APSA

American Pediatric Surgical Association

Saving Lifetimes™

2021

Abstracts

Annual Meeting
May 20-22

APSA
American Pediatric Surgical Association
Saving Lifetimes™

AMERICAN PEDIATRIC SURGICAL ASSOCIATION MISSION

To ensure optimal pediatric surgical care of patients and their families, to promote excellence in the field, and to foster a vibrant and viable community of pediatric surgeons.

WE DO THIS BY:

- Developing and advocating for standards of care for infants and children and influencing public policy around the surgical care of children
- Encouraging discovery, innovation and improvement of care
- Providing rich venues for the dissemination of up-to-date knowledge
- Offering high quality continuing education to members
- Creating identity and community among pediatric surgeons
- Promoting a supportive health care environment for patients, staff and surgeons and making certain that it is sustained by economic health

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EDUCATIONAL OVERVIEW

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 (Advocacy, Cancer, Diversity, Equity and Inclusion, Ethics, Fetal Diagnosis and Treatment, New Technology, Practice, Informatics and Telemedicine, Surgical Critical Care, Research, Trauma, Surgical Quality and Safety, Workforce 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.

Benjy Brooks - Improving Gender Equity in Pediatric Surgery
Erin E. Perrone, MD, Moderator: Osseous Solutions and Development Group, LLC (Self): Ownership Interest (Status: Ongoing)

Case Controversies
Todd A. Ponsky, MD, Speaker: GlobalcastMD (Self): Ownership Interest (Status: Ongoing)

Education: Addressing Today's Educational Challenges Using Technology
Katherine Barsness, MD, MS, MBA, Speaker: Bolder Surgical (Self): Advisor or Review Panel member (Status: Ongoing)

Fetal Diagnosis and Treatment Committee - FETO in the Management of CDH: Is it the Future?
Oluyinka Olutoye, MD, PhD, Speaker: Covidien (Self): Other Research Support (Status: Ongoing); Mallinkrodt (Self): Other Research Support (Status: Ongoing)

Jan Deprest, MD, PhD, FRCOG, Speaker: Duomed Chair 'POP-ART' (Self): Research Grant (Status: Ongoing); European Commission in Horizon 2020 (Self): Research Grant (Status: Ongoing); Fotona Translational Research into Vaginal Laser (Self): Research Grant (Status: Ongoing); Sparks Charity Fund (Self): Research Grant (Status: Ongoing)

New Technology
Bethany J. Slater, MD, MBA, Moderator, Speaker: Boulder Surgical (Self): Consultant (Status: Ongoing)

Brian Gulack, MD, MHS, Speaker: Pacira (Self): Advisor or Review Panel member (Status: Ongoing)

Plenary Session 2
Erin E. Perrone, MD, Discussant: Osseous Solutions and Development Group, LLC (Self): Ownership Interest (Status: Ongoing)

Practice Committee: Strategies to Optimize the Successful Submission and Reimbursement of Unlisted CPT Codes
David Yu, MD, Discussant: Pacira (Self): Consultant (Status: Ongoing)

Quality, Safety and Value in Surgery Award Highlights
Derek Wakeman, MD, Discussant: UR (University of Rochester) Ventures (Self): Co-inventor of a patent pending (no royalties received to date) (Status: Ongoing), Ownership Interest (Status: Ongoing)

Research Committee: Jay and Margie Grosfeld Symposium
James C.Y Dunn, MD, PhD, Discussant: Eclipse Regenesis (Self): Ownership Interest (Status: Ongoing); Surrozen (Self): Consultant (Status: Terminated)

Scientific Session 1 - Neonatal Surgery
#25 A Novel Toll-Like Receptor 4 Inhibitor Treats Established NEC in Newborn Mice
Andres J. Gonzalez Salazar, MD, Presenting Author: Gen1e Lifesciences (Self): Research Grant (Status: Ongoing)

Brad W. Warner, MD, Discussant: Kallyope (Self): Consultant (Status: Ongoing); Takeda (Self): Advisor or Review Panel member (Status: Ongoing)

Scientific Session 2 - Education, Advocacy, DEI, General Surgery
#P12 Reduction of Surgical Site Infections in Pediatric Patients with Complicated Appendicitis: Utilization of Antibiotic Stewardship Principles and Quality Improvement Methodology
Derek Wakeman, MD, Presenting Author: University of Rochester (Self): Ownership Interest (Status: Ongoing), patent pending related to feeding tubes and other medical devices; unrelated to this presentation and no financial benefit received to date (Status: Ongoing); patent pending for magnetically coupled medical devices; The Childress Institute for Pediatric Trauma: $1500 travel reimbursement to attend a meeting / workgroup

Scientific Session 4 - General and Thoracic Surgery
Bethany J. Slater, MD, MBA, Moderator: Boulder Surgical: Consultant/Advisory Board, Consulting Fees (e.g., advisory boards)

Variation in Care - Adolescent Inguinal Hernia
Todd A. Ponsky, MD, Discussant: GlobalcastMD (Self): Ownership Interest (Status: Ongoing)

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.

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Kathryn Bass: Speaker – Mimedx; Speaker - Medline

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Program Committee
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Surgical Quality and Safety Committee
Monica Lopez: UpToDate - Coauthor on 2 topics, Royalties

Adam Goldin: Inside Out Medicine - CMO, Stockholder

Derek Wakeman: University of Rochester (Self): Ownership Interest (Status: Ongoing), patent pending related to feeding tubes and other medical devices; unrelated to this presentation and no financial benefit received to date (Status: Ongoing); patent pending for magnetically coupled medical devices; The Childress Institute for Pediatric Trauma: $1500 travel reimbursement to attend a meeting / workgroup

Wellness Committee
RobertObermeyer: Biomet Zimmer, LLC, Consultant (all payment to group)

Daniel Saltzman: Salspera LLC - Microbial Immunotherapy, Founding Partner and Chief Medical Officer

Plenary Session 1
10:15 AM – 11:30 AM

1

CONTRAST CHALLENGE ALGORITHMS FOR ADHESIVE SMALL BOWEL OBSTRUCTIONS ARE SAFE IN CHILDREN: A MULTI-INSTITUTIONAL STUDY

Nathan S. Rubalcava, MD[1], Christina M. Bence, MD[2], Amanda R. Jensen, MD[3], Peter C. Minneci, MD MHSc[4], Kyle J. Van Arendonk, MD PhD[2], Grace Z. Mak, MD[5], Beth A. Rymeski, DO[3], Jonathan E. Koehler, MD[6], Tariku Beyene, DVM, PhD[4], Irene Isabel P. Lim, MD[4], Ronald B. Hirschl, MD MS[1], K. Elizabeth Speck, MD MS[1]

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Introduction
The safety and utility of water-soluble contrast challenges are well-established in adults with adhesive small bowel obstructions (ASBO). In children, minimal data exist and there is controversy around the safety of this approach. The study objective was to evaluate the safety of a contrast challenge in non-operative management of children with ASBO.

Methods
A multi-institutional retrospective review was conducted in children (ages 1-18 years) who underwent a contrast challenge for ASBO (01/2012–06/2020) at five large academic children's hospitals with similar algorithms: initial non-operative management with water-soluble contrast after at least 1-hour of gastric decompression; 1-hour dwell off suction; AXR after 10 +/-24hours. No cecal contrast on AXR within 24-hours was considered a failed study and prompted operation. Patients with indications for immediate operation were excluded. Minor safety measures evaluated included urticaria, shortness of breath, and increased oxygen requirement and major sequelae included pneumonia, renal failure, anaphylaxis, and cardiovascular collapse.

Results
82 patients underwent a contrast challenge. The median age at presentation was 10 years [interquartile range 2-16], some with neurologic (33%) and/or respiratory (40%) conditions. There were no major or minor complications. 71% had a successful contrast challenge, of which 95% avoided an operation (see figure). 29% failed the contrast challenge, all of whom underwent surgery. Median time from contrast administration to surgery was 23 hours [16, 38]. Overall, the sensitivity of the contrast challenge in this cohort was 87% with 100% specificity, NPV 93%, PPV 100%.

Conclusion
A contrast challenge is safe in children with ASBO, including those with respiratory and neurological comorbidities, and has high predictive value to assist in clinical decision making.

2

SURGICAL NECROTIZING ENTEROCOLITIS WORSENS NEURODEVELOPMENTAL OUTCOMES IN EXTREMELY LOW BIRTH WEIGHT INFANTS WITH CONCOMITANT INTRAVENTRICULAR HEMORRHAGE

Katherine Culbreath, MD[1], Gregory Keefe, MD[1], Erika M. Edwards[2], Jamie Knell, MD[3], Kate A. Morrow[2], Roger Soll[4], Tom Jaksic, MD[3], Jeffrey D. Horbar[2], Biren P. Modi, MD, MPH[5]

[1]Boston Children's Hospital, [2]Vermont Oxford Network, Burlington, VT, USA, [3]Boston Children's Hospital, Boston, MA, USA, [4]Vermont Oxford Network, [5]Boston Children's Hospital and Harvard Medical School, Boston, MA, USA

Purpose
To quantify the effect of necrotizing enterocolitis (NEC) on neurodevelopmental outcomes in extremely low birth weight (ELBW) infants with concomitant intraventricular hemorrhage (IVH).

Methods
This study analyzes prospectively collected data from 55 North American neonatal units regarding surviving ELBW infants born 2011-2017. Infants were stratified by NEC type (none, medical, surgical) and IVH severity (none, mild (Grade I and II), severe (Grade III and IV)) and evaluated at 16-26 months corrected age. The primary outcome was severe neurodevelopmental disability (NDI), defined as any one of: bilateral blindness, hearing impairment requiring amplification, inability to walk 10 steps without support, cerebral palsy, or a Bayley Scales of Infant Development score < 70 in cognitive, language, or motor categories. A generalized estimating equation logistic regression was performed to determine the adjusted relative risk (aRR) of developing NDI in medical or surgical NEC compared to no NEC, stratified by severity of IVH.

Results
13,961 ELBW infants were eligible for the study, 5870 of whom were evaluated at follow-up. In each IVH group, no statistical difference in NDI was seen in surviving ELBW infants with medical NEC compared to infants without NEC (Figure 1). Of patients with concomitant surgical NEC and severe IVH, 75% had NDI. Surgical NEC was associated with increased NDI in all IVH groups; this was statistically significant in patients without IVH (aRR 1.69;1.36,2.09) and with severe IVH (aRR 1.35;1.13,1.60), and trended toward significance in mild IVH (aRR 1.36;0.97,1.92).

Conclusions
ELBW infants with IVH and concomitant surgical NEC, but not medical NEC, have increased rates of severe neurodevelopmental disability at 16 to 26-month follow-up. The incidence of severe neurodevelopmental disability peaks at a remarkably high 75% of infants with both severe IVH and surgical NEC. These benchmark data can help inform prognostic discussions with families and prepare providers for the long-term needs of this fragile patient group.

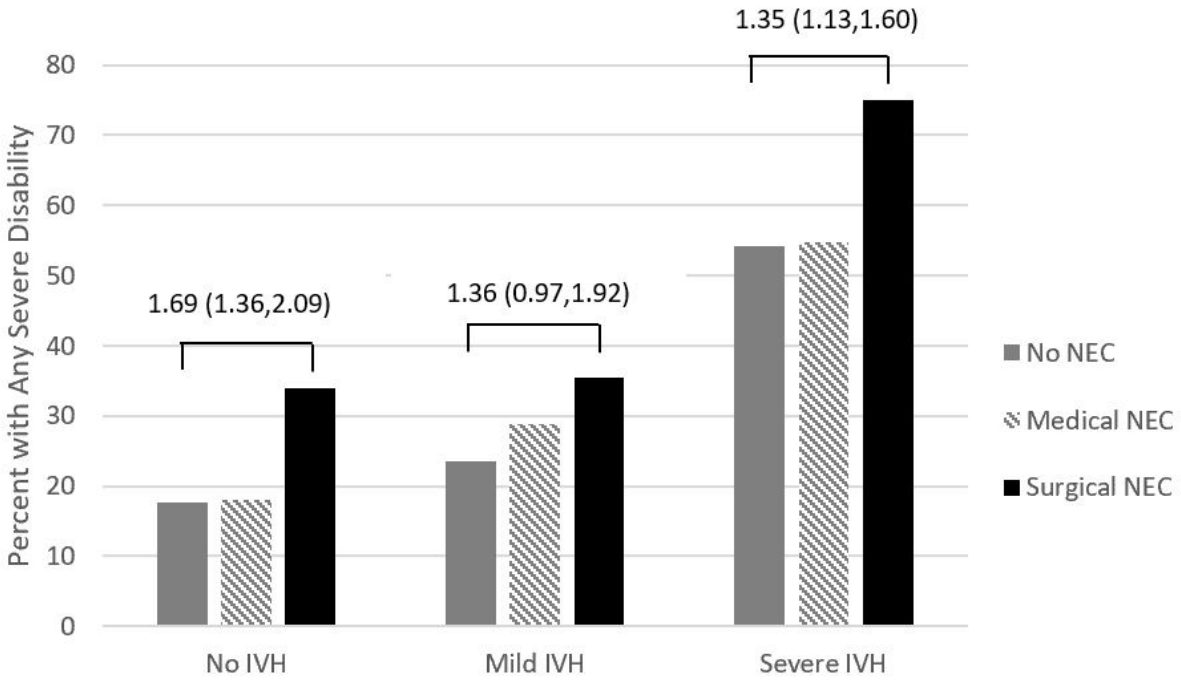

Figure 1. Incidence of severe neurodevelopmental disability in ELBW infants with concomitant IVH and NEC. Adjusted risk ratios and 95% confidence intervals based on generalized estimating equation logistic regression are presented, comparing surgical NEC to no NEC within each IVH category.

3

A NOVEL THERAPY TO REDUCE NEUROINFLAMMATION IN EXPERIMENTAL NECROTIZING ENTEROCOLITIS

George Biouss, MSc.[1], Zhen Zhang, MD[2], Bo Li, PhD[3], Carol Lee[3], Lina Antounians, MSc[3], Benjamin Steinberg[4], Neil Goldenberg[4], Augusto Zani[3], Agostino Pierro, MD[3]

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Purpose
Infants that survive necrotizing enterocolitis (NEC) can present neurodevelopmental impairment. We have previously shown that intestinal injury in experimental NEC is associated with severe neuroinflammation in the brain, with microglia activation and loss of oligodendrocytes. It has been proposed that NEC associated neuroinflammation is mediated by extracellular High-Mobility Group Box-1 (HMGB1), which interacts with Toll-like Receptor-4 (TLR4). Recently, a novel antagonistic peptide, P5779, has been described to block HMGB1-TLR4. Herein, we aimed to evaluate whether administration of P5779 to neonatal mice with NEC attenuates neuroinflammation.

Methods
NEC was induced in 5-day-old (P5) mice using hypoxia, gavage feeding (hyperosmolar formula), and lipopolysaccharide (4mg/kg)). From P6 to P9, a group of pups with NEC received daily intraperitoneal injections of P5779 or scrambled peptide (40mg/kg). To confirm that the effects of P5779 are due to blocking HMGB1-TLR4 and not LPS-TLR4, a group of pups received NEC induction with no LPS. Breastfed pups were used as control. At P9, pups were sacrificed, and brain and intestine were harvested. Cerebral HMGB1/TLR4 signaling was assessed by analyzing the gene expression of TLR4 and HMGB1 protein expression. To assess the extent of neuroinflammation, we quantified the number of Iba1+ activated microglia cells, and proliferating oligodendrocytes (Olig2+Ki67+).

Results
Compared to control, the brain of pups with NEC had higher expression of TLR4, HMGB1, more activated Iba1+ microglia cells, and fewer proliferating oligodendrocytes (Fig. A-C). A similar pattern was observed when a scramble peptide was administered. Conversely, treatment with P5779 resulted in fewer activated microglia and increased number of proliferating oligodendrocytes (Fig. A-C). Furthermore, P5779 also reduced neuroinflammation in the NEC (no LPS) group (Fig. D-E).

Conclusions
Blocking HMGB1-TLR4 signaling significantly reduces NEC associated cerebral neuroinflammation. Studies are underway to assess the effect of P5779 on specific neural cells, and the translational potential of pharmacological therapy in NEC to avoid neuroinflammation.

4

USE OF ULTRASOUND AS A DIAGNOSTIC ADJUNCT IN CASES OF EQUIVOCAL NECROTIZING ENTEROCOLITIS TO REDUCE OVERTREATMENT

Michelle P. Kallis, MD[1], Danielle Aronowitz[2], Bailey Roberts[2], Yan Shi, MD[3], Aaron M. Lipskar, MD[4], John Amodio[2], Alpna Aggarwal[2], Chethan Sathya, MD MSc[5]

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Background

The diagnosis of necrotizing enterocolitis (NEC) is often based on non-specific clinical and radiographic evidence. Cases of diagnostic uncertainty lead to unnecessary treatment and needless antibiotic exposure. This study aims to examine the use of abdominal ultrasound (US) as a diagnostic adjunct in equivocal cases of NEC as part of a structured diagnostic algorithm to diminish unnecessary antibiotic utilization.

Methods

Retrospective study (2017-2019) of infants undergoing evaluation for NEC where abdominal radiograph (AXR) findings and/or clinical factors were equivocal (n=54). US findings were compared to AXR findings, with attention to the ability to discern pneumatosis. Data on final diagnosis, antibiotic usage, and clinical course were extracted.

Results

Twenty-nine patients (53.7%) had a documented positive diagnosis of NEC. Of positive patients, pneumatosis was identified by US in 22 patients (75.9%) and by AXR in 6 patients (20.7%), ($p < 0.01$). Of negative patients, absence of pneumatosis was confirmed in 100% of patients by US and in 48% of patients by AXR ($p < 0.01$). Mean duration of antibiotic treatment in positive patients was 12.0 + 4.4 days. Eight negative patients (32%) received antibiotics, but for a significantly shorter duration (4.5 + 4.6 days; $p < 0.01$). Shortened courses were based on negative US and improved clinical status. No patient diagnosed as negative developed NEC within 1 week of negative US.

