 20 received cryoanalgesia (57%). Baseline characteristics, including Haller index, were similar between groups (Table). Patients who received cryoanalgesia had a lower post-operative opioid requirement compared to usual care (median 2.3 OME/kg, IQR 1.2-3.1, vs. 4.9 OME/kg, IQR 2.9-5.8, $p < 0.001$). One third of cryoanalgesia patients did not require opioids at discharge, whereas all usual care patients did ($p = 0.01$). In addition, as experience in cryoanalgesia increased, post-operative opioid utilization continued to decrease over time. Median LOS was shorter in cryoanalgesia patients: 3.1 days, IQR 2.3-3.4, vs. 5.1 days, IQR 4.3-5.4 ($p < 0.001$). Although cryoanalgesia patients had longer surgical times, total operating room time was similar (Table). Median costs were similar between cryoanalgesia (\$17,231, IQR \$16,172-\$19,569) and usual care patients (\$16,869, IQR \$15,754-\$18,595, $p = 0.7$).

Conclusions: Cryoanalgesia appears to be an effective adjunctive pain control modality in minimally invasive pectus excavatum repair. The use of cryoanalgesia is associated with lower post-operative opioid requirements and shorter lengths of stay, without increased costs. Further multicenter studies are needed to fully evaluate the effectiveness and long-term outcomes of cryoanalgesia in pectus excavatum surgery.

POSTERS

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UTILIZATION OF EXPAREL SHORTENS HOSPITAL STAY IN MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM

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Purpose: The minimally invasive repair of pectus excavatum (MIRPE) has become standard of care for surgical correction of pectus excavatum in the pediatric population. Exparel, liposomal bupivacaine, has demonstrated perioperative pain relief in many surgical specialties. We reviewed whether introduction of Exparel intercostal nerve blocks during MIRPE shortened hospitalization and decreased narcotic use post-operatively in the hospital.

Methods: Previous MIRPE experience (30 consecutive cases) was compared to MIRPE utilizing Exparel intercostal nerve blocks (34 consecutive cases). All patients were otherwise treated with multi-modality pain therapy. Demographics of mean age and gender were compared. For a primary end-point, mean hospitalization length of stay (hours) were compared between the two groups using one-sided t-test. Fisher's exact test was used to compare number of post-op days (POD) to discharge as either POD2 or >POD2. Narcotics use (mg of morphine equivalents/ kg body mass) and rehospitalization (within 30-days postoperatively) were compared between the two groups as secondary end points utilizing one-sided t-test and Fisher's exact test respectively.

Results: Neither mean age nor gender mix differed between the control and Exparel groups (15 and 15.5 years; 10% and 21% female). Hospitalization length was significantly shorter in the Exparel group (55.1hr +/-2.54 vs. 71.5hr +/-3.51, p=0.0001). 61.8% of Exparel patients were discharged on POD 2 compared to only 16.7% of control patients (p=0.0003). There were no differences in total in-hospital narcotics use (mg morphine equivalent/kg) regardless of length of stay. Rehospitalization rates were not different between groups.

Conclusion: Utilization of Exparel intercostal nerve blocks demonstrates significant shortening of post-operative length of stay. While Exparel allowed for earlier discharge avoiding additional expense and risk of longer in-hospital stay, it did not demonstrate a reduction in total post-operative narcotics usage while admitted. We continue to utilize Exparel and further examine its ability to improve post-operative care.

POSTERS

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USE OF NOVEL, HIGH-RESOLUTION MAGNETIC RESONANCE IMAGING TO DETERMINE ANATOMY IN INFANTS WITH TRACHEAL ESOPHAGEAL DEFECTS

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Tweet it! UTE MRI is a useful tool to assess the anatomy of TEDs and predict outcomes in these patients #APSA2020

Purpose: There is currently no validated diagnostic modality to characterize the anatomy of tracheal esophageal defects (TEDs), such as esophageal atresia (EA) and tracheal esophageal fistulas (TEF), prior to surgical repair. Our objective was to determine the size of the proximal esophagus and the resulting effect on airway anatomy in infants with EA/TEF using a novel, high-resolution magnetic resonance imaging (MRI) technique while free breathing.

Methods: Eleven infants with EA/TEFs underwent pre-repair ultrashort echo-time (UTE) MRI of the chest (0.7x0.7x0.7mm). Tracheal and esophageal anatomy was segmented. Esophageal size (diameter and area) was measured at the widest point distal to the epiglottis and proximal to the carina. Angle of tracheal deviation was measured by identifying the initial point of deviation and the farthest lateral point proximal to the carina.

Results: Esophageal diameter and area were significantly larger in infants with EA when independently compared to controls. Infants without a proximal TEF (Gross types A&C, n=8) had a larger proximal esophageal diameter and area when compared to infants with a proximal TEF (Gross types B&E, n=3; 13.5±5.1mm vs. 6.8±2.1mm, p<0.07 and 103.2±62.3mm² vs. 19.4±8.7mm², p<0.06). The angle of tracheal deviation in infants without a proximal TEF was larger than infants with a proximal TEF (16.1±6.1° vs. 8.2±5.4°, p<0.09) and controls (16.1±6.1° vs. 8.0±3.1°, p<0.005). An increase in the angle of tracheal deviation was positively correlated with both duration of post-operative mechanical ventilation (Pearson r=0.80, p<0.002) and duration of total post-operative respiratory support (Pearson r=0.83, p<0.004).

Conclusions: These results demonstrate that infants without a proximal TEF have a larger proximal esophagus and a greater angle of tracheal deviation which is directly correlated with the need for longer post-operative respiratory support. Additionally, these results demonstrate that UTE MRI is a useful tool to assess the anatomy of TEDs and predict outcomes in these patients.

POSTERS

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NATIONWIDE SURGICAL MANAGEMENT IN CONGENITAL CYSTIC LUNG MALFORMATIONS: EQUALITY FOR ALL?

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Purpose: Surgical management of congenital cystic lung malformations (CCLM) varies and there is a lack of national data regarding timing of surgery, surgical approach, and outcomes. This study sought to uncover determinants of surgical management in infants with CCLM.

Methods: Nationwide Readmissions Database 2010-2014 was queried for all newborns with congenital cystic lung malformations. Details of surgical resection were determined, and patients were stratified by surgical approach. Statistical analysis was performed via χ^2 analysis, T-test, and $p < 0.05$ was considered significant.

Results: 363 neonates with CCLM were identified, 67% were male and 83% were born in metropolitan teaching hospitals. Lung resection was performed in the neonatal period in 8%. An additional 55% of infants ($n=198$) underwent lung resection within one year, with a mean age at resection of 5 months \pm 2 months. Resection was performed via thoracoscopy in 75%, while 25% were via open thoracotomy, Table 1. Open lung resections, when compared to thoracoscopic resections, were more commonly performed in those with public insurance (51% vs. 19%), female gender (38% vs 22%), those born low birthweight (22% vs 9%) and in younger patients (126 \pm 77 days vs. 151 \pm 59), all $p < 0.05$. Infants who underwent open resections were more likely to experience serious post-operative complications (40% vs. 10%, $p < 0.001$) such as post-operative hemorrhage, pulmonary failure, or cardiopulmonary collapse. There were no in-hospital deaths during the study period.

Conclusion: Surgical resection of CCLM within the first year of life is associated with excellent survival. However, there are disparities in surgical management as patients in lower socioeconomic strata are more likely to undergo open procedures, which are associated with higher post-operative complications and cost.

POSTERS

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PEDIATRIC TRAUMA-INDUCED COAGULOPATHY: PROSPECTIVE STUDY USING ROTATIONAL THROMBOELASTOMETRY (ROTEM)

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Purpose: Trauma-induced coagulopathy (TIC) is associated with morbidity and mortality in adults and children. Rotational thromboelastometry (ROTEM) provides a real-time assessment of whole blood clotting kinetics and firmness. We hypothesized that ROTEM would identify children with TIC and characterize the coagulopathy.

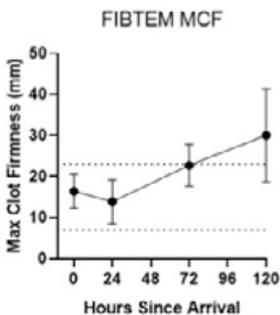
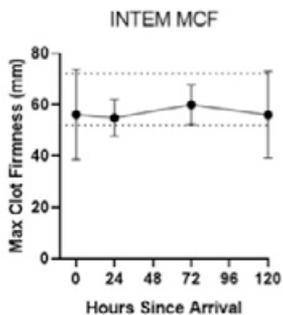
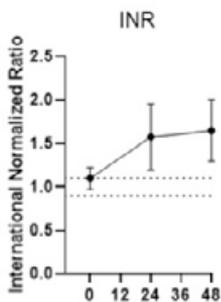
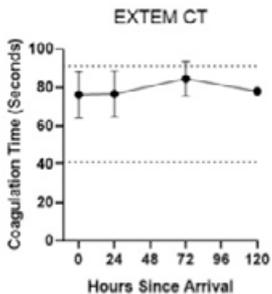
Methods: This is a prospective observational study of coagulation among pediatric trauma patients evaluated as level 1 or 2 (highest-level) trauma activations from 2018-2019. Whole blood samples were collected on admission and hospital days 2, 3, and 5. Extrinsic (EXTEM), intrinsic (INTEM), and fibrin-specific (FIBTEM) ROTEM assays were performed. Chart review was performed for demographics, clinical variables, and other labs. The Wilcoxon signed-rank test was used to compare ROTEM changes throughout admission, and previously published age-specific reference values were used.