Conclusions

The use of US reduced the number of negative patients started on unnecessary antibiotic treatment and reduced the duration of antibiotic treatment when started. US should be used as a diagnostic adjunct for NEC to improve treatment decision-making.

Fisher's exact test

6

IS SAME DAY DISCHARGE POSSIBLE FOLLOWING THE NUSS REPAIR FOR PECTUS EXCAVATUM?

Robert Luke Rettig, MD[1], Andrew Rudikoff[2], Hoi Yee Annie Lo[2], Constance Lee[2], Walter Vazquez[3], Karen Rodriguez[2], Donald B. Shaul, MD[4], Antonio Hernandez Conte, Franklin Banzali, Roman Sydorak[2]

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Purpose

Intercostal Nerve Cryoablation (INC) has significantly improved pain control following the Nuss repair of pectus excavatum (PE). This study sought to compare patients undergoing the Nuss repair with INC to the Nuss repair with an enhanced recovery after surgery (ERAS) protocol including INC and intercostal nerve blocks (INB).

Methods

In June 2020, a new protocol began involving surgery, anesthesia, nursing, physical therapy and child life with the goal of safe same day discharge for patients undergoing the Nuss repair. They were compared to a control group who underwent the Nuss repair with INC alone in 2017-2019. The primary outcome measure was hospital length of stay (LOS) in hours, secondary outcomes were number of patients discharged on postoperative day (POD) 0, and returns to the emergency department (ED), urgent care (UC), and operating room (OR) within 30 days.

Results

The characteristics between the groups were the same (Table 1). The mean LOS was 11.8 hours in the INB group versus 58.2 hours in the INC group, $p < 0.01$. 10 of 15 patients in the INB group went home on POD 0 (average of 5.5 hours postop), versus 0 patients in the INC only group, $p < 0.01$. Five patients in the INB group stayed overnight. Two patients stayed due to anxiety, one due to urinary retention, one due to nausea, and one due to drowsiness. None stayed for pain control. One patient in the INC group returned to the ED for pain control, versus 0 in the INB group, and 1 patient in the INB group returned to UC for constipation.

Conclusions

The majority of patients undergoing the Nuss repair of PE with a multidisciplinary ERAS protocol and performance of direct vision INB and INC can go home on the day of surgery without adverse outcomes or unanticipated returns to the hospital.

7

COMPUTATIONAL DESIGN OF A NOVEL BIORESORBABLE SLEEVE DEVICE FOR ESOPHAGEAL ATRESIA REPAIR

Sriharsha Ramaraju, PhD[1], Scott J. Hollister[2], Shaun M. Kunisaki, MD, MSc[3]

[1]Georgia Institute of Technology, [2]Wallace A. Coulter Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, USA, [3]Johns Hopkins Hospital, Baltimore, MD, USA

Background

Postoperative anastomotic complications, including leak and stricture, are commonplace following neonatal esophageal atresia repair. The purpose of this study was to evaluate a novel bioresorbable external scaffold device aimed at improving anastomotic healing through scaffold functionalization with bioactive peptide sequences.

Methods

We computationally designed esophageal sleeves from the biodegradable shape memory elastomeric polymer, poly-glycerol-dodecanedioate (PGD) using MATLAB based on porosity, suture placement, and opening angle. Finite element analysis of sutured anastomosed ovine esophageal tissue (tissue modeled using the Gasser-Ogden-Holzapfel nonlinear elastic material) with the PGD sleeve were compared to sutured esophagus alone. The material was then functionalized with cell adhesive peptides (RGD and YIGSR) aimed at improving the endothelial cell microenvironment. Esophageal sleeves capable to being externally sutured to the anastomosis were then created by laser machining.

Results

Esophagus tissue was more compliant than PGD in nonlinear stress strain curve analyses. However, the introduction of suture holes and decreasing sleeve thickness reduced sleeve elastic properties toward that of esophageal tissue. Sleeves were capable of reducing anastomotic gap displacement by 11.0% and anastomotic strain by 15.5% (Figure). Functionalization of PGD films with RGD and YIGSR peptides was shown by FTIR spectra and XPS analysis. Tagged human umbilical vein endothelial cells showed significant attachment and spreading after 3hrs on peptide coated PGD even in the absence of serum proteins. Based on optimal design parameters, prototype sleeves measuring 25mm length, 10mm internal diameter, and 2mm thickness were manufactured (Figure). Estimated degradation time in vivo was 5-6 months. Immune responses were not significantly different from silicone controls.

Conclusions

We have designed a prototype structural support device suitable for implantation around the esophageal anastomosis during neonatal esophageal atresia repair. These sleeves accommodate placement of sutures to provide radial tension while simultaneously reducing anastomotic gap displacement and strain. Further development of this bioresorbable sleeve technology is warranted.

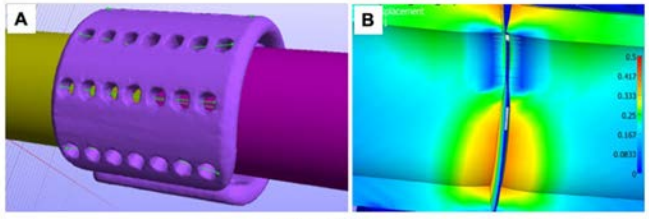

FIG. (A) Prototype sleeve 16mm long with 9 by 7 suture hole matrix with sutures (green lines) across anastomosis. **(B)** Peak displacements are reduced at anastomosis and surrounding tissue compared to anastomosis without sleeve. **(C)** Close up example of PGD with an open angle (60º) sleeve design.

8

EFFECT OF TRANSANASTOMOTIC FEEDING TUBES ON ANASTOMOTIC STRICTURES IN PATIENTS WITH ESOPHAGEAL ATRESIA AND TRACHEOESOPHAGEAL FISTULA: THE QUEBEC EXPERIENCE

Kathryn LaRusso, MD, MPH[1], Ann Aspirot[2], Jean-Martin Laberge[3], Christopher Faure[2], Shahrzad Joharifard, MD[4], Rosa Lakabi[3], Nancy Nimer[2], Amirali Shahi[2], Sara Kasasni[5], Dominique Levesque[3], Brigitte Moreau[5], Sherif Emil, MD, CM[6]

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Purpose
Recent studies have identified transanastomotic tubes (TATs) as a risk factor for the development of anastomotic strictures after repair of esophageal atresia with tracheoesophageal fistula (EA/TEF). We further investigated these findings in a multicenter study.

Methods
We conducted a retrospective cohort study at three university-affiliated hospitals in the province of Quebec. All patients with type C and D EA/TEF who underwent primary repair within 6 months of birth between January 1993-August 2018 were included. Anastomotic stricture was defined as clinical symptoms of stricture with confirmation on esophagram or endoscopy. Multivariate logistic regression and the Wilcoxon Rank-Sum test were used to evaluate the primary outcome of stricture within one year of surgery and secondary outcome of duration of postoperative total parenteral nutrition (TPN).

Results
The study cohort included 244 patients, of which 234 (96%) were type C and 10 (4%) were type D. The anastomotic stricture rate at 1 year was 30%. TATs were utilized in 61% of patients. Thirty-six percent of patients with TATs developed a stricture within one year, as compared to 19% of patients without TATs (p=0.005). TATs were associated with stricture on univariate analysis (OR 2.49, p=0.004, 95% CI: 1.37-4.69). On multivariate analysis, after adjusting for gestational age, leak, long gap, anastomotic tension, and daily acid suppression, patients with TATs had 2.74 times higher odds of developing a stricture as compared to patients without TATs (p= 0.006, 95% CI: 1.36-5.74). The median duration of postoperative TPN was 9 days in both groups (p=0.139, IQR 6-14 in patients with TATs versus IQR 7-16 in patients without).

Conclusion
Transanastomotic tubes are associated with a significantly higher risk of postoperative stricture following repair of esophageal atresia with tracheoesophageal fistula and do not shorten the duration of postoperative total parenteral nutrition.

9

IMPLEMENTING A STANDARDIZED GASTROSCHISIS PROTOCOL SIGNIFICANTLY INCREASES PRIMARY BEDSIDE SUTURELESS CLOSURES WITHOUT COMPROMISING CLOSURE SUCCESS OR EARLY CLINICAL OUTCOMES

Shahrzad Joharifard, MD[1], **Maeve O'Neill Trudeau, MD, MPH, FRCSC**[2], Shin Miyata[3], Josianne Malo[2], Sarah Bouchard[2], Mona Beaunoyer[2], Rebecca Brocks[2], Caroline Lemoine, MD[4], Andréanne Villeneuve[2]

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Purpose

Standardized protocols have been shown to improve outcomes in several pediatric surgical conditions. We implemented a multi-disciplinary gastroschisis practice bundle at our institution in 2013. We sought to evaluate its impact on closure type, success, and early clinical outcomes.

Methods

We performed a retrospective review of uncomplicated gastroschisis patients treated at our institution between 2008-2019. Patients were divided into two groups (pre- and post-implementation) separated by a 3-year washout period. Multivariate logistic regression was used to compare closure location and method.

Results

A total of 108 neonates with gastroschisis were identified but 12 with complicated gastroschisis were excluded (pre- n=4, post- n=8). Neonates (pre- n=53 and post- n=43) were similar across baseline variables. Treatment intent was urgent primary closure for most patients in both groups (76.9% vs. 83.7%, p=0.41). Successful immediate closure rates were comparable (75.5% vs. 72.1%, p=0.71). The proportion of bedside closures increased significantly after protocol implementation (35.3% vs. 95.4%, $p < 0.01$), as did the proportion of sutureless closures (32.5% vs. 71.0%, p= < 0.01). Median duration of postoperative ventilation decreased significantly (4 days IQR [3, 5] vs. 2 days IQR [1, 3], $p < 0.01$). Postoperative complications and duration of parenteral nutrition were equivalent (Table 1). After controlling for the potential confounding effects of birthweight, gestational age, SNAP II, and gastroschisis prognostic score, infants in the post-implementation group had a 44.0 times higher odds of undergoing bedside closure (95% CI: 9.0-215.2, $p < 0.01$) and a 7.7 times higher odds of undergoing sutureless closure (95% CI 2.3-25.1, $p < 0.01$).

Conclusion

Implementing a standardized gastroschisis protocol significantly increased the rate of immediate bedside sutureless closure and decreased the duration of postoperative ventilation, without increasing postoperative complications.

10

DISCONTINUING ANTIBIOTICS ON DISCHARGE IS SAFE IN CHILDREN WITH PERFORATED APPENDICITIS WITHOUT LEUKOCYTOSIS

Christina M. Theodorou, MD[1], Yemi Lawrence[2], Payam Saadai, MD[1], Shinjiro Hirose, MD[1], Erin G. Brown, MD[1]

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Purpose

Opimal management of pediatric perforated appendicitis remains a topic of active investigation. In the spirit of antibiotic stewardship, antibiotic regimens have been shortened as studies have revealed no worsened outcomes with fewer doses. Our institutional perforated appendicitis pathway was modified to discontinue antibiotics on discharge in the presence of a normal white blood cell count (WBC) without neutrophilia. We hypothesized that patients would receive fewer antibiotics without increased complications.

Methods

Patients < 18 years old with perforated appendicitis who underwent appendectomy 7/1/18-8/1/20 at a tertiary care children's hospital were included. The primary outcome was discharge antibiotic prescription. Secondary outcomes included total antibiotic duration, surgical site infection (SSI), post-operative interventions, emergency department (ED) visits, and readmissions. Outcomes were compared for 12 months before pathway modification (pre) and 12 months after (post).

Results

There were 55 patients in the pre cohort and 57 patients in the post cohort. There were no differences in symptom duration (3 days pre vs. 2 days post, p=0.1), initial WBC (18.1 pre vs. 16.6 post, p=0.1), discharge WBC (9.1 pre vs 10.1 post, p=0.4), or discharge neutrophilia (36.7% pre vs 25.5% post, p=0.3). Significantly fewer patients were prescribed antibiotics on discharge after pathway modification (74.5% pre vs. 28.1% post, p < 0.0001) and for shorter duration (2 days pre vs. 0 days post, p=0.0004). Total inpatient and outpatient antibiotic duration decreased significantly (6.1 days pre vs. 5.0 days post, p=0.0006). There were no differences in SSIs (10.9% pre vs. 12.3% post, p=1.0), post-operative interventions (9.1% pre vs. 8.8% post, p=1.0), ED visits (16.4% pre vs. 14.0% post, p=0.8), or readmissions (5.5% pre vs. 8.8% post, p=0.7).

Conclusion

Modification of a pediatric perforated appendicitis pathway to discontinue antibiotics on discharge with a normal white blood cell count without neutrophilia was effective in decreasing antibiotic duration without an increase in complications.

Quality, Safety and Value in Surgery Award Highlights

12:25 PM – 12:45 PM

17

REDUCTION OF POST-OPERATIVE OPIOID USE IN NEONATES FOLLOWING CONGENITAL DIAPHRAGMATIC HERNIA REPAIRS: A QUALITY IMPROVEMENT INITIATIVE

David F. Grabski, MD[1], Rick Vavolizza[2], Daniel E. Levin, MD[3], Jonathan Swanson[2], Eugene D. McGahren, MD[2], Jeffrey W. Gander, MD[4]

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Background

A limited number of post-operative opioid reduction strategies exist for neonates. A standardized post-operative pain control regimen previously implemented in our neonatal intensive care unit (NICU) demonstrated reduced opioid use following gastrointestinal surgery. We evaluated our opiate reduction intervention in our open congenital diaphragmatic hernia (CDH) population given the complex nature of the post-operative course, which often requires prolonged ventilation and large cumulative opioid doses.

Methods

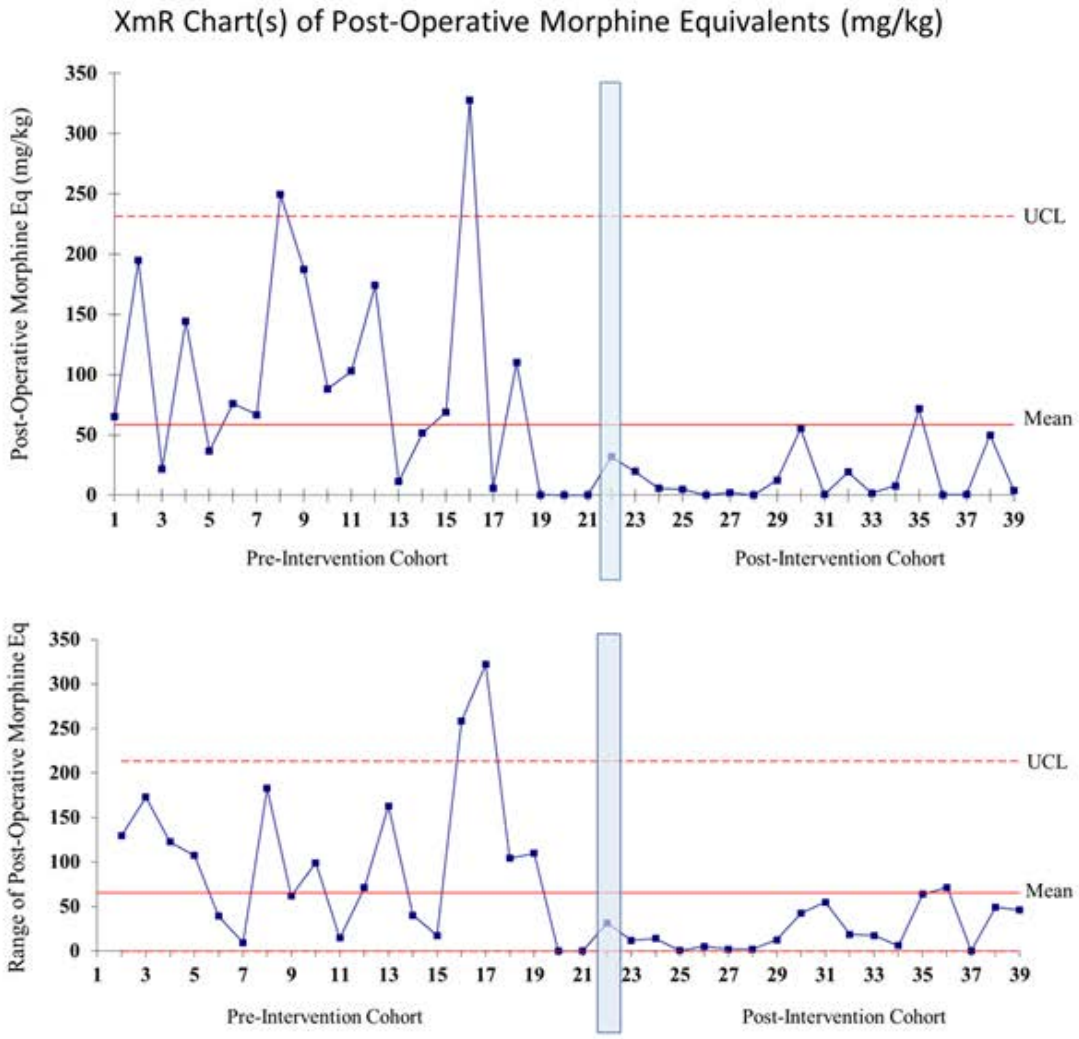
Our opioid reduction intervention was based on standing post-operative IV acetaminophen, post-surgical sign-out between the surgical and NICU teams and education seminars with NICU providers. We used a historical control (January 2011-April 2016) for our pre-intervention cohort and prospectively followed our post-intervention cohort (May 2016-September 2019). We performed a before-and-after analysis and utilized process control charts to investigate time trends in cumulative post-operative opioid use.