Results: Seventeen patients ages 2-15 years (median 8, IQR 7.5) were studied; 13 were boys (76%). The most common mechanism was blunt or crush injury (15/17, 88%), and traumatic brain injury was common (9/17, 53%). Two patients (12%) required resuscitative blood transfusion ≥ 10 mL/kg. One patient (6%) developed a deep vein thrombosis. Conventional coagulation abnormalities were common on arrival, with INR ≥ 1.2 in 6/15 patients (40%) and low PTT (<27 s) in 8/15 patients (53%). ROTEM findings on presentation included 4/17 (24%) patients with EXTEM coagulation time prolongation, 1/17 with INTEM coagulation time prolongation (6%), and paradoxically 2/17 with INTEM coagulation time hypercoagulability (12%). FIBTEM generally showed increasing clot strength through hospital day 5 among admitted patients.

Conclusions: Coagulopathy is common after trauma among pediatric trauma patients, and derangements frequently worsen days after the injury among inpatients. ROTEM identified a complex set of derangements at presentation, including extrinsic factor deficits, followed by relative hypercoagulability on FIBTEM. This paradox demands caution in plasma resuscitation based on INR alone. There was variable activity of the intrinsic system, emphasizing the importance of individualizing hemostatic resuscitation efforts.

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THE IMPACT OF REGIONALITY AND HOSPITAL STATUS ON MORTALITY ASSOCIATED WITH NON-ACCIDENTAL TRAUMA

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Purpose: Non-accidental trauma (NAT) affects 2 per 100,000 children annually in the US and may go unrecognized. The aim of this study to quantify the burden of NAT and to evaluate regional variations in mortality.

Methods: The Kids Inpatient Database (2000-2012) was queried for pediatric patients presenting with a diagnosis of NAT. Data was obtained on demographic, clinical and hospital level characteristics. Primary outcome measure was mortality. Multivariable logistic regression models for age, sex, race/ethnicity, insurance status, income quartile, hospital volume, region (Northeast, South, West and Midwest), teaching status, and injury severity scores.

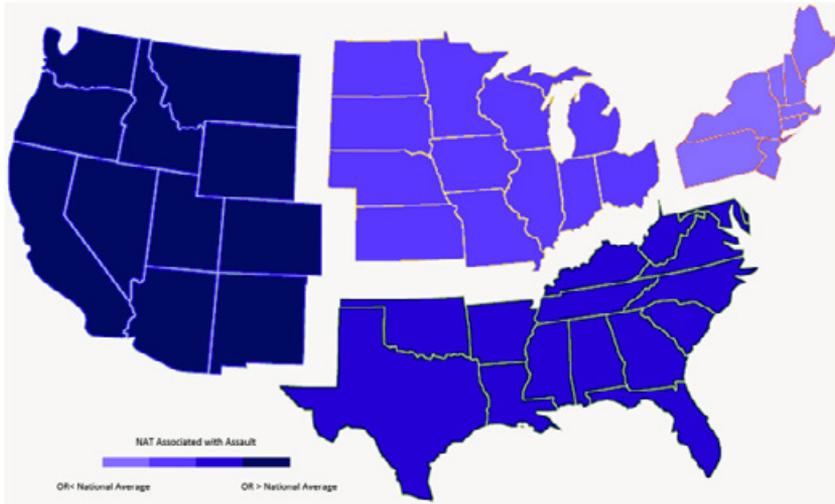
Results: NAT represented 1.92% (n=15,999) of all trauma patients. Mortality rates were 3.98% for patients presenting with NAT. African American children had a higher likelihood of mortality compared to White children (OR[95%CI]:1.35[1.03-1.79]), however this effect was not statistically significant for patients being treated at designated children's hospitals (OR[95%CI]:1.23(0.78-1.95) and urban facilities (OR[95%CI]:1.30[0.99-1.72]). Statistically significant regional variations in mortality (figure 1), lost significance for patients treated at designated children's hospitals ($p>0.05$).

Conclusion: NAT can prove to have devastating consequences and is associated with a high mortality rate. Treatment at designated children's hospitals results in the loss of variation in mortality, resulting in diminished disparities and improved outcomes. These findings align with current trends towards "regionalization of pediatric health care" and reflects the value of regional transfer centers who are equipped to provide advanced trauma care.

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Figure 1: Variations in mortality resulting from non-accidental trauma in the regional United States (reference: Northeast)



POSTERS

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THE BIS AND BIG SCORES IN PEDIATRIC TRAUMA

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Introduction: A reliable and easy to use scoring system to predict the need for blood transfusion and the risk of mortality in pediatric trauma patients has yet to be developed. The BIS score predicts the need for early blood transfusion. The BIG score reliably predicts mortality. It is unknown if the BIS score reliably predicts mortality, or if the BIG score predicts the need for blood transfusion. We hypothesized that both scores would reliably predict the need for blood transfusion and risk of mortality in pediatric trauma patients.

Methods: We identified all highest level pediatric trauma activations from 2008-2018. BIS scores were calculated by combining base deficit (BD), International Normalized Ratio (INR), and shock index-pediatric age-adjusted (SIPA). BIG scores were calculated as follows: $[BD + (2.5 \times INR) + (15 - GCS)]$. Based on published results, we dichotomized BIG scores ≤ 16 as high probability of survival and >16 as high probability of mortality. Sensitivity, specificity, and AUC for each score were calculated to predict need for blood transfusion and risk of mortality.

Results: Five hundred forty-two children were included; 45% received a blood transfusion and 11% died. A BIS score ≥ 1 provided a more balanced predictive ability, with 87% sensitivity and 87% specificity, and an AUC=0.88. The BIG score ≥ 16 was 100% sensitive at predicting mortality, but only 52% specific with an AUC of 0.92. In predicting the need for blood transfusion, the BIS ≥ 1 had a 75% sensitivity and specificity, with an AUC of 0.80. Similarly, the BIG ≥ 16 had a 73% sensitivity, 72% specificity, and 0.78 AUC.

Conclusion: The BIS and BIG scores are excellent bedside emergency department triage tools that help identify pediatric trauma patients in need of a blood transfusion and/or at risk for death.

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VARIATION IN CERVICAL SPINE IMAGING AMONGST TRAUMA CENTERS IN THE POST-TRAUMATIC PEDIATRIC PATIENT

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Purpose: Traumatic pediatric cervical spine (CS) injury can be challenging to diagnose. There is no standard practice and imaging is often determined by individual physicians. Our study investigates the rates and characteristics of pediatric post-traumatic CS imaging across various trauma centers. We hypothesize that less specialized centers will have higher rates of advanced CS imaging.

Methods: The 2015-16 Trauma Quality Improvement Program (TQIP) database was reviewed on patients <18-years-old to assess variability of CS imaging on presentation across different trauma centers. Multivariable logistic regression was performed controlling for demographics, region of country, injury severity, GCS, vital signs, method of injury, and presence of confounding comorbidity or injury. A p value of <0.05 was considered significant.

Results: Of 110,769 patients, 35.2% were female and the average age was 9.6-years-old. 3.5% had CS CT (CCT) and <1% CS MRI. Findings are noted in the table. Level I centers had lower odds of CCT (OR=0.702,95%CI:0.631-0.782) and higher odds of CS x-ray (OR=1.680,95%CI:1.309-2.155) as compared to level II/III centers. In addition, adult-only centers had higher odds of CCT (OR=1.594,95%CI:1.425-1.784) and lower odds of CS x-ray (OR=0.177,95%CI:0.134-0.233) as compared to pediatric centers. Lastly, hospitals with <3 neurosurgeons on staff had higher odds of CCT (OR=1.248,95%CI:1.099-1.418) and CS MRI (OR=1.859,95%CI:1.317-2.625) as compared to centers with ≥3 neurosurgeons.

Conclusions: More specialized centers, as defined by Level I and pediatric trauma designation, as well as increased neurosurgeon support, were associated with lower rates of CCT and CS MRI, modalities that are more expensive, time consuming and may involve a higher radiation dose. This supports the need for development of standardized guidelines to aid in the work-up of CS injury, particularly for centers with a lower pediatric census.

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THE “JULY PHENOMENON” AND PEDIATRIC TRAUMA

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Purpose: The “July phenomenon” describes concerns that patients presenting early in the academic year experience worse outcomes as residents advance to new roles. This has not been evaluated in pediatric trauma patients. Given the standardized approach to trauma patients, we hypothesized that the “July phenomenon” would not impact morbidity or mortality.

Methods: A retrospective review of patients ≤ 16 years ($n = 6135$) presenting to an academic level 1 pediatric trauma center between March 2009 and March 2019 was performed. Patients presenting in July or August ($n = 1194$) were compared to those presenting in the remainder of the year. The primary outcome was mortality. Secondary outcomes were complications, emergency department length of stay (LOS), hospital LOS, intensive care unit (ICU) LOS, ventilator days, readmission, and whether a computed tomography (CT) scan of the head or abdomen was obtained. Data were analyzed with multivariable regression.

Results: The overall mortality rate was 1.7%; overall complication rate was 7.4%. Patients presenting in July or August were more likely to experience a complication than those presenting later in the year (AOR 1.37; 95% CI 1.07-1.76). When examined by type of complication this was statistically significant for delay in disposition (AOR 4.19; 95% CI 1.04-16.97) and delay in consultation (AOR 4.28; 95% CI 1.02-17.84). Patients presenting in July or August were more likely to have an abdominal CT scan than those presenting later in the year (AOR 1.24; 95% CI 1.05 -1.45). Presentation in July or August was not an independent risk factor for mortality, head CT, readmission, increased emergency department, hospital or ICU LOS, or increased ventilator days.

Conclusions: While mortality does not increase at the start of the academic year in pediatric trauma, the “July phenomenon” in these patients may include less efficient delivery of care and overuse of abdominal CT scan in evaluation.

POSTERS

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A VICIOUS CYCLE: MENTAL HEALTH AND PEDIATRIC GUN VIOLENCE

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Purpose: Gun violence affects children by inflicting premature morbidity, disability, and death. Mental health and substance abuse may precede a firearm trauma, however there is a paucity of literature with respect to the relationship of firearm intent and prolonged effects. Thus, this study examines firearm injury intent with respect to psychiatric conditions.

Methods: The Nationwide Readmissions Database 2010-2014 was queried for all pediatric firearm injuries. Outcomes of interest were incidence and predictors of psychiatric conditions related to firearm trauma. 2 analysis was utilized with significance defined as $p < 0.05$.

Results: 13,861 children were hospitalized after firearm injury. Most were teenage males (16 years [15-17], 86%) from an urban setting (98%), and the majority were publicly insured (63%). Mental health conditions were present in 14% and drug use/dependence was seen in 12%. 11% required repeat hospitalization within one year of their injury and cases of mental illness nearly doubled (23% from 14%, $p < 0.001$), half of which were new diagnoses. Particularly, rates of depression (8% vs 2%, $p < 0.001$) and post-traumatic stress disorder (7% vs 4%, $p < 0.001$) were increased from the time of original trauma. Firearm injury intent groups comprised assault (60%), unintentional (29%), or self-inflicted (4%). Overall mortality after firearm injury was 6% and increased to 37% in self-inflicted injuries. Assault and unintentional injuries were more common in those with public insurance while those sustaining self-inflicted injuries had higher injury severity, mortality, and were more likely to have pre-existing mental health and/or drug abuse, Table 1.

Conclusion: There is a high coexistence of mental health conditions and substance abuse in children afflicted with firearm injuries, especially in those with self-inflicted injuries. These psychiatric conditions not only precede trauma but are also increased as another repercussion of trauma. Thus, preventative efforts focused on mental health may help decrease the vicious cycle of gun violence.

POSTERS

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CHILDREN UNDER FIVE PRESENTING AS “FOUND DOWN”: A CASE FOR TRAUMA ACTIVATION

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Introduction: Non-accidental trauma (NAT) is a significant cause of morbidity and a leading cause of death in early childhood, necessitating expeditious trauma evaluation. In cases of young children presenting as “found down” without a clear etiology, we hypothesized that a significant proportion would be due to NAT.

Methods: In 2015, the highest trauma activation criteria was updated at a Level 1 pediatric trauma center to include all children under age five years “found down” without a clear medical etiology. After IRB approval, the trauma registry was queried for these children between January 2015 and July 2019 for relevant presenting characteristics and clinical outcomes.

Results: 65 patients were identified. The median presenting age was 4 months (IQR 2-12), with 65% males, and median ISS of 25.5 (IQR 25-27). 25 patients (38%) were confirmed victims of NAT, 9 (14%) patients were highly suspicious for abuse, 15 (23%) patients had a history of unsafe sleep, 6 (9%) patients were found to have a medical etiology, 9 (14%) of patients had unknown etiology, and 1(2%) patient presented after an unwitnessed fall. When comparing NAT or suspected NAT patients (n=34, 52.3%) to all other patients, there was no difference in presenting vital signs, shock index, or labs. NAT and suspected NAT patients had a median age of 6.5 months (IQR 3-17) compared to other patients at 2.75 months (IQR 2-5) (p=0.007), were more likely to present with bruising (p<0.001), and had prior history involving child protective services (p=0.04). The overall mortality was 71%.

Conclusion: Over half of patients under age five presenting as “found down” without obvious medical etiology were victims of NAT or suspected NAT. Apart from bruising, it may be difficult to distinguish these patients on admission, making the highest level trauma activation key to expeditious trauma evaluation.

POSTERS

P106

EFFECT OF TRAUMA CENTER DESIGNATION ON MORTALITY AFTER ADOLESCENT FIREARM INJURY

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Purpose: Determine the incidence and outcomes of firearm injuries in adolescents and the effect of trauma center type on overall mortality.

Methods: The National Trauma Data Bank (2010 - 2016) was queried for all encounters involving children ages 13 to 16 years old with firearm injuries. The cohort was dichotomized by age ≤ 14 and ≥ 15 years. Patient, injury, and hospital characteristics were identified for each group. Multivariable logistic regression was used to determine the association of covariates with mortality (alpha level, 0.05).

Results: A total of 9,029 children met inclusion criteria. The 15- and 16-year old children comprised 77.8% of the cohort. Older children were more often male (87.9% vs. 80.6%, $p < 0.001$), black (63.8% vs. 56.1%, $p < 0.001$), had a higher initial GCS (13.2 vs. 12.8, $p = 0.001$), had severe injuries (AIS ≥ 3 , 54.5% vs. 50.9%, $p = 0.004$), and were more often injured in the abdomen (25.4% vs. 22.4%, $p = 0.007$) and extremities (62.3% vs. 56.7%, $p < 0.001$). Younger patients were more often injured in the head/neck (23.8% vs. 20.5%, $p = 0.001$) and had higher mortality (12.7% vs. 10.6%, $p = 0.011$). However, multivariable logistic regression demonstrated no difference in mortality between groups. Lower GCS, higher ISS, severe injury, abdominal, chest, and head injuries were all associated with an increased odds of death (Table 1). Odds of mortality were 2.88 times higher at adult trauma centers compared to pediatric trauma centers in this cohort (CI: 1.55 – 5.36, $p = 0.001$). This finding was confirmed in age-stratified analyses of 15- and 16-year-old children and in children with signs of life on presentation.

Conclusions: Adolescents treated for firearm injuries at pediatric trauma centers have an overall lower mortality rate. Investigation into differences between trauma center type and their referral patterns are warranted.

POSTERS

P107

“YOU’LL SHOOT YOUR EYE OUT”: 20 YEAR ESTIMATE OF NON-POWDER GUN INJURIES SUSTAINED BY US CHILDREN

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Background: Non-powder guns (NPGs) are often viewed as introductory firearms or toys for children. Numerous studies have shown that these firearms can cause significant injury, and design changes over time have increased this risk. We sought to estimate the national trends in NPG injuries among children in the United States (US).

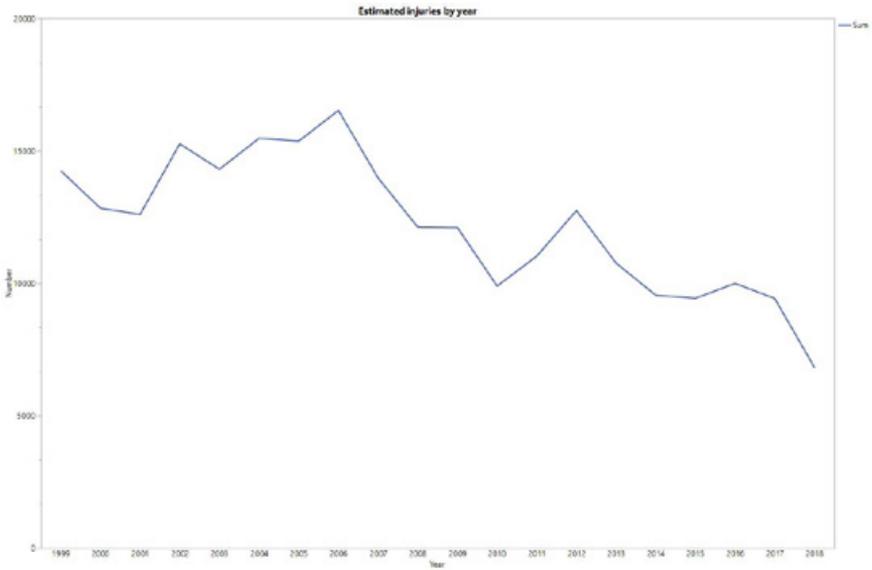
Methods: We included all 0-19 year old patients in the National Electronic Injury Surveillance System database that were seen in an emergency department for an NPG injury from 1999-2018. Reported cases were used to project national estimates of injuries in the US. We utilized weighted logistic regression to estimate trends in injury patterns and severity. Tests for trends over time utilized the Cochran-Armitage test.

Results: Over 20 years, 244,502 children sustained NPG injuries and 8% warranted hospitalization. The majority of injuries occurred at home (56%). Victims were mostly male (87%) with a mean age of 13.7 (+/-0.2). Injuries involved BB (65%), pellet (20%), paintball (9%), air/CO2 (3%), potato (<1%) and other (2%) guns. The most common injury sites were the eyeball (19%), face (13%), and hand (12%). The number of injuries peaked in 2006 but has declined steadily since that time, (Figure, $p < 0.001$). In tandem, the estimated number injured by paintball guns has also declined from 1,567 injuries in 2004 to 119 in 2018 ($p < 0.001$). On multivariable analysis, head/neck [OR 2.7 CI (1.6-4.4)], eye [7.9 (4.9-11.4)], upper trunk [8.0 (4.4-14.3)], lower trunk [4.7 (3.0-7.4)] injury were more associated with hospitalization compared to extremity injury, while age, sex, race, or gun type were not. Hospitalizations for severe injuries appear to be stable over time ($p = 0.44$).

Conclusion: Despite declining injury rates from NPG among US children, hospitalizations remain similar. Ocular and head/neck trauma is particularly morbid and may be influenced by the power of newer NPGs. These trends may influence state policies regarding firearm restrictions for NPGs.

POSTERS

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POSTERS

P108

THE IMPACT OF WEEKEND VERSUS WEEKDAY ADMISSION ON PEDIATRIC TRAUMA PATIENT MORBIDITY AND MORTALITY

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Introduction: In 2016 injuries were the leading cause of death for patients age 1-19 with over 12,000 deaths. Prior studies have demonstrated that weekend surgical admissions have both higher morbidity and mortality due to hospital acquired conditions or postoperative complications. There is limited data, however, for pediatric trauma patients.