Results

A total of 39 patients were included in our investigation; 21 in our pre-intervention and 18 in our post-intervention cohort. The cohorts were clinically similar. The intervention reduced total post-operative opioid use by 96% (69.2 (morphine equivalents mg/kg) to 5.4 (morphine equivalents mg/kg), $p < 0.0001$). Our maximum Neonatal Pain and Agitation Sedation Score (N-PASS) over the first 48 hours were equivalent ($p = 0.669$). There were no differences in post-operative complications. A multivariable regression revealed ventilatory days were dependent on the size of the CDH defect and severity of the underlying pulmonary pathology, not our opioid reduction strategy.

Conclusion

A multi-tiered intervention based on standing IV acetaminophen, provider education and standardizing post-surgical hand-off can decrease opioid use in post-surgical neonates with complex surgical pathology including CDH. The intervention proposed in this investigation is safe and does not increase pain or sedation scores in neonates. Given the clinical and potential neurodevelopment benefits of limiting opioid use in neonates, this intervention may prove beneficial at other institutions.


XmR Chart(s) of Post-Operative Morphine Equivalents (mg/kg)
Post-Operative Morphine Eq (mg/kg)
350
300
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1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
Pre-Intervention Cohort
Post-Intervention Cohort
Range of Post-Operative Morphine Eq
350
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1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
Pre-Intervention Cohort
Post-Intervention Cohort

P6

A COST-EFFECTIVE AND SAFE QUALITY IMPROVEMENT INITIATIVE FOR PEDIATRIC INTUSSUSCEPTION

Seyed A. Arshad, MD[1], Nutan B. Hebballi, BDS, MPH[2], Elenir Avritscher[1], Susan John[1], Robert Lapus[1], KuoJen Tsao, MD[3], Akemi L. Kawaguchi, MD[1]

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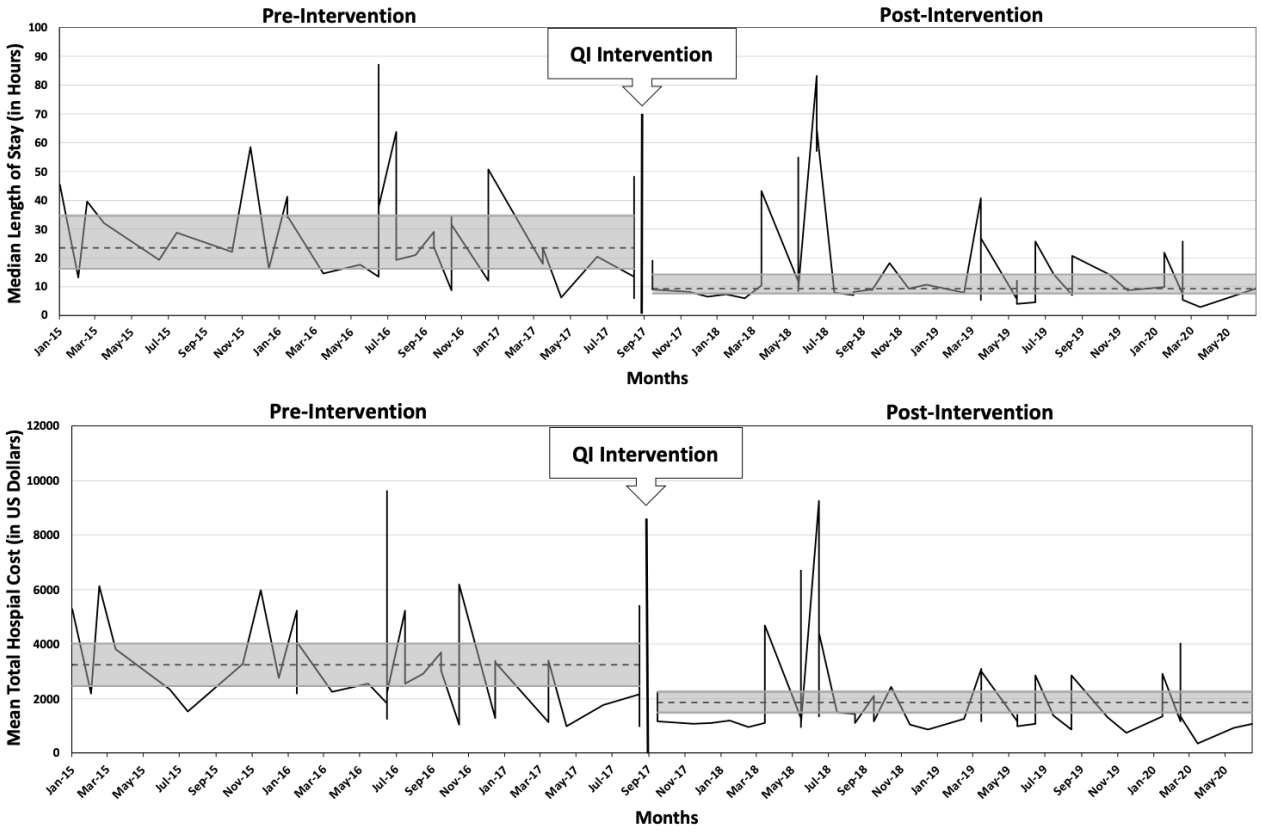
Purpose
We implemented a quality improvement (QI) initiative to safely reduce post-reduction monitoring for pediatric patients with ileocolic intussusception. We hypothesized that there would be decreased length of stay (LOS) and hospital costs, with no change in intussusception recurrence rates.

Methods
A retrospective cohort study was conducted of pediatric ileocolic intussusception patients who underwent successful air enema reduction at a tertiary-care pediatric hospital from January 2015 through June 2020. On 9/4/2017, a QI protocol was implemented which allowed discharge from the emergency department after reduction. Pre- and post-QI outcomes were compared for index encounters and any encounter within 24 hours of discharge. An economic evaluation was performed with hospital costs inflation-adjusted to 2020 United States dollars ($). Cost differences between groups were assessed using multivariable regression, adjusting for Medicaid and transfer status, $P < 0.05$ significant.

Results
Of 90 patients, 37(41%) were pre-QI and 53(59%) were post-QI. Patients were similar by age, sex, race, insurance status, transfer status, and imaging performed. Pre-QI patients had a median LOS of 23.4 hours (IQR: 16.1-34.6) versus 9.3 hours (IQR 7.4-14.2) for post-QI patients, $P < 0.001$ (Figure). Mean total costs per patient in the pre-QI group were $3,231 (95% CI, $2,442 to $4,020) versus $1,861 (95% CI, $1,481 to $2,240) in the post-QI group (Figure). The mean absolute cost difference was $1,370 less per patient in the post-QI group (95% CI, [-$2,251]-[-$490]). Five patients had an additional encounter within 24 hours of discharge [Pre-QI: 1 (3%) versus post-QI: 4 (8%), p=0.7] with four having intussusception recurrence [pre-QI: 1 (3%) versus post-QI: 3 (6%), p=0.6].

Conclusions
Implementation of a quality improvement initiative for the treatment of pediatric intussusception reduced hospital length of stay and costs without negatively affecting post-discharge encounters or recurrence rates. Similar protocols can easily be adopted at other institutions.

Figure: Length of Stay and Hospital Costs: Pre- and Post-Quality Improvement Intervention for Pediatric Intussusception



Plenary Session 2

11:45 AM – 1:00 PM

11

OUTCOMES FOLLOWING IMPLEMENTATION OF A LEVEL 1 NEURO TRAUMA ACTIVATION

Kelli Patterson, DO, MS[1], Andrew B. Nordin, MD[2], Amanda Onwuka[3], Kyle Horvath[4], Eric Sribnick[4], Rajan K. Thakkar[3]

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Traumatic brain injury (TBI) is the most common mechanism of unintentional injury causing death in children. Timely management has demonstrated improved outcomes in patients requiring operative intervention. Our Level 1 pediatric trauma center implemented a specific “Level 1 Neuro” (L1N) trauma activation for severe TBI meeting defined criteria. The purpose was to determine whether a L1N alert would decrease times to operative neurosurgical management.

Trauma patients at our institution with a head abbreviated injury score (hAIS) of ≥3 who underwent emergent operative neurosurgical intervention from 2008-2019 were studied. 116 patients had adequate data for inclusion. We evaluated whether a L1N alert reduced hospital arrival time to incision time. Age, sex, race, year, Glasgow coma scale (GCS), Rotterdam score and hAIS were evaluated as covariates. Variables significantly associated with time to intervention at the $p < 0.05$ level were included in a generalized linear model.

The mean age, GCS, Rotterdam score, and hAIS in this study were 6.5 years (SD: 5.5), 9.5 (SD 5.2), 2.3 (SD 1.2), and 4.3 (SD 0.7), respectively. L1N traumas comprised 31% of patients, while 40% were Level 1 (L1) and 29% were Level 2 (L2) traumas. Age, sex, race and year were not associated with the time to operative intervention. Patients with lower GCS, higher Rotterdam score, and higher hAIS had shorter times to intervention in multivariate regression models. We also demonstrate shorter times to emergent intervention among L1N traumas compared to L1 and L2 traumas after adjusting for other covariates (L1N: 150 minutes, p=0.01; L1: 184 minutes, p=0.07; L2: 226 minutes).

Implementing a Level 1Neuro trauma activation decreased time to emergent operative management. Enhancing trauma communication with the neurosurgery service with a standardized neurotrauma activation improves timeliness for operative intervention in traumatic brain injury. Further data collection and analysis in these patients are needed to determine effects on long term neurological outcomes.

12

BLUNT CEREBROVASCULAR INJURY IN CHILDREN: A PROSPECTIVE OBSERVATIONAL STUDY

Ruth A. Lewit, MD, MPH[1], Lois W. Sayrs, PhD[2], Sandra Grimes[3], Trey Eubanks[4], Adam C. Alder, MD, MSCS[5], Jeremy Johnson[6], Karla Lawson[7], Samara Lewis[8], Robert Maxson[9], Jessica Naiditch[10], David M. Notrica, MD[2], Carol Rangel[9], Cynthia Greenwell[11], Krista Stephenson[12]

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Introduction

The incidence of blunt cerebrovascular injury (BCVI) in children remains largely unknown, with only 16.5% of children receiving appropriate screening. This study sought to determine the incidence, evaluate associated injury patterns and identify risk factors in children with BCVIs.

Methods

This was a prospective, multi-institutional observational study of children less than 15 years old who sustained blunt trauma to the head, face or neck (AIS>0) and presented to six level-one pediatric trauma centers from 2017-2020. Patients were screened using the Memphis Criteria. If criteria met, diagnostic imaging was recommended (CT angiogram of the head/neck).

Results

A total of 2,285 patients met inclusion criteria. Of those, 520 (23%) met Memphis Screening Criteria, and 222 (42.5%) received appropriate imaging. Twenty-four (1.05%) were diagnosed with a BCVI; they were primarily involved in an MVC (42%), had a median age of 8.09 (vs 5.58, p=0.048), and a median GCS of 6.5 (vs 15, p < 0.0001). All but 3 met Memphis screening criteria (sensitivity=88%). The most common injuries seen in those with BCVI were basilar skull fractures (16/24, 66%) and cervical spine bony (5/24, 21%) or ligamentous injuries (6/24, 25%). Five individuals with BCVI suffered a stroke (21%) and mortality was 25% (n=6). On multivariate regression, higher rates of BCVI were significantly associated with a crush injury (OR 12.3, CI 1.3-259, p=0.036), with higher AIS scores of the head/neck (OR 2.7, CI 1.5-5.2, p=0.003) as expected, and of the thorax (OR 2.2, CI 1.4-3.6, p=0.001) and abdomen (OR 1.6, CI 1.03-2.4, p=0.03). ISS and GCS did not correlate with BCVI on multivariate regression.

Conclusion

Institution of screening guidelines improved screening rates, identifying BCVI in 1.05% of children with injuries to the head, neck or face. However, the true incidence is likely higher, as less than 50% of children received appropriate screening. Modified screening guidelines are needed in the pediatric population.

13

TREATMENT AND OUTCOMES OF CONGENITAL OVARIAN CYSTS - A STUDY BY THE CANADIAN CONSORTIUM FOR RESEARCH IN PEDIATRIC SURGERY (CANCORPS)

Nadia Safa, MD, CM[1], Natalie Yanchar[2], Pramod S. Puligandla, MD, MSc[1], Maida Sewitch[3], Robert Baird, MSc, MDCM[4], Mona Beaunoyer[5], Niamh Campbell[6], Rati Chadha[7], Christopher Griffiths[8], Sarah Jones[9], Manvinder Kaur[10], Annie Le-Nguyen[5], Ahmed Nasr[10], Nelson Piche[5], Hannah Piper, MD[4], Pascale Prasil[11], Rodrigo LP Romao, MD MSc[6], Lisa VanHouwelingen[8], Paul Wales[12], Elena Guadagno, MS[1], Sherif Emil, MD, CM[1], for the Canadian Consortium for Research in Pediatric Surgery (CanCORPS)

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Purpose
Wide variation exists in the treatment of prenatally identified ovarian cysts. The effects of various treatment strategies on outcome are not known. We conducted a multi-centre study to assess treatments and outcomes in a national cohort, focusing on predictors of surgical intervention, and the potential effect of surgery on ovarian salvage.

Methods
A retrospective cohort study of female infants who were prenatally diagnosed with intra-abdominal cysts between 2013 and 2017 at 10 Canadian pediatric surgical centres was performed. Sonographic characteristics, management, and outcomes were extracted. Logistic regression was used to determine independent clinical predictors of operative management and to compare ovarian salvage between patients who had an initial observation period and those who underwent early surgical intervention. Subgroup analyses were performed in patients with complex cysts and cysts ≥ 40mm.

Results
A total of 189 female neonates with prenatally diagnosed ovarian cysts constituted the study cohort. Median gestational age at diagnosis and median maximal prenatal cyst diameter were 33 weeks and 40 mm, respectively. Cysts resolved or regressed spontaneously in 128 patients (68%), 14 (7%) prenatally and the rest at a median age of 16.1 weeks. Intervention occurred in 61 patients (32%), including prenatal aspiration (2, 3%), ovary-sparing resection (14, 23%) or oophorectomy (45, 74%). Surgery occurred at a median age of 7.4 weeks. Independent predictors of surgical treatment included postnatal cyst diameter ≥ 40mm (OR 9.4, p = 0.004) and sonographic characteristics of a complex cyst (OR 27.96, p = 0.004). There was no significant difference in the odds of ovarian salvage (OR 3.25, 95% CI 0.79 – 16.1, p = 0.119) between patients who underwent surgery within 3 months of life (n=22) and those who were initially observed (n=131).

Conclusion
Most prenatally identified ovarian cysts are asymptomatic and spontaneously resolve. Early surgical intervention does not increase ovarian salvage.

14

GLIA CELL-DERIVED NEUROTROPHIC FACTOR ENHANCED ENTERIC PROGENITOR MIGRATION IN AN EMBRYONIC GUT EXPLANT MODEL OF HIRSCHSPRUNG'S DISEASE

Dorothy Lee, BSc[1], Bo Li, PhD[1], Atsuyuki Yamataka, MD PhD[2], Agostino Pierro, MD[1]

[1]The Hospital for Sick Children, Toronto, ON, Canada, [2]Department of Pediatric General and Urogenital Surgery, Juntendo University School of Medicine, Tokyo, Japan

Purpose

Hirschsprung's disease (HD) is a congenital disease characterized by the absence of ganglion cells in the distal intestine. It remains unknown if endogenous neural progenitors present in the ganglionic region can be induced to migrate further. We hypothesize that administration of glia cell-derived growth factors (GDNF) can promote migration of enteric progenitors from the ganglionic region to the aganglionic intestine.

Methods

Ednrb knockout mice (Ednrb-/-) were studied as an animal model of Hirschsprung's disease, with transgenic expression of Sox10-Venus to allow tracing of enteric progenitors. Following ethical approval (#47780), embryonic guts of wildtype and Ednrb-/- embryos at E11.5 with Sox10-Venus expression were isolated and embedded into Matrigel domes. These embryonic gut explants were cultured in either control media (wildtype n=8, Ednrb-/- n=3) or media supplemented with GDNF (100ng/mL) (wildtype n=7, Ednrb-/- n=3) for 48 hours, followed by live imaging to track cell migration.

Results

Prior to administration of GDNF, migration wavefront of Sox10+ cells in wildtype embryonic gut was observed to have reached the junction between the midgut and hindgut, where in Ednrb-/- embryonic gut the wavefront has only reached the beginning of midgut or the stomach (Fig. A), demonstrating a delay in migration of Sox10+ enteric progenitors in Ednrb-/- embryos at E11.5. 48 hours after administration of GDNF, outward migration of Sox10+ cells was observed in both wildtype and Ednrb-/- embryonic gut explants (Fig. B), with quantification of neurite extension length confirming significant increased migration compared to explants cultured in control media (Fig. C).

Conclusion

Administration of GDNF significantly enhanced Sox10+ enteric progenitors migration in both wildtype and Ednrb-/- embryonic gut explants. These results proof the concept that endogenous enteric progenitors can be triggered to migrate. These findings open the way to the development of a novel treatment for HD.

15

PRENATAL IMAGING MEASUREMENTS CORRELATE WITH EARLY POST-NATAL PULMONARY HYPERTENSION AND CARDIAC DYSFUNCTION IN CONGENITAL DIAPHRAGMATIC HERNIA

Vikas S. Gupta, MD[1], Matthew T. Harting, MD, MS, FAAP, FACS[2], Erin E. Perrone, MD[3], Neil Patel[4], Yigit Guner, MD, MS[5], Tim Jancelewicz, MD, MA, MS[6], Ashley Ebanks[7], Anthony Johnson, MD[8], KuoJen Tsao, MD[9], Kevin P. Lally, MD, MS[2]

[1]McGovern Medical School at UTHealth, Dallas, TX, USA, [2]McGovern Medical School at UTHealth, Houston, TX, USA, [3]University of Michigan, Ann Arbor, MI, USA, [4]Royal Hospital for Children Glasgow, Department of Neonatology, [5]Children's Hospital of Orange County and University of California Irvine, Orange, CA, USA, [6]Le Bonheur Children's Hospital, University of Tennessee Health Science Center, Memphis, TN, USA, [7]University of Texas Health Sciences Center at Houston, [8]McGovern Medical School at UTHealth, [9]McGovern Medical School at the University of Texas Health Science Center at Houston, Houston, TX, USA

Purpose
Previous investigation from the Congenital Diaphragmatic Hernia Study Group (CDHSG) identified early cardiac dysfunction (CD) and pulmonary hypertension (PH) as critical factors related to outcome in CDH. Our objective was to assess the utility of fetal ultrasound (US) and magnetic resonance imaging (MRI) in predicting CDH-associated PH and CD.