Methods: A cross-sectional analysis was performed of the 2016 Kids' Inpatient Database. Cases included patients age <19 years with an ICD-10 diagnosis code for trauma. Patient characteristics were analyzed using ICD-10 codes, and national estimates were obtained using case weighting. A weekend was defined as day of admission on a Saturday or Sunday.

Results: In 2016 120,637 trauma patients were admitted, with 85,485 (70.9%) admitted on a weekday and 35,152 (29.1%) on a weekend. The mean age was 9.9 years for weekday and 10.1 years for weekend. For patients admitted on weekends compared to weekdays there were more major surgeries (49.2% vs 44.8%, $p < 0.01$) and ICU admissions (8.8% vs 7.5%, $p < 0.01$). More hospitalized deaths occurred on weekends versus weekdays, 479 (1.4%) versus 995 (1.2%), respectively ($p < 0.01$). Multivariable regression demonstrated no difference in morbidity between weekend and weekday admissions, but there was a higher mortality overall for weekends (OR 1.18, $p = 0.01$). In this analysis, those who had 4-7 or >8 diagnoses had significantly higher mortality as compared to those who had 0-3 diagnoses (OR 7.36, $p < 0.01$; OR 36.35, $p < 0.01$, respectively).

Conclusions: Pediatric trauma patients admitted on weekends have a higher mortality as compared to weekday admissions even after adjusting for the number of diagnoses and procedures.

POSTERS

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OBESITY INCREASES THE RISK OF IN-HOSPITAL COMPLICATIONS IN PEDIATRIC TRAUMATIC BRAIN INJURYDouglas E. James, MD¹, Jose M. Prince, MD²¹Cohen Children's Medical Center at Northwell Health, Flushing, NY, USA,²Cohen Children's Medical Center, Zucker School of Medicine at Hofstra/Northwell, Queens, NY, USA

Purpose: Obesity is associated with increased morbidity and mortality in the adult traumatic brain injury population. The purpose of this study is to analyze the effect of obesity on morbidity and mortality in traumatic brain injury in the pediatric population.

Methods: We performed a retrospective analysis of the National Trauma Data Bank from the years 2013-2015. Inclusion criteria were patients age 2-18 with ICD-9 diagnosis codes for traumatic brain injury. Patients were classified as obese if their body mass index (BMI) was greater than the 95th percentile for age utilizing Center for Disease Control growth charts. Our primary outcome was mortality. Our secondary outcome was in-hospital complications. Statistical analysis by logistic regression was performed utilizing R software (R Core Team, Vienna, Austria).

Results: There were 10,178 obese patients and 48,579 nonobese patients with traumatic brain injury identified. Mortality was similar between both groups (obese = 2.7%, nonobese = 2.4%, OR 1.12, CI 0.98-1.28, p=0.07). The obese group had a higher overall complication rate (obese = 5.3%, nonobese = 4.1%, OR 1.26, 95%CI 1.12-1.41, p<0.001). Specifically, the obese population had higher rates of acute respiratory distress syndrome (obese = 0.6%, nonobese = 0.4%, OR 1.44, 95% CI 1.09-1.88, p<0.01), surgical site infection (obese = 0.3%, nonobese = 0.18%, OR 2.31, 95% CI 1.48-3.55, p<0.001), and venous thromboembolism (VTE) (obese = 0.6%, nonobese = 0.4%, OR 1.45 95% CI 1.09-1.91, p<0.01).

Conclusions: Obese pediatric patients are at higher risk for post-traumatic complications than non-obese patients. The increased risk of VTE is particularly important when considering risks and benefits of initiating chemoprophylaxis in obese pediatric patients with traumatic brain injury.

POSTERS

P111

MANAGEMENT OF COMPLEX CERVICOFACIAL LYMPHATIC MALFORMATIONS REQUIRES A MULTIDISCIPLINARY APPROACH

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Purpose: Cervicofacial lymphatic malformations (CFLM) are a rare, potentially life-threatening vascular anomaly, yet there are few reports on treatment results following multidisciplinary management. We sought to evaluate outcomes for CFLMs following sclerotherapy, surgical resection, and/or medical management.

Methods: This retrospective review identified 105 children with a CFLM at a single vascular anomalies center from 2004-2019. Exclusion criteria included: retro-orbital malformations, patients who received no treatment and those lost to follow-up. Primary outcome was significant clinical improvement, defined as LM volume reduction of at least 50% by visual estimate. χ^2 test was used for statistical analysis with $\alpha=0.05$ for significance.

Results: Sixty-five children met inclusion criteria: 36 with macrocystic CFLMs, six with microcystic malformations, and 23 with mixed macro- and microcystic disease. Median age at presentation was 16 months (range: 1 day-18 years). Median post-intervention follow-up was 17 months (range: 1-115). Sixty patients underwent at least one sclerotherapy treatment (median: two treatments). Doxycycline and bleomycin were the most common sclerosants with one or both used in 95% of patients. After sclerotherapy, 97% of macrocystic CFLMs improved significantly compared to 82% of mixed and 33% of microcystic lesions ($p=0.002$). Surgical resection was performed for 67% of microcystic CFLMs, 43% of mixed and only 8% of macrocystic lesions ($p=0.001$). In total, 16 children underwent surgical resection, including 10 following sclerotherapy with 87% significantly improving; those not improved by surgery all had microcystic CFLMs which had failed sclerotherapy. Resection was complicated by marginal mandibular nerve weakness in four patients (25%). Six children received sirolimus for microcystic disease; two (33%) experienced symptomatic improvement and one discontinued therapy due to intolerable side effects.

Conclusion: Sclerotherapy is very effective for macrocystic components of CFLMs, albeit less so for microcystic disease. Microcystic CFLMs frequently require surgical resection. Sirolimus may be a helpful therapeutic adjunct, particularly for microcystic lesions but more study is needed.

POSTERS

P112

SERINE-THREONINE KINASE RECEPTOR ASSOCIATE PROTEIN (STRAP) CONFERS AN AGGRESSIVE PHENOTYPE IN NEUROBLASTOMA

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Background: Serine-threonine kinase receptor associated protein (STRAP) is upregulated in many adult malignancies and plays an important role in tumor growth and metastasis. The role of STRAP in pediatric malignancies and specifically in neuroblastoma (NB) has not been explored. Previous studies from our laboratory have shown that STRAP is overexpressed in human tumor specimens and CRISPR gene knockout of STRAP resulted in decreased tumor cell growth and motility. We hypothesized that STRAP overexpression (OE) would promote the malignant phenotype in NB.

Methods: The human NB cell line, SK-N-AS (AS) was stably transfected with pcDNA3 plasmids with empty vector (EV) or STRAP. Immunoblotting confirmed STRAP OE. STRAP EV and OE cells were cultured for 24, 48, and 72 hours and counted to evaluate growth. Cell survival and proliferation were compared using alamarBlue and CellTiter96 assays, respectively. Cell migration was measured using a cell monolayer wounding (scratch) assay. Photographs of the scratch area were obtained at 6, 12, 24, and 48 hours and scratch area analyzed using Image J software. Student's t-test was used deeming $p < 0.05$ significant.

Results: Cell proliferation and survival were significantly increased in the OE cells by 22% ($p < 0.02$, Figure 1A) and 18% ($p < 0.001$, Figure 1B), respectively. Cell growth was also significantly increased in the OE at 24, 48, and 72 hours compared to EV cells ($p < 0.001$, Figure 1C). STRAP OE cells showed significantly decreased distance across the scratch area at 24 (10%, $p = 0.02$) and 48 (4%, $p = 0.006$) hours (Figure 1D) indicating increased migration with STRAP OE.

Conclusion: Serine-threonine kinase receptor associated protein overexpression in neuroblastoma cells led to increased cell growth, survival, proliferation, and motility in vitro. These novel findings demonstrated that serine-threonine kinase receptor associated protein plays a role in promoting the malignant phenotype in neuroblastoma and warrants further investigation as a potential therapeutic target in neuroblastoma.

POSTERS

P112 (continued)

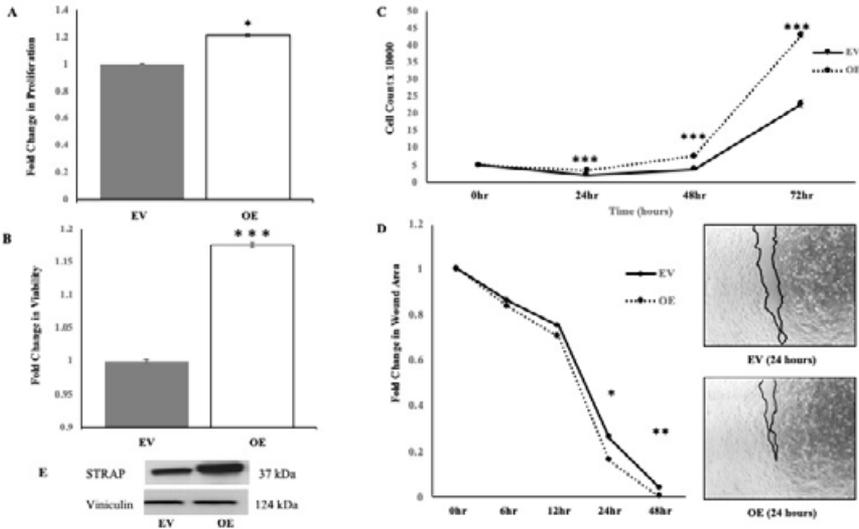


Figure 1: STRAP promotes the malignant phenotype in neuroblastoma cells. STRAP over-expression (OE) in SK-N-AS cells (AS) led to increased (A) proliferation, (B) viability, (C) growth, and (D) migration. STRAP immunoblotting of EV and OE (E). * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$ vs AS empty vector (EV) cells.

POSTERS

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SILENCING OF SHMT2 DOWNREGULATES AKT2 IN MYCN AMPLIFIED NEUROBLASTOMA CELLS

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Purpose: Reprogrammed metabolism is essential for cancer cell growth and proliferation. MYC is a commonly deregulated metabolism gene with several downstream effects on cancer cells, such as induction of serine hydroxymethyltransferase (SHMT)2. SHMT2 is upregulated in several cancer cell types; its expression has been correlated with clinical prognosis and tumor aggressiveness. MYCN amplification is associated with poor prognosis in high-risk neuroblastoma, suggesting a potential role of SHMT2 in neuroblastoma cancer metabolism. We have previously described that AKT2 plays a critical role as an important regulator for metastatic potential in neuroblastoma. Herein, we hypothesize that SHMT2 expression is associated with high-risk, MYCN amplified neuroblastoma via activation of AKT2.

Methods: SHMT2 gene expression was examined in four human neuroblastoma cancer cell lines, MYCN-amplified, BE(2)-C and SK-N-DZ, and non-MYCN amplified, SK-N-AS and SK-N-SH. Real time PCR and Western blotting were performed to assess for SHMT2 expression. SHMT2 knockdown was performed using the siRNA, siSHMT2, in the MYCN-amplified neuroblastoma cells. Specificity of SHMT2 knockdown and phosphorylated AKT2 expression were analyzed in siSHMT2 cells using qPCR and Western blotting.

Results: SHMT2 gene expression was higher in MYCN-amplified cell lines, BE(2)-C and SK-N-DZ, as compared to non-MYCN amplified cell lines, SK-N-AS and SK-N-SH. Phosphorylated AKT2 expression was also increased in the MYCN-amplified cells. siSHMT2 successfully downregulated SHMT2 gene expression in the MYCN-amplified neuroblastoma cells. SHMT2 knockdown decreased phosphorylated AKT2 expression in the MYCN-amplified neuroblastoma cell lines.

Conclusion: We conclude that SHMT2 expression is correlated with MYCN amplification in neuroblastoma; knockdown of SHMT2 decreased activation of AKT2, suggesting the potential role of SHMT2 in the regulation of PI3K-AKT pathway. Future studies are necessary to further evaluate the role and mechanisms of SHMT2 in neuroblastoma tumorigenesis. Potent SHMT2 inhibitors may provide significant benefits for the treatment of high-risk neuroblastoma.

POSTERS

P117

TARGETED DRUG REPURPOSING TO TREAT RHABDOMYOSARCOMA

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Purpose: Rhabdomyosarcoma (RMS) is an aggressive soft tissue sarcoma of childhood for which novel therapeutic strategies are urgently needed. We have recently found that pannexin1 (PANX1) is down-regulated in RMS and that increasing its levels inhibits RMS progression in vitro and in vivo. Here our goal is to use information attained from a recently published genome-wide transcriptome profiling of murine cells treated with over 200 clinically approved drugs to identify drugs that increase PANX1 levels in RMS, and evaluate the ability of these PANX1-upregulating drugs to inhibit RMS progression.

Methods: Institutional Research Ethics Board approval has been obtained. Based on our transcriptome profiling, 11 drugs increased PANX1 transcript levels (Z-score > ~2), including quercetin. RMS patient-derived cell lines were treated with these candidate drugs and PANX1 levels were examined. PANX1-upregulating drugs were assessed for their ability to inhibit RMS tumor growth and to induce RMS regression in vitro. Statistical significance was analyzed using two-tailed Student's t-test ($n \geq 3$; $*p < 0.05$).

Results: Our results thus far indicate that PANX1 levels are significantly increased by quercetin in eRMS (Rh18) and aRMS (Rh30) cells in a dose-dependent manner. Importantly, quercetin treatment inhibited RMS tumor growth, and induced complete regression of established RMS tumors in a dose-dependent fashion.

Conclusions: We found that quercetin treatment increases PANX1 levels in RMS, inhibits RMS growth, and induces RMS regression in vitro. Future preclinical experiments in mice will determine the potential benefit of quercetin treatment for RMS patients. Our studies testing the efficacy of quercetin and other clinic-ready drugs for their repurposing towards a novel RMS therapy could significantly accelerate their application in the treatment of RMS patients.

POSTERS

P118

INCREASING INCIDENCE AND EVOLVING SURVIVAL TRENDS IN HEPATOBLASTOMA BETWEEN 1973 - 2015

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Purpose: Hepatoblastoma is a rare condition, comprising just 1% of all pediatric malignancies, though it is the most common primary hepatic malignancy in children. While there have been significant advances in treatment, the epidemiology remains poorly characterized. The purpose of this study is to evaluate changes in incidence, demographics, and survival between 1973–2015.

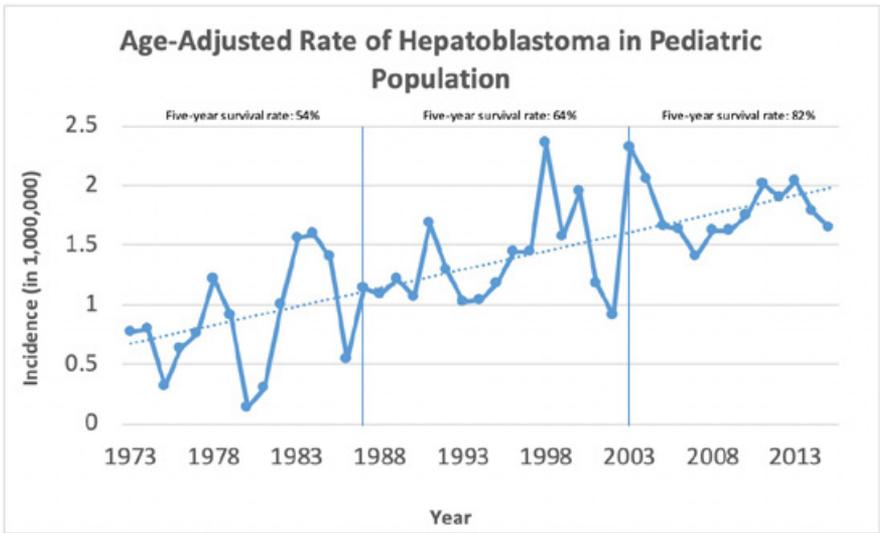
Methods: The Surveillance, Epidemiology, and End Results (SEER) database was used to analyze all pediatric patients (<19 years old) diagnosed with hepatoblastoma (n = 919) and to determine trends in incidence between 1973 and 2015. Kaplan-Meier survival analysis was conducted to calculate survival rates across this time frame. Cox Regression analyses were used on all variables to evaluate hazard ratios ($p < 0.05$).

Results: Incidence increased from 0.7 per 1,000,000 in 1973 to 1.64 per 1,000,000 in 2015 (see Figure 1). Overall 1-, 3-, and 5-year survival rates were 83%, 73%, and 72%, respectively. When stratified by time period, five-year survival improved from 54% between 1973 – 1987 to 64% between 1988 – 2003 and 82% between 2004 – 2015. When controlling for race, severity of disease, and treatment, the 1973 – 1987 and 1988 – 2003 cohorts demonstrated significantly greater risk of death (HR: 1.635 and 1.460, respectively) vs. the 2004 – 2015 cohort. All treatment methods, including radiation, chemotherapy, and surgery, were protective factors between 2004 – 2015, whereas only the combination of surgery/chemotherapy was protective between 1973 – 1987. Distant extension/metastasis was a greater risk factor between 1973 – 1987 (HR: 3.910) than it was between 1988 – 2003 (HR: 2.650) or 2004 – 2015 (HR: 0.632).

Conclusions: Hepatoblastoma incidence has increased by more than 130% in the last four decades. However, survival rates continue to improve, and overall risk of death has decreased over time. Potential improvements in early detection and treatment intervention may explain the improved prognosis.

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CONSOLIDATION OF MULTI-MODALITY CARE AT A SINGLE INSTITUTION IS NOT ASSOCIATED WITH IMPROVED OVERALL SURVIVAL FOR CHILDREN WITH HIGH-RISK NEUROBLASTOMA

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Purpose: This study aims to determine whether care consolidated at a single institution confers superior outcomes for children with high-risk neuroblastoma (NB) receiving multi-modal therapy compared to care at multiple institutions (“fragmented care”).

Methods: We reviewed paper and electronic medical records for 128 high-risk NB patients aged < 18 and having received ≥ 1 bone marrow transplant (BMT) at our institution from 1990-2017. Demographic, treatment-related, and survival variables were collected. Consolidated care was defined as all multi-modal care occurring at our institution, while fragmented care was defined by treatment occurring at >1 institution. Fisher’s exact and Wilcoxon Rank-Sum tests were used in univariate analyses. Overall survival (OS) was estimated using the Kaplan-Meier method, and differences were tested using the log-rank test. Cox Proportional Hazards regression was used to identify factors associated with OS. Significance was defined as $p < 0.05$.