Methods
Patients from the CDHSG born 2015-2020 were included. Prenatal data were collected from the initial US and MRI. The primary outcome was prediction of early PH and CD, determined on echocardiography within 48 hours of life. Data were analyzed using receiver operating characteristics (ROC) curves and non-parametric tests of comparison.

Results
A total of 2,822 patients were included. US and MRI data were available for 1,434 (50.8%) and 944 (33.5%) patients, respectively. Median estimated gestational age of US and MRI were 24 weeks and 30 weeks, respectively. On US, patients with PH on initial echo had a lower lung-to-head ratio (LHR) (1.2 vs. 1.6, p=0.003) and observed to expected LHR (O:E LHR) (41.0 vs. 49.8, p=0.002) than patients without PH. On MRI, presence of early PH was associated with lower O:E total lung volume (O:E TLV) (32.0 vs. 51.0, p=0.002) and percent predicted lung volume (PPLV) (23.7 vs. 36.0, p=0.03). Similarly, early CD was associated with lower LHR (1.2 vs. 1.3, p=0.002), O:E LHR (38.0 vs. 45.0, $p < 0.001$), O:E TLV (29.0 vs. 39.0, $p < 0.001$), and PPLV (19.3 vs. 28.0, $p < 0.001$). On ROC analysis, O:E TLV was the most sensitive and specific measurement associated with early PH, and PPLV was the most sensitive and specific measurement associated with early CD (Figure).

Conclusion
We conclude that fetal ultrasound and MRI measurements are strongly associated with early congenital diaphragmatic hernia associated pulmonary hypertension and cardiac dysfunction. Specific MRI measurements may be predictive for the critical pathophysiologic derangements that drive disease course and outcome in diaphragmatic hernia.

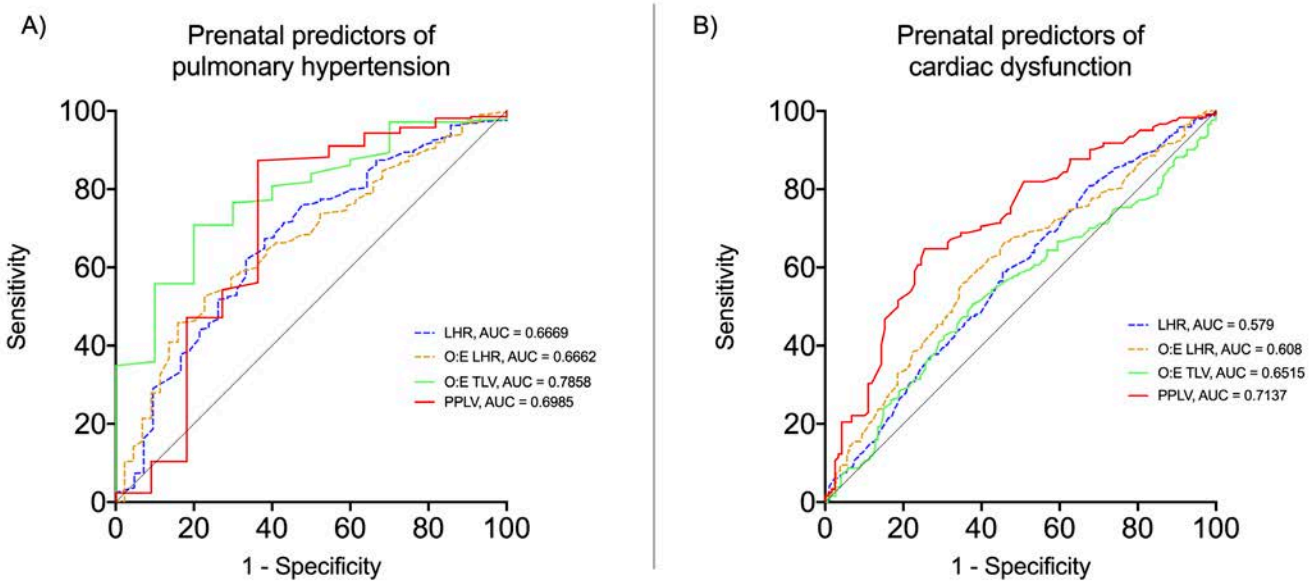

Figure: ROC curves for prenatal predictors of (A) pulmonary hypertension (B) cardiac dysfunction. Ultrasound values are denoted by hash lines, and MRI values are denoted by solid lines. AUC = Area under the curve.

16

RISK-ADJUSTED STANDARDIZED MORTALITY RATIOS AMONG NEONATES WITH CONGENITAL DIAPHRAGMATIC HERNIA ON EXTRACORPOREAL LIFE SUPPORT. STUDY BY ELSO CDH INTEREST GROUP

Yigit Guner, MD, MS[1], Matthew T. Harting, MD, MS, FAAP, FACS[2], Tim Jancelewicz, MD, MA, MS[3], Peter T. Yu, MD, MPH[4], Danh Nguyen[5]

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Background

Despite advances in management of infants with congenital diaphragmatic hernia (CDH) requiring extracorporeal life support (ECLS), the mortality rate remains at 50% and varies widely between centers. We sought to elucidate the degree of variation across centers by calculating center-specific standardized mortality ratios (SMRs) that adjust for patient baseline characteristics (case-mix).

Methods

The Extracorporeal Life Support Organization (ELSO) registry data (2000-2019) from 109 centers were used to estimate SMRs using hierarchical logistic regression to risk-adjust for case-mix and account for center clustering. Center-specific SMRs and their 95% confidence intervals (CIs) were used to identify centers with mortality as significantly worse (SW), significantly better (SB), or not different (ND) relative to the median mortality rate across all centers.

Results

We identified 4,223 neonates with CDH from 109 centers with an overall mortality of 50.3%. SMRs were risk-adjusted for birthweight, sex, race, Apgar at 5-minute, pre-ECLS blood gases, gestational age, side of hernia, prenatal diagnosis, pre-ECLS arrest, and pre-ECLS comorbidities. Observed (unadjusted) mortality rates across centers varied substantially (range: 14.3% to 90.9%; interquartile range [IQR]: 42.9% to 62.1%). Thirteen centers (11.9%) had SB SMRs < 1 (SMR 0.52 to 0.84), 7 centers (6.4%) had SW SMRs >1 (SMR 1.25 to 1.43), and 90 centers (81.7%) had SMRs ND relative to the median SMR across all centers (i.e., SMR not different from one). Descriptive analyses demonstrated that SB centers had lower rates of renal and infectious complications, more frequent use of conventional ventilation, and higher rates of post-ECLS CDH repair.

Conclusion

There is significant variation in risk-adjusted SMRs among ECLS centers for neonates with CDH. Future studies examining more detailed characteristics of treatment and care processes are needed to identify potential practice patterns that contribute to centers flagged as having significantly worse or better outcomes in order to inform clinical practice guidelines.

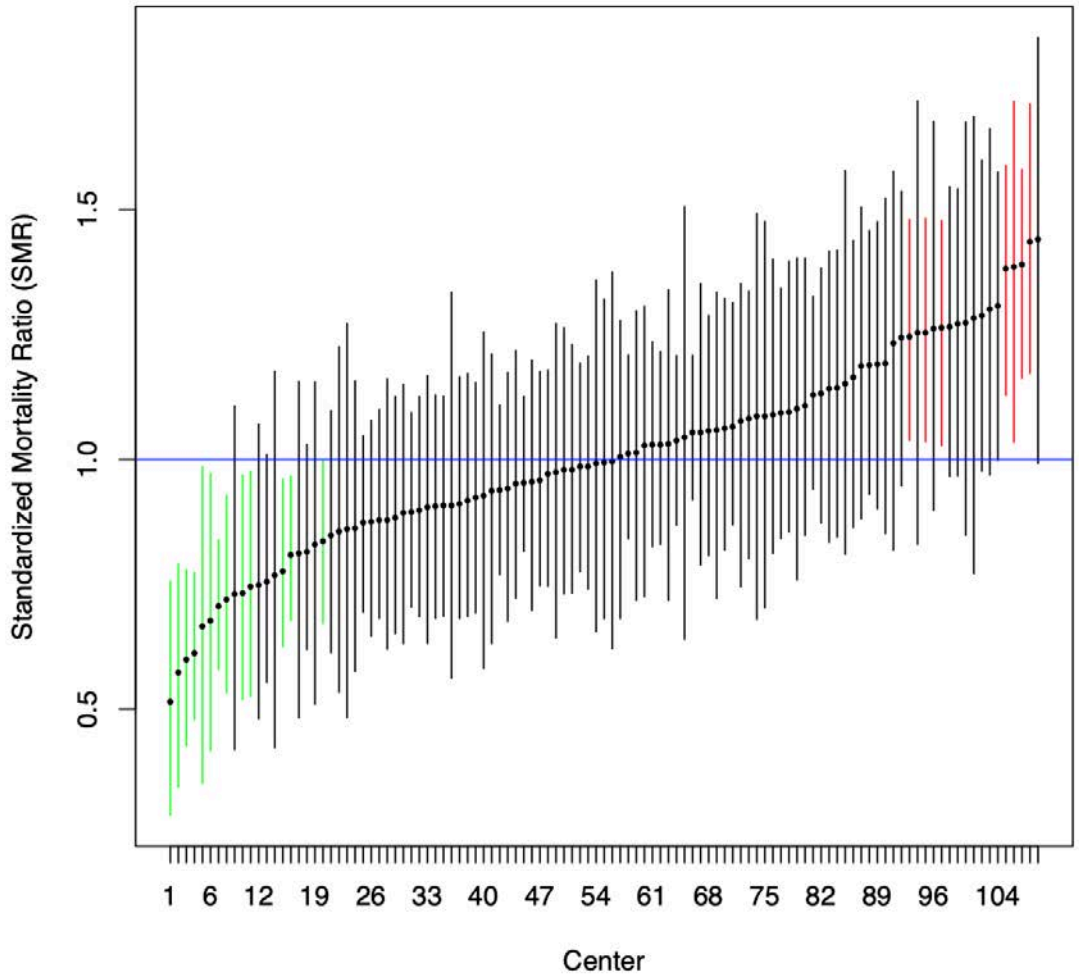

Figure. Risk-adjusted standardized mortality ratios (SMRs) and their 95% confidence intervals for 109 centers. Thirteen centers (11.9%) were flagged as having significantly better SMR < 1 (green), 7 centers (red) having significantly worse SMR >1 (red), and 90 centers (81.7%) having SMR ND relative the median SMR rate across all centers.

18

SURVIVAL EFFECT OF COMPLETE SURGICAL RESECTION OF THE PRIMARY TUMOUR IN PATIENTS WITH METASTATIC, HIGH-RISK NEUROBLASTOMA IN A LARGE CANADIAN COHORT

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Purpose

To determine if the extent of surgical resection affects survival in a Canadian cohort with International Neuroblastoma Staging System (INSS) stage 4, high-risk neuroblastoma.

Methods

Data was extracted for patients with INSS stage 4, high risk neuroblastoma at initial presentation between 2001-2019 from the National Cancer in Young People in Canada (CYPC) database. Complete surgical resection (CR) was defined as gross total resection of the primary tumor. Data was collected from operative reports by trained CYPC research personnel at each CYPC site. Primary endpoints were event-free survival (EFS) and overall survival (OS) at 3 and 5 years. Survival analysis was completed using log-rank test and Cox proportional hazards regression using the following covariates: age, sex, decade of treatment (2001-2009 vs. 2010-2019), immunotherapy, and tandem stem-cell transplant (SCT).

Results

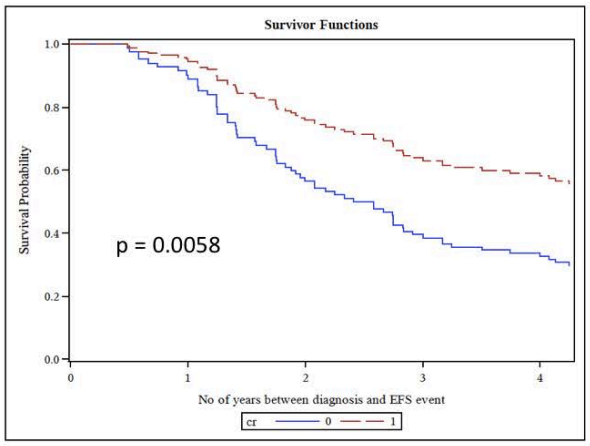
376 patients met inclusion criteria; all 200 patients from Ontario and an additional 36 patients had incomplete surgical data available and were thus excluded. 140 patients with complete surgical data were included from all other Canadian provinces. On univariate analysis, 3-year EFS and OS for patients that had complete vs. incomplete resection was 71% (CI 57%-80%) vs. 48% (36%-60%) and 86% (75%-93%) vs. 64% (51%-74%), p=0.008 and p=0.002, respectively. On Cox Proportional Hazards models adjusted for age, immunotherapy and/or tandem SCT, the only variable associated with statistically significant improved EFS and OS was CR, HR=0.48 (0.29-0.81; p=0.006) and HR=0.42 (0.24-0.73; p=0.002).

Conclusions

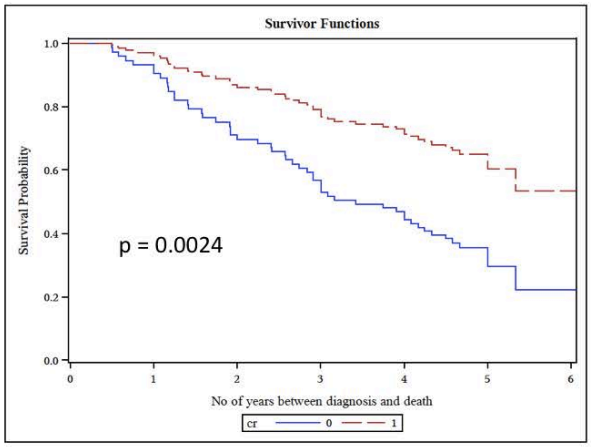
In a large cohort of Canadian children with stage 4, high-risk neuroblastoma, we found that CR had a statistically significant association with 3 and 5-year EFS and OS on multivariable analysis. Within the constraints of a retrospective study where surgical data was abstracted from operative reports, these results suggest that the ability to achieve a CR of the primary tumor in patients with aggressive disease may have a role in EFS and OS.

Complete vs. Incomplete Resection

EFS



OS



19

DEVELOPMENT OF AN ACADEMIC RVU (ARVU) SYSTEM TO PROMOTE PEDIATRIC SURGICAL ACADEMIC PRODUCTIVITY

Gail E. Besner, MD[1], Nicole Brigstock[2]

[1]Nationwide Children's Hospital, Columbus, OH, USA, [2]Child USA, Philadelphia, PA USA

Introduction

Improvements in patient care are directly affected by scientific discovery, and surgeons have historically played a vital role in this process. However, increasing clinical demands, and incentivization for pure clinical productivity present challenges for promoting academic productivity. The objective of this work was to analyze the effects of adding an academic relative value unit RVU (aRVU) scoring system to an existing work RVU (wRVU)-based incentivization plan on academic productivity in a Department of Pediatric Surgery.

Methods

Prior to 2012, incentive bonuses in our Department were mainly based on clinical wRVU activities. A weighted scoring system for 30 specific aRVUs was established in 2012. Incentivization for wRVUs vs. aRVUs was based on the clinical full-time equivalent (cFTE) of each faculty member. Academic activities incentivized include grant submissions/funding, peer reviewed publications, national presentations, Study Section participation, education and mentoring activities, receipt of research or teaching awards, initiation of IRB protocols, new academic society committee memberships/chairpersons, and patents. Academic progress was analyzed from 2012 to 2019.

Results

Over the 9-year study period, annual external federal funding increased from $750,168 to $5.77 million (7.7-fold increase); annual peer-reviewed publications increased from 24 to 135 (5.6-fold increase); annual national presentations accepted for oral/poster presentations nearly doubled; and faculty members and their trainees received 36 competitive research awards including 6 APSA Folkman Awards, 2 APSA Quality Awards, and 9 AAP Section on Surgery Rosenkrantz Awards. During the same study period, wRVUs increased by 8%.

Conclusions

Incentivization based on the addition of an aRVU system to a pre-existing wRVU system was associated with a significant increase in academic productivity, while still maintaining clinical productivity. Implementing an aRVU program is an important means of increasing academic productivity in Pediatric and other Surgery Departments.

20

COMPASSION FATIGUE, BURNOUT, AND COMPASSION SATISFACTION IN PEDIATRIC SURGEONS IN THE U.S.

Alex J. Sarosi, BA[1], Kurt F. Heiss, MD[2], Brian Arrinza Coakley, MD[3], Loren Berman, MD[4], Kristy Rialon, MD[5], Claudia Mueller, MD[6], Mary Brandt, MD[7], Andrea Weintraub, MD[8]

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Purpose

Compassion fatigue (CF) is emotional distress experienced from bearing witness to patients' suffering. Burnout (BO) is emotional exhaustion, depersonalization, and a reduced sense of accomplishment due to uncontrollable occupational factors. Compassion satisfaction (CS) is professional fulfillment experienced through providing patient care. CF, BO, and CS profoundly impact emotional well-being and professional performance. We sought to parse 'distress' and 'well-being' in national sample of pediatric surgeons by evaluating CF, BO, and CS scores.