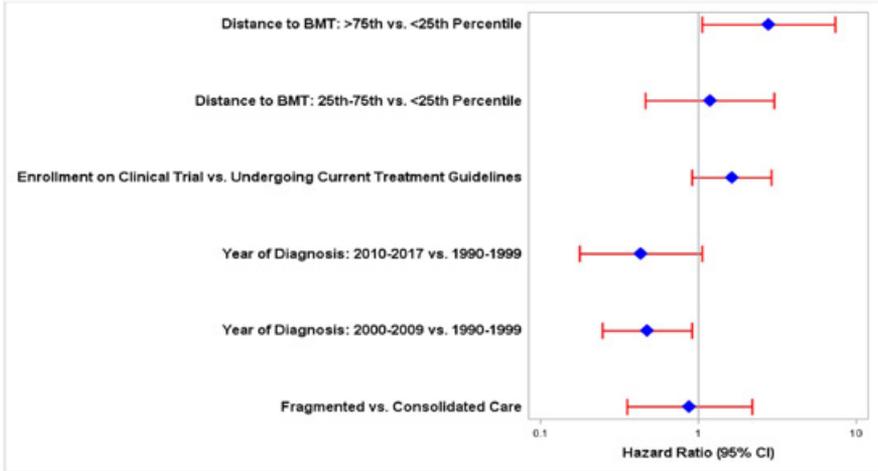
Results: We identified 25/108 (19.5%) patients receiving consolidated care. Patients with consolidated care traveled further for chemotherapy [median 78.1 miles (IQR 34.8-123.0) vs. 32.3 (19.3-71.0)] and surgery [78.1 (34.8-150.0) vs. 33.6 (19.3-76.8)], but less far to BMT [78.1 (34.8-123.0) vs. 134.0 (89.3-198.0)] compared to fragmented care (all $p < 0.01$). Ten-year OS was 52%, but there was no difference in unadjusted OS for consolidated vs. fragmented care (log-rank $p = 0.52$). Univariate analysis identified diagnosis in earlier decades, clinical trial enrollment (vs. guideline-driven treatment), and increased distance to BMT (all $p < 0.05$), but not fragmented care ($p = 0.52$), as predictors of worsened OS. After adjustment, only earlier diagnostic year and distance to BMT remained significantly associated with worsened OS (both $p < 0.05$).

Conclusion: In this large single institution analysis, we found no association between consolidated care and improved OS for high-risk NB patients receiving multimodal therapy. These findings provide insight for care teams managing complex treatment regimens and for families who have difficulty accessing consolidated treatment at tertiary centers.

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Figure 1. Forest Plot of Adjusted Overall Survival



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ENHANCED RECOVERY AFTER SURGERY PROTOCOL AFTER TOTAL NEPHRECTOMY FOR WILMS TUMORJames K. Moon, MD¹, Rosa Hwang², Peter Mattei²¹Children's Hospital of Philadelphia, New York, NY, USA, ²Children's Hospital of Philadelphia, Philadelphia, PA, USA

Purpose: Standard therapy for children with unilateral renal tumors in the US includes upfront total nephrectomy and surgical staging. We examined our enhanced recovery after surgery (ERAS) protocol for children after uncomplicated Wilms nephrectomy.

Methods: We reviewed records of children who underwent unilateral total nephrectomy for Wilms tumors at our institution from 2013 to 2019, including data regarding tumor stage, surgical approach, length of operation, use of anesthesia adjuncts and catheters, diet, length of stay, and complication rates. Our ERAS protocol includes: parental education, no routine nasogastric tube, clear liquids on POD0, minimizing opiates, routine IV ketorolac, no routine ICU stay, and avoiding thoraco-abdominal incisions. We examined the effects of our protocol on length of stay (LOS) by comparing early (LOS < 3days) vs. late discharges (LOS > 3days).

Results: Sixty-six children (31 boys, mean age 3.8y, range 0-11.9) underwent unilateral total nephrectomy for Wilms tumor. Mean nephrectomy duration was 2.7 hours. Post operatively, seven (11%) had temporary gastric tubes, 24 (36%) had epidural catheters. Ten (15%) recovered in the ICU. Patients were advanced to regular diet mean 1.9days post op. Mean LOS was 3.7 days, with 56% of patients being comfortably discharged within 2-3 days. One patient returned to ED within 30 days (chylous ascites); none returned to OR. Presence of tumor thrombus, longer epidural catheter duration, delayed diet advancement, and total IV narcotic usage were associated with longer LOS. Routine use of IV ketorolac was associated with shorter LOS.

Conclusions: Use of an ERAS protocol in children undergoing nephrectomy for Wilms tumor is safe, resulting in rapid return to regular diet and, compared to the published literature, shorter postoperative lengths of stay without an increase in complications or return to ED or OR.

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HOW WELL DO IMAGE-DEFINED RISK FACTORS PREDICT SURGICAL OUTCOMES AND SURVIVAL IN PATIENTS WITH NEUROBLASTOMA? - A SYSTEMATIC REVIEW AND META-ANALYSIS

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Background: Neuroblastoma is the most common extra-cranial solid tumor of childhood. The International Neuroblastoma Risk Group (INRG) added Image-Defined Risk Factors (IDRFs) to its pretreatment staging system in 2009. Since their introduction, the role of IDRFs in predicting surgical and oncologic outcomes has been extensively studied. We conducted a systematic review and meta-analysis in order to examine how well IDRFs predict postoperative resection status, surgical complications, overall survival (OS), and event-free survival (EFS).

Methods: We conducted an electronic database search to identify studies between January 1990 and July 2019 that compared surgical outcomes and/or survival in pediatric neuroblastoma patients presenting with one or more IDRF to patients presenting without an IDRF. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocols were followed.

Results: We identified 19 retrospective cohort studies for inclusion. The relative risk of incomplete surgical resection in IDRF-positive patients as compared to IDRF-negative patients was 3.082 [95% CI 1.925-4.933, $p < 0.001$]. The relative risk of surgical complications in IDRF-positive patients as compared to IDRF-negative patients was 2.336 [95% CI 1.468-3.719, $p < 0.001$]. The relative risk of 5-year mortality (OS) in IDRF-positive patients as compared to IDRF-negative patients was 2.681 [95% CI 1.473-4.879, $p = 0.001$]. The relative risk of 5-year mortality and/or relapse (EFS) in IDRF-positive patients as compared to IDRF-negative patients was 1.909 [95% CI 1.284-2.838, $p = 0.001$].

Conclusions: Neuroblastoma patients presenting with an IDRF have a higher relative risk of incomplete surgical resection and surgical complications. Further, patients presenting with an IDRF have a higher relative risk of 5-year mortality and a higher relative risk of 5-year mortality and/or relapse. Our results suggest that IDRFs are a useful prognostic tool for neuroblastoma patients.

POSTERS

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THE IMPACT OF PRIMARY SURGICAL MANAGEMENT AND DISEASE CHARACTERISTICS ON SURVIVAL IN HEPATOBLASTOMA: A RETROSPECTIVE REVIEW

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Purpose: To compare survival in hepatoblastoma patients based on primary surgical management and disease characteristics to determine their utility in predicting patient outcomes.

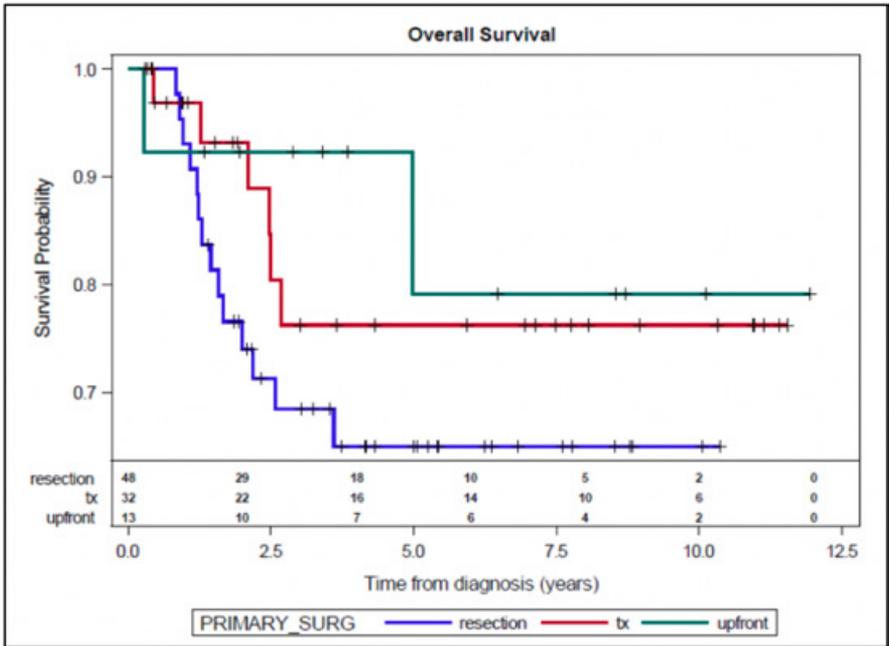
Methods: An Institutional Review Board-approved single institution retrospective review of 100 patients was conducted. Patients who presented for hepatoblastoma management between January 1, 2008 and December 31, 2018 were eligible. Patients were grouped by primary surgical management: resection at diagnosis (n=13), primary conventional resection (n=48), primary liver transplantation (n=32), and unresectable/ineligible for transplant (n=7). Additional groups analyzed included: presence (n=34) versus absence (n=66) of metastases at diagnosis; primary (n=32) versus salvage (n=8) transplantation; and, chemosensitivity (defined as a 1-log drop in AFP between diagnosis and primary surgical management, n=55) versus non-chemosensitivity (n=16). Overall and event-free survival (EFS - events defined as relapse, disease progression, and death) were assessed using the Kaplan-Meier method. Significance level: $p < 0.05$.