Methods

The modified Compassion Fatigue and Satisfaction Self-Test for Helpers (CFST) and a questionnaire of personal and professional characteristics were distributed electronically and anonymously to pediatric surgeons. Univariate analyses of participants' personal and professional characteristics as a function of CF, BO, and CS scores was performed using independent t –tests. Univariate analyses of participants' personal and professional characteristics as a function of CF, BO, and CS subscale scores was performed using independent t –tests. Hierarchical linear regression models for CF, BO, and CS scores as a function of factors significant at $p < 0.05$ in univariate analyses were constructed.

Results

The survey response rate was 31.6%. CF, BO, and CS scores are shown in Table 1. Higher CF scores were significantly associated with: higher BO score, current distress about a 'clinical situation'; ≥ 5 operating days per week; solo on the clinical team; annual compensation $400,000-$450,000; personal history of serious surgery in childhood; use of mental health care. Higher BO scores were significantly associated with: higher CF score; current distress about 'coworkers'; prior history of lawsuit that was kept confidential. Lower CS scores were significantly associated with higher BO scores.

Conclusion

CF, BO, and CS are interrelated phenomena. Greater awareness of these phenomena, as well as their predictors, may allow pediatric surgeons to more effectively manage the emotional, physical, and cognitive stresses of their clinical practices.

24

CLINICAL REGRESSION OF INGUINAL HERNIAS IN PREMATURE INFANTS WITHOUT SURGICAL REPAIR

Mark Fleming, II, MD[1], David Grabski, MD[2], Emmanuel L. Abebrese, MD[2], Daniel Levin, MD[2], Sara K. Rasmussen, MD PhD[2], Eugene D. McGahren, MD[2], Jeffrey Gander, MD[3]

[1]University of Virginia Health, Charlottesville, VA, USA, [2]University of Virginia, Charlottesville, VA, USA, [3]University of Virginia Children's Hospital, Charlottesville, VA, USA.

Background

The incidence of inguinal hernias in premature infants is approximately 30%. Due to the perceived risk of incarceration, many premature infants diagnosed with an inguinal hernia undergo a repair prior to discharge. Some pediatric surgeons offer repair in a delayed fashion. We hypothesized that delaying herniorrhaphy until after 55 weeks corrected gestational age (GA) is safe, and may allow some inguinal hernias to clinically regress.

Methods

Between June 2015 and July 2020, premature infants (<37 weeks GA) diagnosed with inguinal hernias on physical examination were identified. Families of eligible infants were offered delayed herniorrhaphy after 55 weeks corrected GA. Infants were followed until their hernia(s) clinically regressed or until older than 55 weeks corrected GA. Demographic and clinical data were collected and analyzed.

Results

Families of 87 infants with inguinal hernias were offered delayed herniorrhaphy. Fourteen elected not to delay repair and 5 patients were excluded. Ultimately 68 families agreed to delay repair. Twenty-three infants (33.8%) had hernias that clinically regressed. Of these, a higher proportion were female compared to male (10/19 vs. 13/49; p=0.04). Univariate logistic regression demonstrated female sex as a significant predictor of hernia clinical regression (unadjusted OR: 3.08; p=0.002). After adjusting for birth weight and GA on multivariable analysis, female sex was no longer significant (adjusted OR: 2.89; p=0.07). Of the 45 infants who ultimately underwent herniorrhaphy, 38/45 (84.4%) safely persisted to 55 weeks corrected GA. Four had symptoms requiring an earlier repair and one had repair during concurrent surgery. Importantly, only two patients (4.4%) underwent repair prior to 55 weeks due to an incarceration. None of the infants suffered any long-term morbidity.

Conclusion

Offering to delay inguinal herniorrhaphy in premature infants until after 55 weeks corrected gestational age is reasonable, safe and may render one third clinically undetectable obviating the need for surgery.

APSAsode - Trauma

7:00 PM – 8:30 PM

102

A COMPARISON OF AT-HOME VERSUS AWAY-FROM-HOME YOUTH SUICIDES: IMPLICATIONS FOR PREVENTION EFFORTS

Joseph Wertz, AB[1], Emily Jones, BS[2], Ilaria Stewart[3], Howard C. Jen, MD[4]

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Purpose

Suicide is the 2nd leading cause of death in adolescents. Prior studies of youth suicides have focused on the home environment, primarily in the context of lethal means accessibility. Our study aims to test how additional youth suicide characteristics differ between suicides occurring at versus away from the victim's residence.

Methods

All suicide victims ≤18 years of age were extracted from the 2005-2017 National Violent Death Reporting System (NVDRS). County-level population and economic data from the American Community Survey were linked using FIPS (Federal Information Processing Standard) codes. Univariate analysis and multivariate logistic regression were performed. The outcome variable was location of fatal injury (away from the victim's residence vs. at home); control variables included NVDRS-derived victim demographics, mental health, substance abuse, and suicidality histories, means used, and linked county-level urbanicity and poverty rankings. Adjusted odds ratios and 95% confidence intervals are reported. P-values < 0.05 were considered significant.

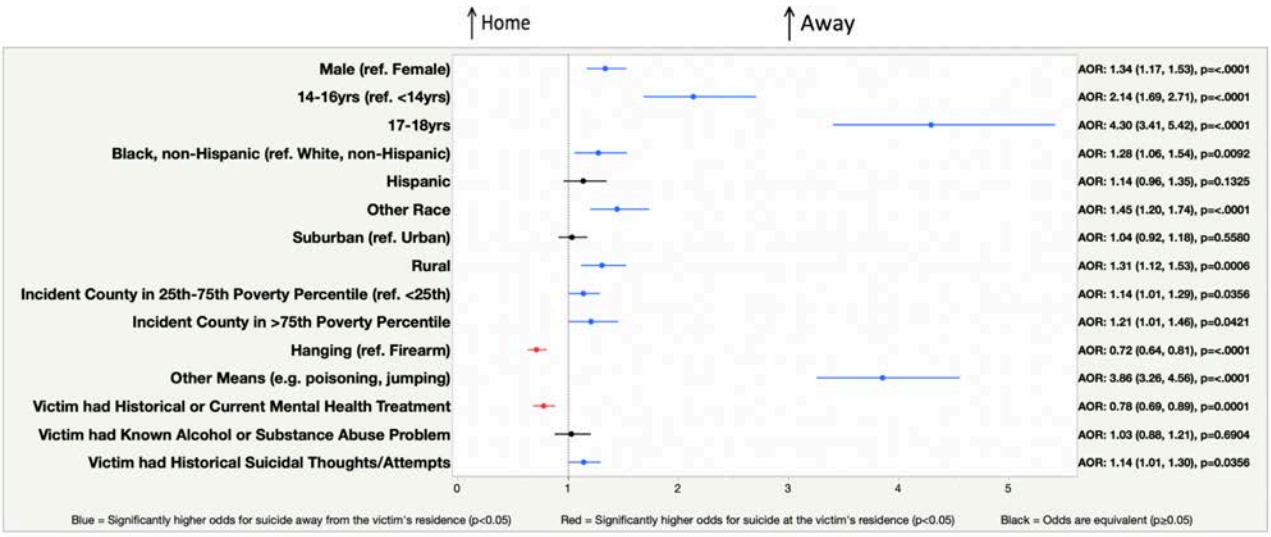
Results

Overall, 7939 youth suicide records were extracted: 5794 (73.0%) suicides occurred at the victim's residence and 2145 (23.0%) occurred elsewhere. In multivariate analysis, suicides away from the victim's residence were significantly more likely to involve older [14-16yrs: AOR2.14, 95%CI(3.41-5.42); 17-18yrs: AOR4.30, 95%CI(3.41-5.42)], male [AOR1.34, 95%CI(1.17-1.53)] victims with a history of suicidality [AOR1.14, 95%CI(1.01-1.30)], and were significantly more likely to take place in poor [25th-75thpoverty percentile: AOR1.14, 95%CI(1.01-1.29); >75thpoverty percentile: AOR1.21, 95%CI(1.01-1.46)] and rural [AOR1.31, 95%CI(1.12-1.53)] communities. Odds of firearm use were equivalent [AOR1.05, 95%CI(0.94-1.17)].

Conclusion

Characteristics of youth suicide differed significantly by location. Children who died away from their residence were older boys with prior history of suicidality; their communities were poorer and more rural. These results suggest that prevention efforts may fall short if focused exclusively on at-home risk factors. Our results also warrant further research to understand youth access to lethal means, especially firearms, outside the home environment.

Figure 1: Multivariate Logistic Regression of Adolescent Suicide Away From vs. At the Victim's Place of Residence



104

OUTCOMES AFTER TRAUMATIC ARREST WITH PRE-HOSPITAL CPR AT A LEVEL 1 PEDIATRIC TRAUMA CENTER

Kayla B. Briggs, MD[1], James A. Fraser, MD[2], Wendy Jo Svetanoff, MD, MPH[3], Joseph J. Lopez, MD[3], Neal Talukdar, MS[4], Valerie Waddell[5], Tolulope A. Oyetunji, MD, MPH[3]

[1]Children's Mercy, Kansas City, MO, USA, [2]Children's Mercy Hospital, Kansas City, MO, USA, [3]Children's Mercy Kansas City, Kansas City, MO, USA, [4]Kansas City University, Kansas City, MO, USA, [5]Children's Mercy

Introduction

The survival of traumatic cardiopulmonary arrest (TCA) requiring pre-hospital cardiopulmonary resuscitation (P-CPR) is abysmal across age groups. We aim to describe the patterns of injury, pre-hospital interventions, and outcomes of children suffering from TCA leading to P-CPR at our institution to support standardized guidelines addressing the termination of prolonged resuscitation attempts in children.

Methods

Following IRB approval, retrospective review was conducted to identify children ages 0-17 years who suffered TCA leading to P-CPR at our institution between 5/1/2009–3/1/2020. For analysis, patients were stratified into those still undergoing CPR at arrival and those who attained pre-hospital return of spontaneous circulation (ROSC). Primary outcome was discharge alive from the hospital. Secondary outcomes included length of treatment and neurologic outcomes. Analysis was performed using STATA®, a p-value of ≤0.05 was significant.

Results

48 children came to our facility after having P-CPR initiated for TCA (Table 1). Drownings were not included unless the trauma team was involved. 48% had pre-hospital ROSC. Of the 25 children who were undergoing CPR at presentation, none survived to discharge. 68% died after resuscitation attempts in the emergency department (median CPR time to death 34 minutes [29,50]) and 32% died after admission to the pediatric intensive care unit (median length of stay to death 24.5 hours [15,41.5]). Of the 23 children who attained pre-hospital ROSC, 26% survived to discharge (median length of stay 38 days [9,49], p=0.002). All 6 children required rehabilitation services at discharge and at most recent follow-up, 83% had residual deficits requiring medical attention but were partially independent with family support.

Conclusion

These data further describe the poor outcomes in children with pre-hospital traumatic cardiopulmonary arrest, particularly in those without pre-hospital return of spontaneous circulation. Further study is ongoing to determine the cost and emotional impact of these seemingly futile resuscitation attempts.

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RE-THINKING PEDIATRIC TRAUMA: RISK STRATIFICATION AND PREDICTING NEED FOR MASSIVE TRANSFUSION USING MACHINE LEARNING FOR BLUNT AND PENETRATING TRAUMA

Niti Shahi, MD[1], Ashwani Shahi[2], Ryan C. Phillips, MD[3], Denis Bensard[4], Steven L. Moulton, MD[4]

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Purpose
Embedded, real-time methods in electronic medical records to identify risk and predict massive transfusion (MT) in pediatric blunt and penetrating trauma are lacking. The ABC score has been used in adults, however, Focused Assessment with Sonography in Trauma (FAST) and vital signs have shown to have poor sensitivity in children. We used deep learning models to systematically categorize patients into subgroups i.e., high risk patients who need MT versus low risk patients who may not need a blood transfusion.

Methods
A total of 1048 pediatric blunt and penetrating trauma patients managed at a pediatric level 1 trauma center from 2009-2019 were included. Two models using deep learning were developed to: 1) identify “high risk” patients who would require MT; and 2) identify “low risk” patients who would not require transfusion. Models were created using Google’s Bidirectional Encoder Representations from Transformer. The following features were used as inputs: clinical values [vital signs, shock index-pediatric adjusted, GCS, blood products received], laboratory results [hemoglobin, TEG, base deficit, lactate, coagulation studies], and text features [injury mechanism, location, and diagnosis]. These features were used as inputs into downstream Artificial Neural Networks and Convolution Neural Networks.

Results
The “high risk” model predicting MT had an accuracy of 92%, sensitivity of 96%, specificity of 92%, and area under the curve (AUC) of 0.938. The “low risk” model predicting patients who would not need transfusion had an accuracy of 96%, sensitivity of 98%, specificity of 84%, and AUC 0.912. Feature selection methods identified TEG, PTT, INR, lactate, and base deficit as most informative predictors.

Conclusion
In this single center study, we showed that deep learning models can achieve high specificity, sensitivity, and accuracy for predicting the need for massive transfusion in pediatric blunt and penetrating trauma.

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UPSTREAM TARGETS: SOCIAL DEPRIVATION AND INCREASED VIOLENCE-RELATED PEDIATRIC INJURY

Meera Kotagal, MD, MPH[1], Cole Brokamp[2], Rashmi Sahay[2], Suzanne Moody[2], Dawne Gardner[2], Carley Riley[2], Nicole Sofer[2], Richard A. Falcone, MD, MPH[3], Andrew Beck[2]

[1]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, USA, [2]Cincinnati Children's Hospital Medical Center, [3]Cincinnati Children's, Cincinnati, OH, USA

Purpose

Disparities in pediatric injury have been widely documented and are driven, in part, by differential exposures to social determinants of health (SDH). We previously demonstrated a correlation between census tract-level injury-related admission rates and socioeconomic deprivation, crime, and green space paucity. We know far less about how SDH, including deprivation, may affect the distribution of injury types across census tracts. We characterized the distribution of mechanisms of injuries (MOI) across census tracts, hypothesizing a higher proportion of violence-related injuries in tracts with more deprivation.

Methods

We conducted a retrospective review of all admissions (children ≤16 years) to our level 1 pediatric trauma center, evaluating demographics and MOI. We geocoded addresses linked to each admission to identify the associated census tract. We determined the deprivation index – a composite measure assessing socioeconomic status, education and housing (normalized to 0-1 range; higher values indicate more deprivation) – of each census tract. We divided tracts into tertiles based on ascending deprivation index scores and compared rates of violence-related injuries – firearm, abuse, and assault injuries – between tracts with high and low deprivation indices.

Results

There were 15,686 injury-related admissions (2010-2019). The most common MOIs overall were falls (24.6%) and poisonings (21.2%). Violence-related injuries comprised 18.8% of injuries overall. The percentage of violence-related injuries amongst patients living in census tracts in the highest tertile of deprivation (22.2%; 1,161 of 5,226 total injuries) was significantly higher than in tracts in the lowest tertile (15.8%; 823 of 5,220 total injuries; $p < 0.001$).

Conclusion

Evaluation of mechanisms of injury at the census tract-level provides a nuanced understanding of regional injury patterns. Tracts with higher deprivation – and higher stress – have an elevated proportion of pediatric injuries due to violence. This census tract-level approach to injury characterization, using geospatial analysis, can be used to better identify targets for injury prevention efforts.

Scientific Session 1 - Neonatal Surgery

6:00 PM – 8:00 PM

P2

LAPAROSCOPIC KASAI PORTOENTEROSTOMY: TRENDS IN MORBIDITY AND REDO SURGERY FROM 10 YEARS' EXPERIENCE.

Hiroyuki Koga[1], Joel Cazares[2], Go Miyano, MD[3], Shogo Seo, MD[4], Takanori Ochi[1], Hiroki Nakamura[1], Geoffrey Lane[1], Atsuyuki Yamataka, MD PhD[5]

[1]Department of Pediatric General and Urogenital Surgery, Juntendo University Graduate School of Medicine, [2]Department of Pediatric Surgery, Hospital Regional de Alta Especialidad Materno infntil, [3]Juntendo University School of Medicine, Bunkyo-ku, Tokyo, Japan, [4]Department of Pediatric General and Urogenital Surgery, Juntendo University School of Medicine, Tokyo, Japan, Toronto, ON, Canada, [5]Department of Pediatric General and Urogenital Surgery, Juntendo University School of Medicine, Tokyo, Japan

Purpose

We investigated trends in postoperative morbidity and indications for redo Kasai portoenterostomy (re-KPE) based on 10 years' experience of performing laparoscopic KPE (lap-KPE) for biliary atresia (BA).

Methods

Data for blood tests and radiologic investigations retrieved from the medical records of all BA patients (n=39) who had lap-KPE between 2009-2020 at two institutions with protocolized management were reviewed retrospectively.

Results

BA was type I (n=2), type II (n=5), and type III (n=32); 37 were non-syndromic and 2 were syndromic. Mean age and weight at lap-KPE were 66.8 days (range: 21-123) and 4.3kg (range: 2.8-7.1), respectively. Mean operative time was 468 minutes (range: 240-790), and blood loss ranged from 2-35g. Jaundice disappearance (JD; total bilirubin≤1.2 mg/dL) was achieved in 31 patients (JD ratio: 79.4%).
Morbidity identified was cholangitis (n=17/39; 43.5%), splenomegaly (n=8/39; 20.5%), esophageal varices (n=5/39; 12.8%), and bile lake formation (n=4/39; 10.2%). Bile lakes were treated by ultrasonography-guided percutaneous transhepatic cholangio-drainage (n=2), laparoscopic marsupialization (n=1), and open marsupialization (n=1). Re-KPE (n=7) was indicated for persistent jaundice without JD (n=5) and relapse of jaundice after initial JD (n=2) and performed as an open (n=3) or laparoscopic(n=4) procedure, a mean of 74.4 days (range: 45-154) after initial lap-KPE (Table). After re-KPE, JD was achieved in 5/7 cases (4 laparoscopic, 1 open; JD ratio 71.4%); the 2 remaining open cases did not achieve JD. Current status of our 39 subjects is: 29 (74.3%) with native livers are anicteric after mean follow-up of 4.9 years (range: 1.0-12.5); 9 have had liver transplantation (LTx); 1 patient declined LTx and died.

Conclusions

From 10 years' experience, lap-KPE would appear to be a valid treatment option, re-KPE is best performed laparoscopically, and follow-up of lap-KPE cases must include monitoring for bile lake formation.

Case	Initial laparoscopic KPE				Redo KPE					
	Age (days)	Weight (kg)	JD after KPE (days)	Outcome	Age (days)	Weight (kg)	Technique	JD after re-KPE (days)	Outcome	Re-KPE follow-up (years)
1	58	4.2	26	JD+ → JD- →re-KPE	140	5.3	Open	JD-	JD- → LTx	-
2	42	3.8	JD -	JD- → re-KPE	91	5.0	Open	JD-	JD - → Died*	-
3	58	3.7	JD -	JD- → re-KPE	103	4.6	Open	66	JD + → SNL	2.5
4	76	4.0	JD -	JD- → re-KPE	230	6.5	Laparoscopic	63	JD + → SNL	1.8
5	60	4.6	JD -	JD- → re-KPE	118	5.6	Laparoscopic	65	JD + → SNL	1.6
6	50	3.7	JD -	JD- → re-KPE	125	5.6	Laparoscopic	68	JD + → SNL	1.1
7	77	4.4	32	JD+ → JD- → re-KPE	135	5.7	Laparoscopic	11	JD + → SNL	1.0

KPE: Kasai portoenterostomy, re-KPE: redo Kasai portoenterostomy, JD: jaundice disappearance (JD +: achieved JD, JD -: did not achieve JD),
LTx: Liver transplantation, SNL: Survival with the native liver,
*: died after declining LTx

P3

PREDICTORS OF ANTI-REFLUX PROCEDURE FAILURE IN ESOPHAGEAL ATRESIA PATIENTS

Kyle Thompson[1], Thomas E. Hamilton, MD[2], Benjamin Zendejas-Mummert[1], Ali Kamran, MD[2], Wendy Jo Svetanoff, MD, MPH[3], Peter Ngo[1], Michael Manfredi[1], Jessica Yasuda[1], Russell W. Jennings, MD[2], Charles J. Smithers[4]

[1]Boston Children's Hospital, [2]Boston Children's Hospital, Boston, MA, USA, [3]Children's Mercy Kansas City, Kansas City, MO, USA, [4]Johns Hopkins All Children's Hospital, St. Petersburg, FL, USA

Purpose

Anti-reflux procedures (ARP) in esophageal atresia (EA) patients can be challenging due to prior operations, hiatal hernia (HH), anastomotic stricture, microgastria, and/or dysmotility. Hence, ARP failures (ARPF) are not uncommon in this population. We sought to determine predictors of ARPF in EA patients.

Methods

Single-institution retrospective review of EA patients who underwent an ARP from 2002-2019 was performed. ARPF was defined as HH recurrence, wrap migration/loosening, or reoperation. Predictors of ARPF were evaluated using univariate and multivariate time-to-event analysis.

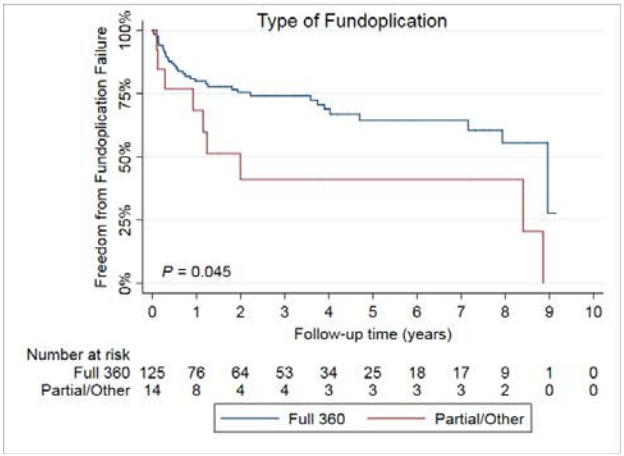
Results

21 patients (52% female; EA type C [52%], A or B [47%]; 52% with history of Foker procedure; 14% with prior ARP and 54% with a HH) underwent 140 ARP at a median age of 13.5 months (IQR 7, 26.5). Nissen fundoplication (89%) was the most common ARP, often performed via laparotomy (75%). Mesh reinforcement was used in 41% of patients. With a median follow-up of 3.2 years (IQR 0.9, 5.8), 44(31%) instances of ARPF occurred, though only 20(14%) required reoperation. Median time to ARPF was 8.7 months (IQR 3.2, 25). Univariate predictors of ARPF included partial fundoplication (60% vs 28% for Nissen fundoplication, p=0.01), lack of mesh reinforcement (39% vs 21% with mesh, p=0.02), and lack of endoscopic guidance to mark the gastroesophageal junction (GEJ, 48% vs 22% with, p=0.0002). Multivariable time-to-event analysis demonstrated partial fundoplication (HR 2.22 [95% CI 1.01-4.78]) and minimally invasive repair (HR 2.57 [95% CI 1.12–6.01]) to be significant predictors of ARPF (Figure 1a-b). Mesh-related complications (all asymptomatic intra-gastric mesh erosions) occurred in 5/58 (9%) cases.

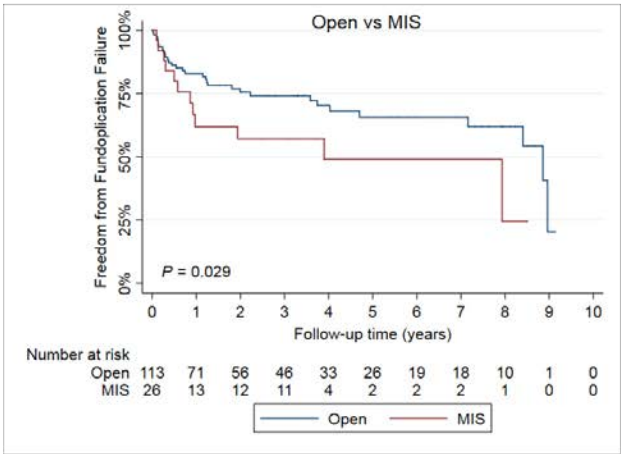
Conclusion

About 1/3 of anti-reflux procedures in EA patients can fail. In our practice, a Nissen fundoplication performed via laparotomy provided the least risk of ARPF. Endoscopic guidance for GEJ identification and mesh reinforcement appear to decrease the risk of ARPF but warrant further study.

1a:



1b:



1a: Kaplan-Meier Curve comparing full 360-degree wrap vs partial wrap and time to wrap failure
1b: Kaplan-Meier Curve comparing open operative approach vs minimally invasive (MIS) for ARP and time to wrap failure. Includes only patients with full 360-degree wrap

P4

FREQUENCY AND NATURAL HISTORY OF RECURRENT LARYNGEAL NERVE INJURY IN COMPLEX PEDIATRIC ESOPHAGEAL AND AIRWAY SURGICAL INTERVENTIONS

Jay Meisner, MD[1], Claire Lawlor, MD[2], Thomas E. Hamilton, MD[3], Carlos Munoz-San Julian, MD[4], Russell W. Jennings, MD[3], Sukgi Choi, MD[4], Benjamin Zendejas, MD, MSc[3]

[1]Boston Children's Hospital, [2]Children's National Medical Center, [3]Boston Children's Hospital, Boston, MA, USA, [4]Esophageal and Airway Treatment Center, Boston Children's Hospital

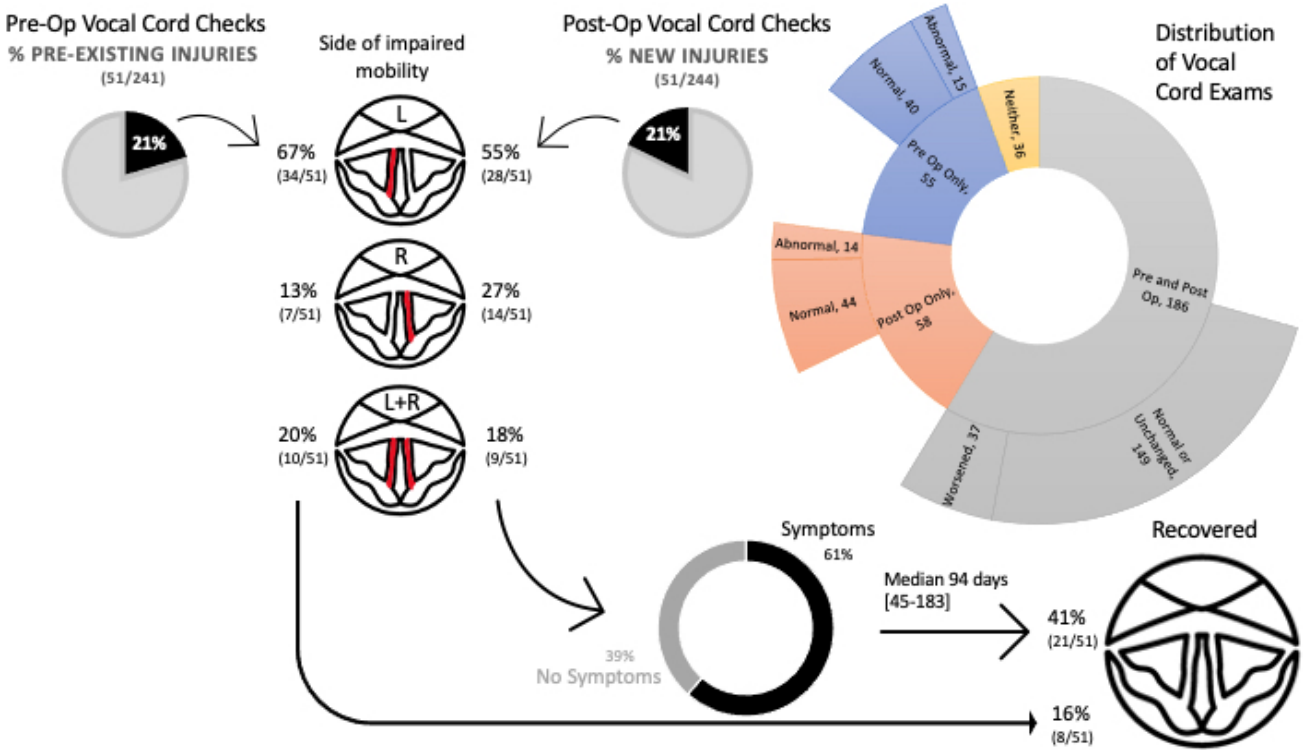
Purpose

To determine the frequency and natural history of vocal fold movement impairment (VFMI) resulting from recurrent laryngeal nerve (RLN) injury during complex pediatric esophageal and/or airway surgical interventions.

Methods

Retrospective review of a single-institution, prospectively maintained database of patients who underwent cervical and/or thoracic procedures in which the RLNs were at risk. Pre- and post-operative flexible nasolaryngoscopic exams were attempted on all patients regardless of symptoms to evaluate for VFMI (hypo or immobility).

Results


Pre-Op Vocal Cord Checks
% PRE-EXISTING INJURIES
(51/241)
21%
Side of impaired mobility
67%
(34/51)
L
55%
(28/51)
Post-Op Vocal Cord Checks
% NEW INJURIES
(51/244)
21%
13%
(7/51)
R
27%
(14/51)
20%
(10/51)
L+R
18%
(9/51)
Distribution of Vocal Cord Exams
Abnormal, 15
Normal, 40
Neither, 36
Pre Op Only, 55
Abnormal, 14
Normal, 44
Post Op Only, 58
Pre and Post Op, 186
Worsened, 37
Normal or Unchanged, 149
Symptoms
61%
39%
No Symptoms
Median 94 days
[45-183]
41%
(21/51)
Recovered
16%
(8/51)

P5

HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS FROM CDH PATIENTS DEMONSTRATE PROPENSITY FOR ENDOTHELIAL-TO-MESENCHYMAL-TRANSITION

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Purpose

Congenital diaphragmatic hernia (CDH)-associated pulmonary hypertension (CDH-PH) results in significant morbidity and mortality in patients. Endothelial-to-mesenchymal transition (EndoMT) has been established in the pathogenesis of PH in many disease processes, however its role in CDH-PH in not elucidated. EndoMT is classically demonstrated as loss of endothelial cell adhesion molecules CD31 and VE-Cadherin, with increase in expression of Col1A1 and aSMA. miR-30a is known to downregulate delta like ligand 4(Dll4), a gene that functions in promoting EndoMT via Notch pathway activation. We hypothesize that endothelial cells in patients with CDH have increased susceptibility to EndoMT mediated via miR-30a downregulation, promoting pathological vascular ECM remodeling.

Methods

Endothelial cells were isolated from the umbilical vein (HUVECs) of heathy control patients (n=2) or patients with CDH (n=4) and sorted using FACS for CD31. HUVECS were treated with TGF-ß1(10ng/ml) for 48h to mimic fibrotic milieu that promotes EndoMT. Expression of aSMA, Col1A1, miR-30a(5a and 3p), and Dll4 were measured using RT-qPCR and BrdU proliferation assay was performed. Data: mean fold change±SD; $p < 0.05$ by ANOVA.

Results

CDH HUVECS demonstrated greater expression of aSMA (4.8±2.2 vs 1.0±0.1) and Col1A1(6.4±1.9 vs 1.0±0.3) in response to TGF-ß1 compared to healthy control HUVECs. Expression of miR-30a-3p and -5p in CDH HUVECS decreased (3p: 0.4±0.07 from 1.1±0.02; 5p: 0.7±0.36 from 1.4±0.15) in response to TGF-ß1, while healthy control HUVECS increased expression of miR-30a-5p and -3p in response to TGF-ß1 stimulation. CDH HUVECs had greater expression of Dll4 after exposure to TGF-ß1 compared to control (13.4±1.3 vs 1.0±0.17). CDH HUVECs also demonstrated greater proliferation over 48 hours compared to control, with TGF-ß1 treatment resulting in decreased proliferation compared to no treatment.

Conclusion

CDH HUVECs undergo raid proliferation, with an increased susceptibility to overexpress fibrotic markers and EndoMT with miR-30a downregulation in response to TGF-ß. Understanding these mechanisms will help direct effective clinical management and development of novel therapeutics for CDH-PH.

21

LAPAROSCOPIC VERSUS OPEN SURGICAL REPAIR OF DUODENAL ATRESIA IN NEONATES: A NSQIP-PEDIATRIC ANALYSIS

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Purpose

Laparoscopic repair of duodenal atresia in neonates has gained popularity, and single center studies suggest comparable short-term outcomes to open surgery. This study examines 30-day post-operative complications by operative approach for duodenal atresia repairs using a national pediatric dataset.

Methods

We identified 335 neonates aged ≤1 week in the 2015-2018 National Surgical Quality Improvement Program-Pediatric (NSQIP-P) database who underwent a laparoscopic or open repair for duodenal atresia. Preoperative characteristics were compared between operative approaches using chi-squared and Wilcoxon rank sum tests. Primary outcomes of postoperative complications, operative time, and postoperative length of stay (LOS) were assessed using multivariate logistic regression and gamma generalized linear models, with $p < 0.05$ set as significant.

Results

There were 289 (86.3%) newborns who had an open repair for duodenal atresia, whereas 46 (13.7%) newborns underwent laparoscopic repair. Sixteen (32.6%) laparoscopic cases were converted to open. The median age at operative repair was two days (range 0-7 days). There were no significant differences in gestational age (p=0.325), weight at operation (p=0.375), or cardiac risk factors (p=0.871) between groups. The median postoperative length of stay was 21 days (range 0-114 days). Mean operative time was 176 ± 54 minutes for laparoscopy versus 119 ± 52 minutes for open cases. Sixty (17.9%) infants developed complications including bleeding requiring transfusion (4.8%), reoperation (3.9%), reintubation (3.6%), and infection (2.7%). There were no significant differences in overall postoperative complications by operative approach (OR 1.22, 95% CI [0.51, 2.66], p=0.634). Total operative time for laparoscopy was 57 minutes longer (95% CI [37, 81], $p < 0.001$) but postoperative LOS was 4.2 days shorter (95% CI [-7.6, -0.1], p=0.024).

Conclusion

Our findings suggest laparoscopic repairs of duodenal atresia have comparable safety to open repairs, supporting results seen in smaller cohort studies. Laparoscopy also results in significantly longer operative times but shorter postoperative LOS.

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OUTCOMES FOR LADD'S PROCEDURE: DOES APPROACH MATTER?

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Purpose
Laparoscopic Ladd's procedure has proven safe and effective for treatment of malrotation. However, the nationwide utilization and outcomes of elective Ladd's are largely unknown.

Methods
The Nationwide Readmissions Database from 2010-2014 was used to identify patients 0-18 years (excluding newborns) with malrotation who underwent elective Ladd's procedure. Demographics, hospital factors, and complications were compared by approach (laparoscopic vs. open) using standard statistical tests. Results were weighted for national estimates.

Results
1343 patients (44% male) underwent elective Ladd's procedure via laparoscopic (22%) or open (78%) approach. Laparoscopic approach was more common in large hospitals (26% vs. 16%), patients >13 years (30% vs. 20%), and those with higher income (29% vs. 16%), all $p < 0.001$. When comparing laparoscopic to open approaches (Table 1), open technique was used more often in younger children and those with low income, and was associated with longer lengths of stay and higher hospital costs. Open procedures were also associated with higher post-operative infection rate and gastrointestinal complications.

The 30-day and 1-year readmission rates were 8% and 15%, respectively, with higher rates following open Ladd's (Table 1). The majority of readmissions were unplanned (86%) with 72% due to gastrointestinal complaints, 31% for small bowel obstruction (SBO), and 21% for operative SBO. There was no difference in readmission for SBO or volvulus comparing laparoscopic and open Ladd's. Redo Ladd's procedure was performed in 3% of readmissions and was higher following the laparoscopic approach (2% vs. 0.2%, $p=0.002$). All redo Ladd's were performed within 5 days of initial hospital discharge.