Results: Five-year cohort survival was 67%. Based on primary surgical management, no difference was found in overall ($p=0.32$) or EFS ($p=0.24$). Overall (HR 3.03, $p=0.015$) and EFS (HR 3.79, $p < 0.001$) were reduced in patients with metastatic disease at diagnosis versus local disease at diagnosis; five-year survivals were 45% and 77%, respectively. No difference was found in overall survival between primary and salvage transplantation ($p=0.88$); five-year survivals were 76% and 75%, respectively. Overall (HR 0.31, $p=0.032$) and EFS (HR 0.47, $p=0.036$) were reduced in non-chemosensitive versus chemosensitive patients.

Conclusion: Patients who require more aggressive medical and surgical management in the form of neoadjuvant chemotherapy and/or liver transplantation have no increased risk of death, relapse, or progression of disease compared to patients whose disease is resectable at diagnosis. In contrast, high risk features included non-chemosensitive disease and metastases at diagnosis.

POSTERS

P114 (continued)



POSTERS

P115

PEDIATRIC BONE AND SOFT TISSUE BIOPSIES--IS PERCUTANEOUS BIOPSY GOOD ENOUGH?

Jo Cooke-Barber, MD¹, Michael Sorger², Neil Johnson, MD², Joseph Pressey, MD², Brian Turpin, DO², Rajaram Nagarajan, MD², Sara Szabo, MD, PhD², Joel Sorger, MD², Roshni Dasgupta, MD, MPH³

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Background: There are no consensus guidelines regarding percutaneous needle biopsy for the diagnosis of soft tissue and bone tumors. The aim of this study was to understand the efficacy of percutaneous biopsy, the role of pre-procedural imaging, and diagnostic accuracy.

Methods: A retrospective institutional chart review was performed on patients who underwent percutaneous biopsy of soft tissue or bone tumors. 169 bone or soft tissue masses in 141 children with suspected malignancy between 6/1/2014 and 11/1/2017 were included in this study. Data collected included preoperative imaging, gender, age, race, insurance status, fluoroscopy time, number of samples taken, and pathologic results.

Results: The majority (79.8%) of patients were Caucasian race and 8.8% were African American. 52.7% of patients were male and 47.3% were female. The average age at time of biopsy was 14.7 years \pm 7.2 years. 88.8% were core needle, 9.5% FNA, and 1.8% of patients had both core needle and FNA performed. The mean number of samples obtained during each procedure was 3.6 \pm 2.5. When taking all biopsies into account, 101 (40.2%) used more than one method of imaging for guidance/pre-procedure planning while 68 (59.8%) used only one imaging modality. The most common imaging modality overall was CT guidance (74.6%) followed by fluoroscopy (65.7%) and US (24.3%). The most common pathology was osteoid osteoma (n=29). The most common malignant tumors were osteosarcoma (n=10) and Ewing sarcoma (n=7). The majority (97.6%) of percutaneous bone and soft tissue biopsies provided specimens that were diagnostic. 4 patients (2.4%) out of 169 biopsies required repeat biopsy for diagnosis. There were no post procedural complications.

Conclusion: Percutaneous, rather than open, biopsy of soft tissue and bone masses is safe, and an effective method of obtaining tissue samples in children with soft tissue or bone masses.

WITHDRAWN ABSTRACTS

Due to the cancelation of the 2020 in-person meeting, abstract presenters had the option to withdraw their presentation from the virtual meeting without penalty. The abstracts listed below were originally accepted for presentation.

IPSO POSTERS

IPSO P2

Identification of Kinases Involved in the Pathogenesis of Fibrolamellar Hepatocellular Carcinoma

Alan F. Utria¹, Heidi Kenerson¹, Raymond Yeung¹, Taran Gujral², Kimberly Riehle¹

¹University of Washington, Seattle, WA, USA, ²Fred Hutch, Seattle, WA, USA

IPSO P4

Zika Virus as an Oncolytic Treatment for Nephroblastoma

Joseph Mazar, PhD¹, Tamarah J. Westmoreland, MD, PhD¹, Peter Phelan, MS¹, Jeanne Brooks, MS¹, Cynthia Reyes, MD²

¹Nemours Children's Hospital, Orlando, FL, USA, ²St. Joseph's Children's Hospital, Tampa, FL, USA

IPSO P10

Characteristics of Benign Neuroblastic Tumors

Richard S. Whitlock, MD¹, Sara Larson, BS², Jennifer Foster, MD³, John Hicks, MD³, Jed Nuchtern, MD³, Sanjeev A. Vasudevan, MD³, Bindi J. Naik-Mathuria, MD, MPH³

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IPSO P13

Evaluation of Pre- and Postoperative Split Renal Function in Surgical Treatment of High-risk Abdominal Neuroblastoma

Tomoro Hishiki¹, Akihiro Fujino², Kazunori Tahara², Yohei Yamada², Teizaburo Mori², Mai Kutsukake², Takuro Fujita², Yumi Kudo², Kazue Miyake², Yutaka Kanamori²

¹National Center for Child Health and Development, Chiba, Chiba, Japan, ²National Center for Child Health and Development, Tokyo, Tokyo, Japan

WITHDRAWN ABSTRACTS

IPSO P15

Experiences of Percutaneous Liver Biopsy for the Diagnosis of Hepatoblastoma

Tianyou Yang, MD¹, **Manna Zheng**², Jiahao Li², Jing Pan², Jiliang Yang², Tianbao Tan², Chao Hu², Yan Zou²

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APSA POSTERS

P6

Extended Spectrum Penicillins During the First Trimester of Pregnancy Reduce the Risk for Omphalocele

Arimatias Raitio, MD¹, Asta Lahtinen, MD², Johanna Syvänen, MD¹, Teemu Kemppainen, MSc³, Eliisa Löyttyniemi, MSc³, Ulla Sankilampi, MD, PhD⁴, Mika Gissler, PhD⁵, Anna Hyvärinen, MD, PhD⁶, Ilkka Helenius, MD, PhD⁷

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P8

The Mechanism Behind Improved Glucose Control After Sleeve Gastrectomy in a Diet-induced Obese Mouse Model May Be Independent of Intestinal-specific FXR

Monica D. Chow, MD¹, Andrew M. Wassef, BA², Bo Kong, PhD³, Laura E. Armstrong, PhD³, Justin D. Schumacher, PharmD, PhD³, Daniel Rizzolo, BS³, Ragui W. Sadek⁴, Grace L. Guo, MBBS, PhD³, Yi-horng Lee, MD⁵

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WITHDRAWN ABSTRACTS

P14

Small Bowel Resection Alters the Mucin Barrier via Alterations in the Microbiota

Cathleen M. Courtney, MD¹, David M. Alvarado, PhD², Scott A. Handley, PhD³, Barry L. Hykes, MS³, Lindsay Droit, BS³, Adam Bajinting, BS⁴, Emily J. Onufer, MD, MPH⁵, Matthew Ciorba, MD², Brad W. Warner, MD⁶

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P22

Biodistribution of Nanoparticles in Fetal Lung After IV Injection

Sarah J. Ullrich, **MD¹**, **Mollie R. Freedman-Weiss, MD¹**, Samantha Ahle¹, Adele Ricciardi, PhD², Hanna Mandl², Alexandra Piotrowski-Dapsit², Mark Saltzman², David H. Stitelman, MD³

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P24

Utilization of the 13 French Avalon® Bicaval Dual Lumen Catheter for Venovenous Extracorporeal Membrane Oxygenation in Young Infants with Respiratory Failure

Allison F. Linden, MD, MPH¹, Roshan J. D'Cruz, MD¹, Michael Golecki¹, Courtney L. Devin, MD², Michael R. Phillips, MD³, Curt Froehlich¹, Kirk Reichard¹, Loren Berman, MD¹, Daniel Dirnberger¹

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WITHDRAWN ABSTRACTS

P33

Outborn Delivery Predicts Mortality in Neonates with CDH Needing ECMO

Peter T. Yu, MD, MPH¹, Carol A. Major, MD², Tim Jancelewicz, MD, MA, MS³, Pamela A. Lally, MD⁴, Matthew T. Harting, MD, MS⁵, Danh V. Nguyen, PhD⁶, Yigit S. Guner, MD, MS²

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P36

Congenital Lung Malformations: Development of Perinatal Care Clinical Algorithm

Alice King, MD¹, Timothy Lee¹, Emily Steen², Amy Mehollin-Ray¹, Christopher Cassady¹, Sundeep Keswani¹

¹Texas Children's Hospital, Houston, TX, USA, ²Baylor College of Medicine, Houston, TX, USA

P37

Evidence for Schwann-cell Derived Enteric Neurogenesis in Humans

Andrea Bischoff, MD¹, Alberto Peña, MD¹, Luis de La Torre, MD¹, Mark A. Lovell, MD², Jaime Belkind-Gerson, MD²

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P49

Predictors of Postoperative Systemic Inflammatory Response Syndrome After Total Pancreatectomy with Islet Autotransplantation in Children

Gillian R. Goddard, MD, Monica L. Wagner, MD, Todd M. Jenkins, PhD, MPH, Maisam Abu-El-Haija, MD, Tom K. Lin, MD, Stuart Goldstein, MD, Jaimie D. Nathan, MD

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WITHDRAWN ABSTRACTS

P50

Characterization of Intestinal Microbiota After Small Bowel Transplantation

Qingqing Wang, MD, PhD¹, Nicholas J. Ollberding², Dawit G. Tadesse², Heidi Andersen³, Amanda Schreiber¹, David B. Haslam³, Samuel A. Kocoshis⁴, Jaimie D. Nathan, MD⁵

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P52

Direct Admissions of Pediatric Appendicitis Patients upon Referral to a Tertiary Children's Hospital Have a High False Positive Rate

Matthew T. Grant, MD, MPhil, Jesse D. Vrecenak, MD

Washington University in St. Louis, St. Louis, MO, USA

P69

A Self-contained Renewable Battery Replacement Module for Critical Diagnostic and Therapeutic Surgical Devices

Michael M. Fuenfer, MD¹, Nevan Hanumara², Gim Horn², Rachel Hoffman², Kerrie Wu², Alexandre Urpi², Peter Duerst², Jaemyon Lee², Alex Slocum²

¹Harvard Medical School, Massachusetts General Hospital, Marblehead, MA, USA, ²MIT, Cambridge, MA, USA

P86

Prediction of Surgical Outcomes of Oesophageal Atresia: Is a Revised and Relevant Prognostic System Needed in Africa?

Agneta O. Odera, MBChB, MSCi Ped surg¹, Mahomed H. Sheik- Gafoor², Nasheeta Peer, MBChB, MBA, MPH, PhD³, Yusenantha Balakrishna³

¹Tenwek Hospital, Bomet, Rift Valley, Kenya, ²Inkosi Albert Luthuli Central Hospital, Durban, KwaZulu-Natal, South Africa, ³South African Medical Research Council, Durban, KwaZulu-Natal, South Africa

WITHDRAWN ABSTRACTS

P101

Improving Detection of Blunt Cerebrovascular Injury (BCVI) in Pediatric Trauma Patients

Peter T. Yu, MD, MPH¹, John Schomberg, PhD, MPH², Elizabeth L. Salas, MPH², Katie W. Russell, MD³, Theodore W. Heyming, MD², David L. Gibbs, MD⁴, Yigit S. Guner, MD, MS⁴

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P102

Angioembolization Drives Overall Increase in Rates of Intervention in Children with Blunt Liver and Spleen Injuries

Nicholas Yung, MD¹, Emily R. Christison-Lagay, MD², Daniel G. Solomon, MD²

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P110

The Surgery of Mesenteric or Portal Vein Obstruction in Children with Periportal Malignant Tumors

Caroline Lemoine, MD, Katherine Brandt, CRC, Joan Lokar, APN, Riccardo Superina, MD

Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA

IPSO SCIENTIFIC PROGRAM

IPSO-3

Microcoil Localization as an Effective Adjunct to Thoracoscopic Resection of Pulmonary Nodules in Children

Katrina M. Morgan, MD¹, John J. Crowley, MD², Benjamin T. Many³, Timothy B. Lautz⁴, Marcus M. Malek²

¹University of Pittsburgh Medical Center, Pittsburgh, PA, USA, ²UPMC Children's Hospital of Pittsburgh, Pittsburgh, PA, USA, ³Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA, ⁴Division of Pediatric Surgery, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA

WITHDRAWN ABSTRACTS

IPSO-7

Functional Fecal and Urinary Outcomes After Sacrococcygeal Tumor Resection in Pediatric Patients

Hira Ahmad, MD¹, Marc A. Levitt, MD², Richard J. Wood, MD², Jennifer H. Aldrink³

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IPSO-13

99m Tc-tilmanocept for Pediatric SLNB? Results of a Prospective, Open-label Multicenter Trial Evaluating Sentinel Lymph Node Biopsy (SLNB) in Pediatric Solid Tumor Patients

Roshni Dasgupta, MD MPH¹, Tamarah J. Westmoreland², MD PhD, Marcus M. Malek³, MD, Mary T. Austin, MD MPH⁴, MD, Jennifer H. Aldrink⁵, MD

¹Cincinnati Children's Medical Center, Cincinnati, OH, USA, ²Nemours Children's Hospital, Orlando, FL, USA, ³Children's Hospital of Pittsburgh, Pittsburgh, PA, USA, ⁴The University of Texas MD Anderson Cancer Center, Houston, TX, USA, ⁵The Ohio State University College of Medicine, Nationwide Children's Hospital, Columbus, OH, USA

IPSO-18

Repeat Nephron-sparing Surgery in Bilateral Pediatric Renal Tumors

Matthias Schunn¹, Steven Warmann¹, Jürgen Schäfer², Joerg Fuchs, MD³

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IPSO-23

Pathway to Personalized Targeted Therapy for Refractory Hepatoblastoma

Richard S. Whitlock, MD¹, Tianyou Yang, MD², Roma Patel, BS², Samuel Larson, BS², Sarah Woodfield, PhD², Sanjeev A. Vasudevan, MD²

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WITHDRAWN ABSTRACTS

IPSO-24

Impact of Local Control and Surgical Lymph Node Evaluation in Localized Paratesticular Rhabdomyosarcoma: A Report from the Children's Oncology Group Soft Tissue Sarcoma Committee

Roshni Dasgupta, MD MPH¹, Jonathan Routh, MD², Yueh-Yun Chi, PhD³, Margaret Shnorhavorian, MD, MPH⁴, Jing Tian, Msc³, David Walterhouse, MD⁵, John Breneman, MD⁶, Suzanne L. Wolden, MD⁷, Carola Arndt, MD⁸, Douglas S. Hawkins, MD⁴, David Rodeberg, MD⁹

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APSA SCIENTIFIC PROGRAM

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Administration of Amniotic Fluid Stem Cell Exosomes Increases the Expression of Heparin-binding Epidermal Growth Factor in CDH Hypoplastic Fetal Lungs

Louise Montalva¹, Andreea Matei¹, **Lina Antounians¹**, Rebeca Figueira², Karina Miura Da Costa², Lourenco Sbragia-Neto², Augusto Zani¹, Lina Antounians¹

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WITHDRAWN ABSTRACTS

S38

Likely Pathogenic de novo Variants in Congenital Diaphragmatic Hernia Patients Are Associated with Worse Clinical Outcomes

Lu Qiao, PhD¹, Julia Wynn, MS, MS, CGC¹, Lan Yu, PhD¹, **Rebecca Hernan, MS, CGC²**, Xueya Zhou, PhD¹, Vincent P. Duron, MD¹, Gudrun Aspelund, MD, MS¹, Foong-Yen Lim, MD³, Robert Cusick, MD⁴, Kenneth S. Azarow, MD⁵, Melissa Danko, MD⁶, Brad W. Warner, MD⁷, George B. Mychaliska, MD, MS⁸, Douglas Potoka, MD⁹, Amy J. Wagner, MD¹⁰, Samuel Z. Soffer, MD¹¹, David T. Schindel, MD¹², David McCulley, MD¹³, Yufeng Shen, PhD¹, Wendy Chung, MD, PhD¹, Rebecca Hernan, MS, CGC²

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S51

Volume-outcome Relationship for Repair of Pectus Excavatum in Children

Benjamin T. Many¹, Jonathan Vacek, MD¹, Megan Beck, MD¹, Yazan K. Rizeq, BS¹, Seth D. Goldstein², Hassan Ghomrawi³, Fizan Abdullah, MD, PhD²

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S57

Implementation of a Contextually Appropriate Pediatric Emergency Surgical Care Course in Uganda

Sarah J. Ullrich, MD¹, Phyllis Kisa², Nensi M. Ruzgar³, Martin Situma⁴, Doruk E. Ozgediz, MD⁵

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WITHDRAWN ABSTRACTS

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Inhibition of the Bacterial Receptor Toll-like Receptor 4 (TLR4) Reduces Post-operative Ileus After Abdominal Surgery in Juvenile Mice

Mark L. Kovler¹, Chhinder P. Sodhi², Mitchell R. Ladd¹, William B. Fulton², Andres J. Gonzalez Salazar¹, Maame Efua S. Sampah¹, Yukihiko Yamaguchi², Hongpeng Jia², Peng Lu², Chelsea Zhou², Thomas Prindle², Sanxia Wang², David J. Hackam¹

¹Johns Hopkins Hospital, Division of General Pediatric Surgery, Baltimore, MD, USA, ²Johns Hopkins University School of Medicine, Baltimore, MD, USA

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Scientific Session 6: Gastrointestinal - Foregut, Midgut, Hepatobiliary Diminished Hepatic Lipid Synthesis Accompanies Reduced Bile Acid Resorption After Small Bowel Resection to Promote Dietary Lipid Malabsorption

Emily J. Onufer, MD, MPH¹, Rafael Czepielewski, PhD², Yong-Hyun Han, PhD², Cathleen M. Courtney, MD³, Stephanie Sutton¹, Gwendalyn Randolph, PhD², Brad W. Warner, MD⁴

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WITHDRAWN ABSTRACTS

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Index Admission Cholecystectomy Decreases Recurrence of Pediatric Gallstone Pancreatitis: A Multicenter Cohort Analysis

Armando Salim Munoz Abraham, MD¹, Hector Osei, MD³, Faidah Badru², Adam Bajinting, BS⁴, Robert A. Cowles, MD⁵, Jose Greenspon², Brian Hosfield⁶, Martin Keller⁷, Matthew P. Landman, MD⁸, Hawkins Owens⁹, Matthew P. Shaughnessy¹⁰, Shawn D. St. Peter¹¹, Joseph Sujka¹¹, Adam M. Vogel, MD⁹, Gustavo A. Villalona²

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Administration of Amniotic Fluid Stem Cell Extracellular Vesicles to Hypoplastic Cdh Fetal Lungs Induces Epithelial Proliferation and Differentiation via a miRNA Mediated Mechanism

Lina Antounians, Benjamin Liu, Andreea Matei, Huayun Hou, Cadia Chan, Michael Wilson, Augusto Zani

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FUTURE MEETINGS

APSA 2021 Annual Meeting Joint meeting with IPEG May 20-23, 2021

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

Abstract submission dates for the APSA meeting

Submission opens August 12, 2020
Submission deadline October 13, 2020

APSA 2022 Annual Meeting May 12-15, 2022

Marriott Marquis San Diego Marina
San Diego, California USA

2020 Program Chair – Casey M. Calkins, MD

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