Conclusion
The majority of Ladd's procedures in the U.S. are being performed open and disparities exist with utilization of laparoscopy. Although readmission rates are similar with either approach, the rate of redo Ladd's procedure is lower than previously reported and is more common following laparoscopic repair.

23

SURGICAL NEEDS AND SURVIVAL IN TRISOMY 13 AND 18: A THIRTY-YEAR REVIEW

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Background
Due to their classically described early mortality, surgical risks and survival in trisomy 13 and 18 are unclear. This, in turn, makes patient selection and family counseling difficult. Here, we reviewed the surgical needs, outcomes, short and long-term survival of patients with trisomy 13 and 18. We predict that there may be predictors associated with improved survival which may guide clinicians.

Methods
Medical records at a tertiary children's hospital between 1990-2019 were retrospectively reviewed after IRB approval. Patients with trisomy 13 or 18 were included; patients who were stillborn or with insufficient records were excluded. Data regarding overall and postoperative survival were collected.

Results
One hundred eighteen patients were identified. Collectively, 64% had trisomy 18, 36% trisomy 13, 73% were female, 85% had at least four comorbidities; 75% survived to initial hospitalization lasting median 13.0 days, and 77% of deaths occurred by six months at median age 42.2 days. "Partial" cytogenetics (mosaicism, translocation)($p < 0.001$), higher birth weight($p=0.001$) and higher gestational age($p < 0.001$) were associated with improved survival, while the presence of cardiac($p=0.015$), orthopedic($p=0.019$), and general surgical($p < 0.001$) comorbidities were associated with decreased survival. Over half(n=64) underwent an invasive procedure at median age 2.9 months. The most common surgical procedures were for feeding dysfunction(35%) and intestinal diseases(50%). Median survival times were significantly higher in operative rather than nonoperative patients($p < 0.001$, table). Higher birth weight($p=0.011$) and "partial" cytogenetics($p=0.0004$) were associated with improved post-operative survival, while undergoing general surgery($p < 0.001$), especially tracheoesophageal fistula/esophageal atresia($p < 0.001$), was associated with significantly decreased survival compared to other procedures.

Conclusions
Patients with trisomy 13 and 18 suffer from many comorbidities and have vast surgical needs. Higher birth weight and partial trisomy was associated with improved surgical survival while undergoing a general surgical procedure was associated with decreased survival. Those who survived to undergo a surgery survived longer overall.

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A NOVEL TOLL-LIKE RECEPTOR 4 INHIBITOR TREATS ESTABLISHED NEC IN NEWBORN MICE

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Purpose

Necrotizing enterocolitis (NEC) is the leading cause of death from gastrointestinal disease in premature infants. Recent studies have revealed that the susceptibility of premature intestine may be explained by increased expression and signaling of Toll-Like Receptor 4 (TLR4). This has opened an avenue for potential therapeutic options by inhibiting TLR4 signaling. To this end, we recently discovered a TLR4 inhibitor (C34) which effectively prevents development of NEC in animal models. However, its potential as treatment, once NEC has developed, remains unknown. We hypothesize that C34 reduces severity of established NEC in mice via reduction of TLR4 and proinflammatory cytokine expression.

Method

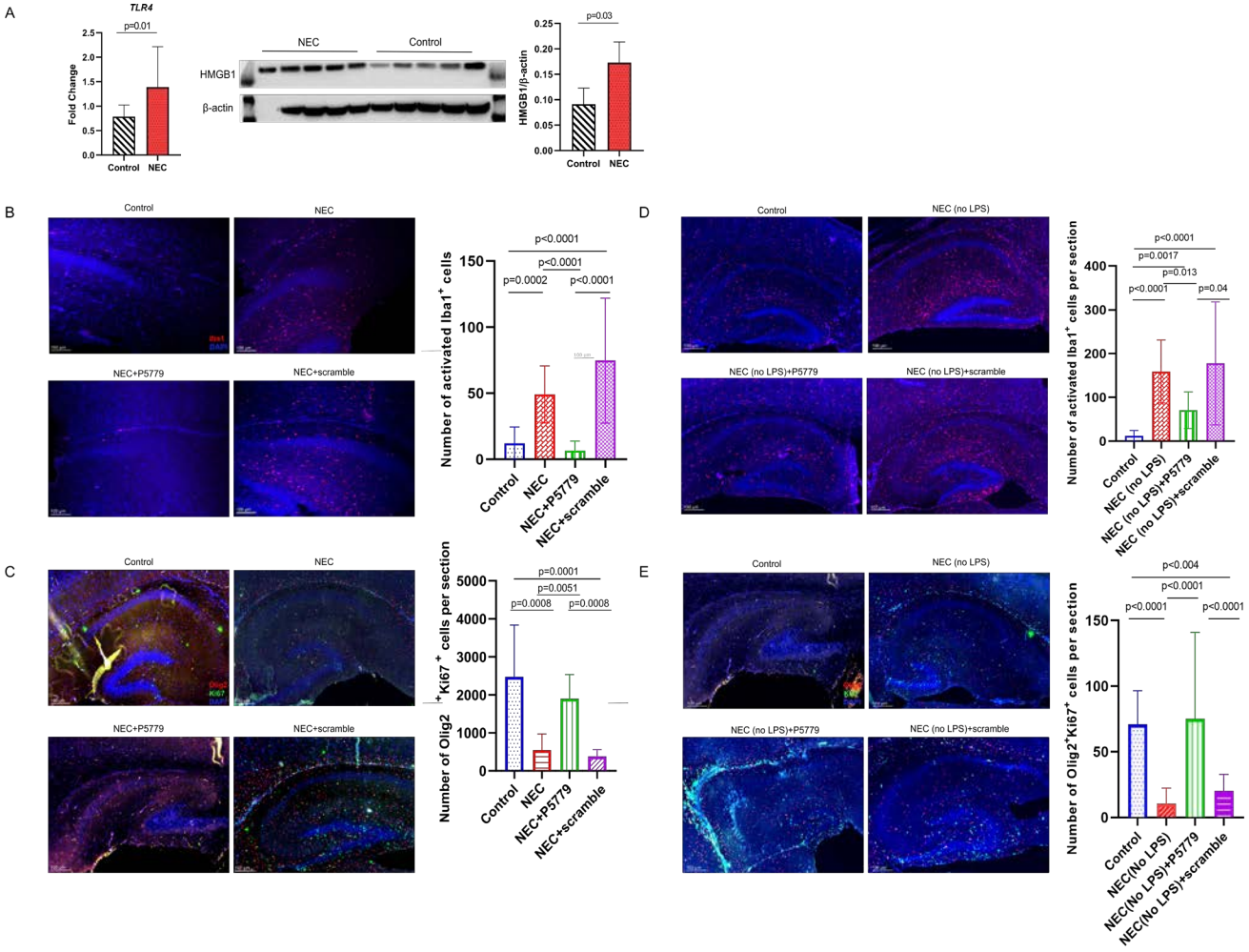
NEC was induced in neonatal C57BL/6 mice through four days of formula-gavage, hypoxia, and NEC stool treatment. On the third and fourth day, intraperitoneal injections (2.5mg/kg) of C34 were given twice daily. Terminal ileum samples were then obtained for RNA isolation and histology. PCR was performed for measurement of proinflammatory cytokines and apoptosis gene expression, and H&E staining for histologic score. These results were compared with mice who received injections of C34 carrier (DMSO) and with breastfed mice (BF).

Results

Mice subjected to NEC had a significant increase in histologic injury scores; and inflammation and apoptosis as revealed by increased TNFα expression and apoptosis-related gene expression. In contrast, treatment with C34 on the third and fourth day of the NEC model restored histologic integrity and reduced expression of proinflammatory cytokines and apoptosis genes as revealed by a decrease in TNFα expression (BF=2; NEC+DMSO=4.2; NEC+C34=2.2, $p < 0.001$) and BCL2 expression (BF=30; NEC+DMSO=50; NEC+C34=25, $p < 0.001$). C34 treatment significantly reduced expression of TLR4 as compared to BF and DMSO (BF=15; NEC+DMSO=22; NEC+C34=10, $p < 0.001$).

Conclusion

This study suggests that a novel TLR4 inhibitor (“C34”) can be used to treat active NEC in newborn mice through a TLR4-dependent pathway, thus identifying a potential therapy for this devastating disease.


A
TLR4
p=0.01
Fold Change
Control
NEC
NEC
Control
HMGB1
β-actin
p=0.03
HMGB1/β-actin
B
Control
NEC
NEC+P5779
NEC+scramble
Number of activated Iba1+ cells
p<0.0001
p<0.0001
p=0.0002
p<0.0001
C
Number of Olig2+Ki67+ cells per section
p=0.0001
p=0.0051
p=0.0008
p=0.0008
D
Control
NEC (no LPS)
NEC (no LPS)+P5779
NEC (no LPS)+scramble
Number of activated Iba1+ cells per section
p<0.0001
p=0.0017
p=0.013
p<0.0001
p=0.04
E
Number of Olig2+Ki67+ cells per section
p<0.004
p<0.0001
p<0.0001
p<0.0001
NEC(No LPS)
NEC(No LPS)+P5779
NEC(No LPS)+scramble

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RESECTION-ASSOCIATED LIVER INJURY IN MURINE MODEL OF SHORT BOWEL SYNDROME

Emily J. Onufer, MD, MPH[1], Yong-Hyun Han, PhD[2], Rita Lu[3], Cathleen M. Courtney, MD[4], Stephanie Sutton[1], Li Ding[3], Gwendalyn Randolph, PhD[2], Brad W. Warner, MD[5]

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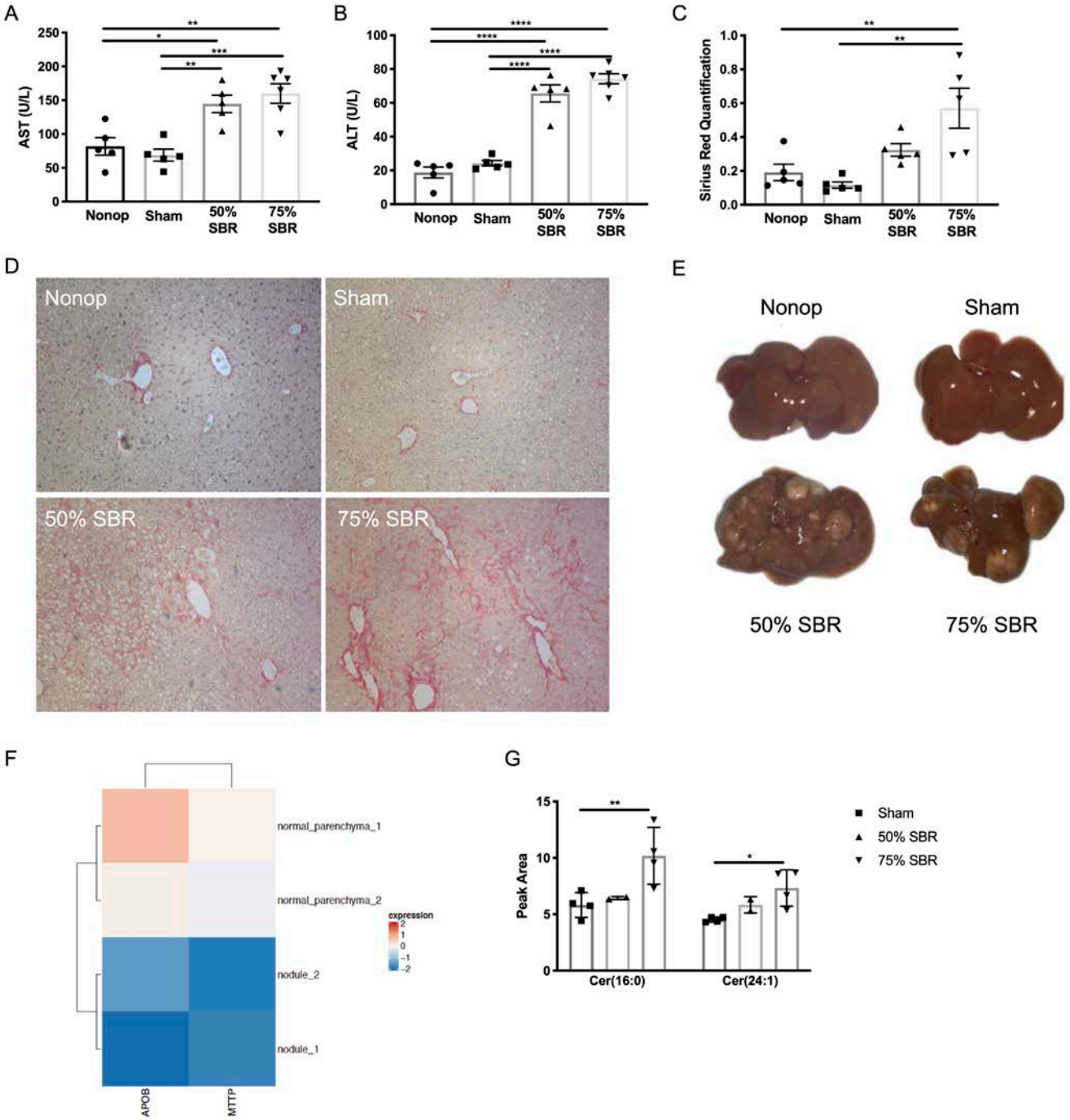
Purpose
Intestinal failure associated liver disease (IFALD) is the leading indication for intestinal transplantation in children with short bowel syndrome (SBS) and represents a spectrum of liver injury from steatosis to cirrhosis. Its pathogenesis is similar to non-alcoholic fatty liver disease (NAFLD) with progression to non-alcoholic steatohepatitis (NASH). Using a parenteral nutrition-independent murine model of SBS, we demonstrate liver injury that directly correlates with the magnitude of intestinal resection. We hypothesize that similar to NALFD, one of the possible mechanisms of IFALD is defective hepatic VLDL secretion.

Methods
Male C57BL6 mice underwent a 50% or 75% proximal small bowel resection (SBR), sham operation, or no operation. Eighteen months later, plasma aspartate and alanine aminotransferase levels were quantified. Sirius red staining was quantified for fibrosis. RNA sequencing was performed on normal parenchyma and nodules of the 75% SBR liver tissue. Hepatic ceramide levels were determined using liquid chromatography-tandem mass spectrometry after homogenization and extraction.

Results
Serum transaminase levels (Figure 1A-B) and degree of hepatic fibrosis (Figure 1C-D) were elevated with increasing loss of bowel. Gross nodularity with histology revealing severe liver injury including hepatitis, steatosis, necrosis, and varying degrees of regenerative foci were present in all resected mice compared to sham and nonoperative controls (Figure 1E). Heat map RNA sequencing of VLDL assembly genes, microsomal triglyceride transfer protein (MTTP) and apolipoprotein B (APOB), were significantly decreased in nodules compared to normal hepatic parenchyma. Hepatic ceramide 16:0 and 24:1 levels, which are linked with NASH, were elevated in SBR mice.

Conclusion
Alterations in VLDL assembly develop after SBR and are associated with hepatic steatosis, fibrosis, and severe liver injury. Like NASH, elevated levels of ceramides 16:0 and 24:1 contained within VLDL proteins may be important hepatotoxic factors. These findings offer the possibility of modifiable nutritional interventions for the prevention of IFALD.


A
AST (U/L)
Nonop
Sham
50% SBR
75% SBR
B
ALT (U/L)
C
Sirius Red Quantification
D
Nonop
Sham
50% SBR
75% SBR
E
Nonop
Sham
50% SBR
75% SBR
F
normal_parenchyma_1
normal_parenchyma_2
nodule_2
nodule_1
expression
APOB
MTTP
G
Peak Area
Cer(16:0)
Cer(24:1)
Sham
50% SBR
75% SBR

27

THE IMPORTANCE OF THE ILEOCECAL VALVE AND COLON IN ACHIEVING INTESTINAL INDEPENDENCE IN INFANTS WITH SHORT BOWEL SYNDROME

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Purpose

Infants with short bowel syndrome (SBS) require parenteral nutrition (PN) until intestinal function improves. Small bowel length is a predictor of PN duration, but the importance of the ileocecal valve (ICV) and the colon are unclear. Our objective is to determine if the ICV and/or colon impact PN duration in infants with SBS, independent of small bowel length and SBS etiology.

Methods

Infants in a single intestinal rehabilitation program between 2010-2019 were retrospectively reviewed. Etiology of SBS, intestinal anatomy and duration of nutritional support was collected for three years after diagnosis. The primary outcome was time to intestinal independence, measured by duration of PN support. Fifty-six infants were included: 34 (61%) had their ICV and 39 (70%) had >50% of their colon in continuity. ANCOVA and Cox proportional hazards model were used, with $p < 0.05$ considered significant.

Results

During the study 44 (79%) weaned off of PN, 7 (12%) did not, 3 (5%) died, and 2 (4%) were lost to follow-up. PN support duration was shorter for infants with their ICV (mean 183 days vs. 619 days, p=0.001) and with >50% of colon (mean 234 days vs. 637 days, p=0.031), independent of % expected small bowel remaining. Having an ICV and >50% of colon were both associated with PN weaning at 6, 12 and 24 months. In patients with ≤50% of colon, those with their ICV spent less time on PN (mean 753 days vs 251 days, p=0.036) (Figure 1). There was no significant difference in duration of PN support based on etiology of SBS including atresia, gastroschisis and necrotizing enterocolitis.

Conclusions

Preservation of the ICV and >50% of colon were both associated with a shorter duration of PN support and the ability to wean within the first 2 years in infants with SBS.

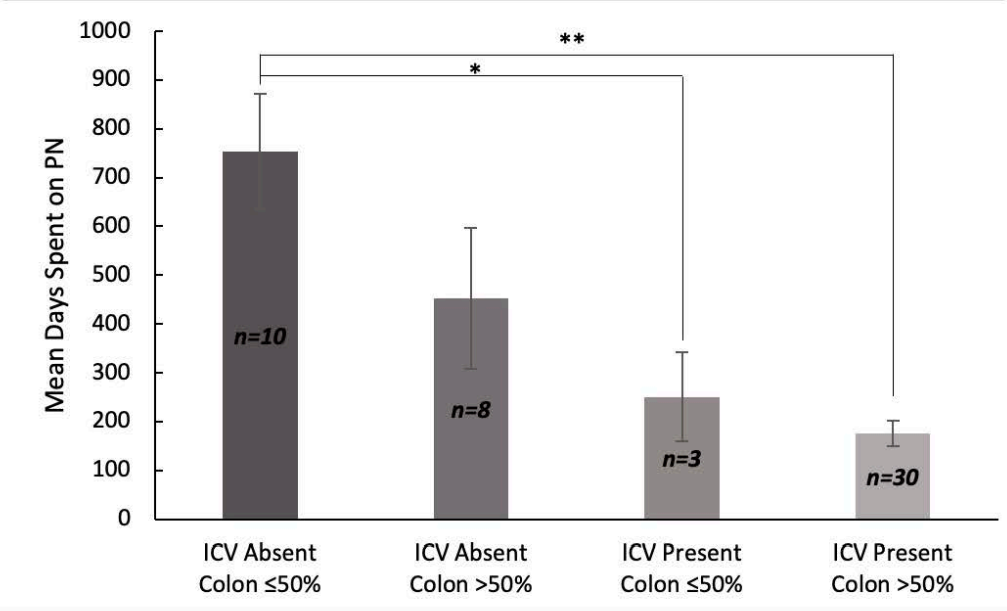

Figure 1. Number of days spent on parenteral nutrition grouped by presence and absence of ICV, and >50% or ≤50% of colon (* denotes $p<0.05$, ** denotes $p<0.01$).

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LONG-TERM ASSESSMENT OF BILIRUBIN AND TRANSAMINASE TRENDS IN PEDIATRIC INTESTINAL FAILURE PATIENTS DURING THE ERA OF HEPATOPROTECTIVE PARENTERAL NUTRITION

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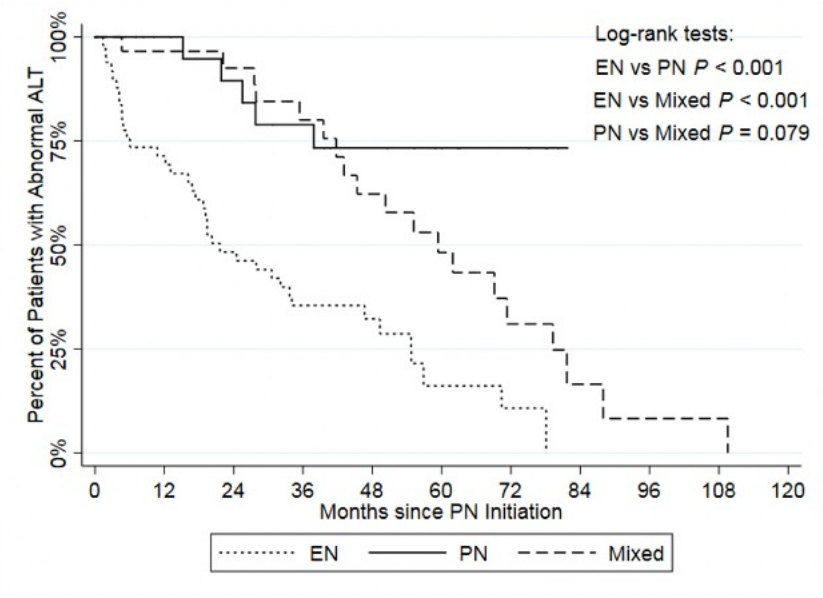
Purpose
This study aimed to characterize the relationship between hepatoprotective parenteral nutrition (PN) dependence and long-term serum liver tests in children with intestinal failure (IF).

Methods
Retrospective review of children with severe IF (>90 consecutive days of PN) who were followed from 2012-2019 at a multidisciplinary intestinal rehabilitation program. Patients were stratified into three groups based on level of PN dependence at most recent follow up: EN (achieved enteral autonomy), mixed (parenteral and enteral nutrition), and PN (>75% of caloric intake from PN). PN at any point for this cohort was hepatoprotective, defined as soy-based lipids < 1.5g/kg/day, combination (soy, medium chain fatty acid, olive and fish oil) lipid emulsion, or fish oil-based lipid emulsion. Kaplan-Meier analysis and a generalized estimating equation (GEE) model were utilized to estimate the time to normalization and trends, respectively, of two serum markers of liver health: direct bilirubin (DB) and alanine aminotransferase (ALT).

Results
The study included 123 patients (67 EN, 32 mixed, 24 PN). Median follow up time for all groups was 4 years. Based on the Kaplan Meier curve, all EN and mixed group patients achieved normal direct bilirubin levels by 3 years, while 32% of the PN group had abnormal DB levels. At 5 years, 16% of EN patients had elevated ALT levels compared to 73% of PN patients ($p < 0.001$, Fig. 1). The PN group's ALT levels were 1.76-fold above normal at 3 years (95%CI 1.48-2.03) and 1.65-fold above normal at 5 years (95%CI 1.33-1.97).

Conclusions
While serum bilirubin levels tend to normalize, long-term PN dependence in the era of hepatoprotective parenteral nutrition is still associated with a persistent transaminase elevation in an overwhelming majority of patients. These data support continued vigilant monitoring of liver health in children with intestinal failure.

Figure 1. Kaplan-Meier curves demonstrating time to normalization of alanine aminotransaminase (ALT) levels in patients in the PN (>75% of caloric intake from PN), mixed (parenteral and enteral nutrition), and EN (enteral autonomy) groups.



Saturday, June 5, 2021

APSAsode - Jay and Margie Grosfeld Symposium: Research on CDH, Lung Abnormalities and Tumors

2:00 PM – 4:30 PM

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CHEMOKINE RECEPTOR CXCR4 MEDIATES THE PIM3-INDUCED METASTATIC PHENOTYPE OF HEPATOBLASTOMA CELLS

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Purpose

Metastatic hepatoblastoma has limited treatment options with a survival rate as low as 25%. We have shown that overexpression of PIM3 promotes hepatoblastoma cell motility in vitro and formation of lung metastasis in vivo, but the responsible mechanism has not yet been defined. The chemokine receptor CXCR4 has been implicated in migration and invasion of various cancer types. We hypothesized that CXCR4 mediates the PIM3-induced pro-metastatic phenotype of hepatoblastoma cells.

Methods

The human hepatoblastoma cell line, HuH6, was stably transfected with PIM3 overexpression (PIM3-OE) or empty vector (EV) control plasmids. PIM3 and CXCR4 protein expression was evaluated by immunoblotting. Following treatment with AMD3100, a small molecule inhibitor of CXCR4 (0-30 μM, 24 hours), migration and invasion were assessed using transwell assays. CXCR4 cell surface expression was detected by flow cytometry. Data were normalized to untreated EV cells. Student's t-test was used with mean ± standard error of the mean reported and $p \leq 0.05$ significant.

Results

PIM3-OE hepatoblastoma cells exhibited higher Ser339-phosphorylated CXCR4 levels (Figure 1A). PIM3-OE upregulated the cell surface expression of CXCR4 (22±1.2 compared to 34±0.5 % in EV cells, $p \leq 0.001$, Figure 1B) and resulted in increased migration and invasion compared to EV cells (1.8±0.2 and 1.7±0.1 fold change, respectively, $p \leq 0.05$, Figure 1D-E, black bars). AMD3100 decreased the percentage of cells labeled with an anti-CXCR4 competitive binding antibody in both PIM3-OE and EV cells ($p \leq 0.05$, Figure 1B-C), indicating blockade of the CXCR4 receptor. AMD3100 treatment decreased migration and invasion of PIM3-OE and EV hepatoblastoma cells and reversed the PIM3-induced pro-metastatic phenotype ($p \leq 0.05$, Figure 1D-E).

Conclusion

PIM3 upregulated the cell surface expression of CXCR4 which mediated the PIM3-induced migration and invasion of hepatoblastoma cells. Our findings suggest CXCR4 is a mechanism of PIM3's promotion of hepatoblastoma metastasis and may prove to be a plausible target for therapeutic intervention.

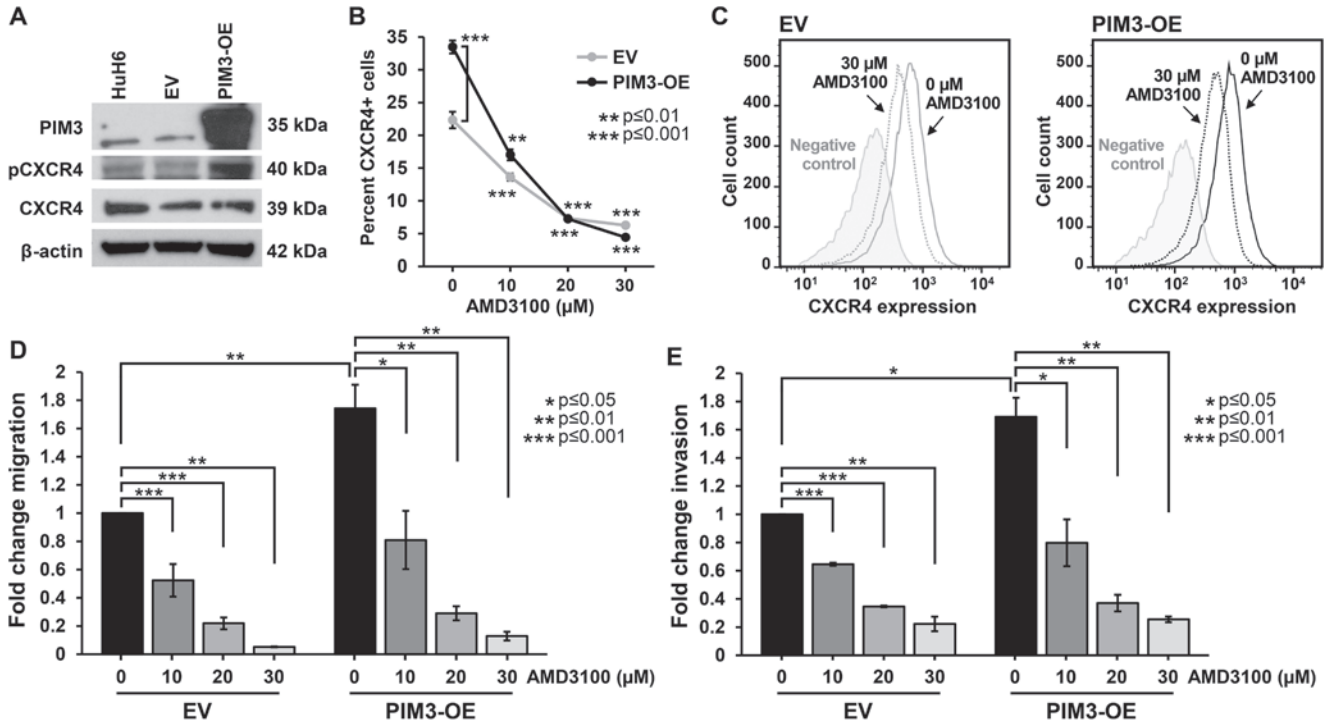

Figure 1. CXCR4 mediates PIM3-induced metastatic phenotype of hepatoblastoma cells. PIM3 overexpression (PIM3-OE) cells had higher (**A**) levels of phosphorylated CXCR4 (at Ser339) and (**B**) CXCR4 cell surface expression, compared to the empty vector (EV) control HuH6 cells. (**B**) Treatment with AMD3100 decreased percent CXCR4 positive cells in both EV and PIM3-OE cells. (**C**) Representative histograms showing the significant decrease in CXCR4 expression signal following AMD3100 treatment (at 30 μM, *dotted lines*) compared to untreated cells (*solid lines*) indicating blockade of the CXCR4 receptor. AMD3100 treatment of EV and PIM3-OE cells significantly decreased (**D**) migration and (**E**) invasion in a concentration-dependent manner compared to untreated cells.

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CNP-MIR146A REDUCES LUNG INFLAMMATION AND FIBROSIS FOLLOWING ACUTE INJURY

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Purpose

Acute respiratory distress syndrome (ARDS) affects nearly 3% of pediatric intensive care unit (PICU) admissions and carries an in-hospital mortality of up to 30%. With the development of the coronavirus pandemic, the need for novel therapeutics targeting acute lung injury (ALI) are increasingly urgent. The progression to ARDS from ALI centers on unrestrained inflammation and oxidative stress, which promote pulmonary fibrosis. Our therapeutic, CNP-miR146a, is the conjugation of cerium oxide nanoparticles (CNP), a reactive oxygen species scavenger, to the anti-inflammatory microRNA(miR)-146a. We hypothesize that administration of CNP-miR146a after injury onset will lower inflammatory cell infiltrate and fibrosis, rescuing the lungs from injury.

Methods

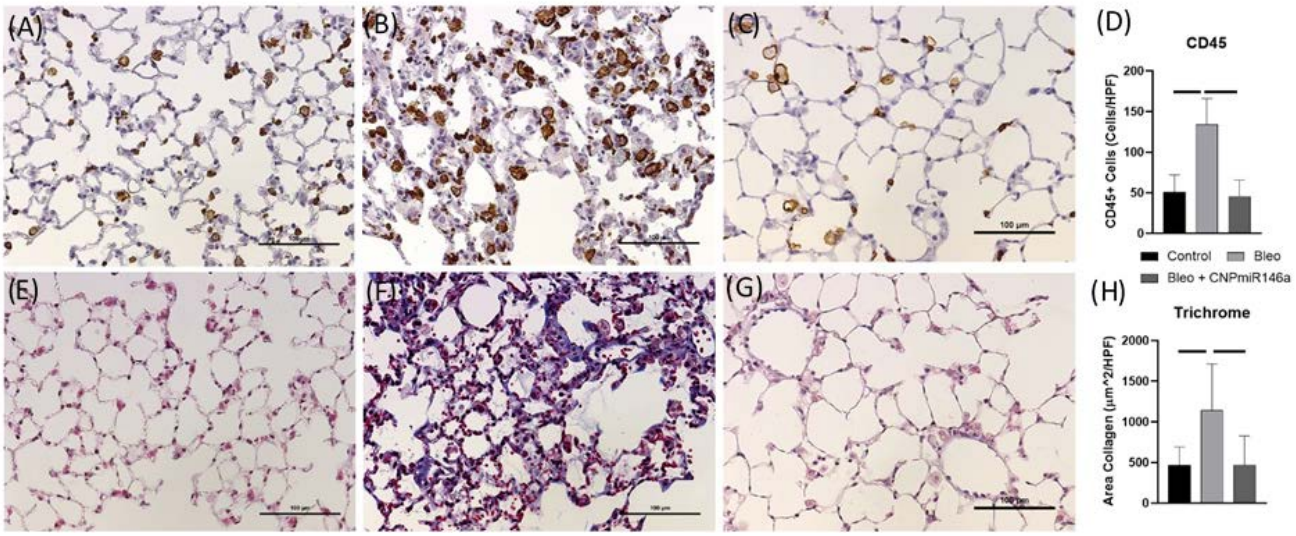
Age-matched C57BL/6 mice (n = 20) underwent intratracheal (IT) administration of 3 units/kg bleomycin (Bleo, n = 7) or PBS (Control, n =7). A subset of injured mice was given IT CNP-miR146a three days after injury (Bleo + CNP-miR146a, n = 6). Mice were euthanized 14 days after injury, lungs were processed for histological analysis, and tissue sections were stained with trichrome for collagen or for CD45, a marker present on leukocytes. Twenty random high-powered fields (HPF, 400x) were imaged and analyzed using NIS Elements – Advanced Research imaging software. Area of collagen in trichrome-stained images and CD45+ cells in CD45-stained images were quantified and groups were compared with One-Way ANOVA.

Results

Treatment with CNP-miR146a 3 days after injury lowered inflammatory cell infiltrate compared to untreated mice ($p < 0.0001$). Compared to untreated mice, there was a reduction in the area of collagen per HPF after treatment with CNP-miR146a 3 days after injury ($p = 0.0249$).

Conclusion

IT treatment with CNP-miR146a three days after lung injury reduces inflammatory cell infiltrate and collagen levels in the lung. CNP-miR146a could have significant clinical implications and improve ARDS-related outcomes by reducing inflammation and preventing long-term fibrosis.


(A)
(B)
(C)
(D)
CD45
CD45+ Cells (Cells/HPF)
200
150
100
50
0
Control
Bleo
Bleo + CNPmiR146a
(E)
(F)
(G)
(H)
Trichrome
Area Collagen (µm^2/HPF)
2000
1500
1000
500
0

94

CONGENITAL DIAPHRAGMATIC HERNIA ASSOCIATED PULMONARY HYPOXIA AND INFLAMMATION ARE INITIATED IN UTERO

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Purpose
Previous work has established that, in the immediate postnatal period, the lungs of rodents with congenital diaphragmatic hernia (CDH) are profoundly hypoxic, have increased hypoxia inducible factor (HIF) expression, and have more inflammation than the lungs of control rodents. Whether CDH-associated pulmonary hypoxic and inflammatory changes are present only postnatally or begin in utero is unknown. We hypothesized that the increased tissue hypoxia and inflammation associated with CDH would be present in the prenatal period.

Methods
We used the well-characterized nitrofen CDH rodent model. At gestational day 20, 70mg/kg intraperitoneal hypoxyprobe (Pimonidazole-HCl), a marker of cellular hypoxia, was administered to all dams. Dams were divided into three groups: control-normoxia, control-hypoxia (exposed to 8% O2), and nitrofen-normoxia. After one hour, dams underwent laparotomy, pups were delivered, and left lungs were collected. Only pups with severe diaphragmatic defects (CDH study group stage C or D equivalent) underwent tissue harvest. The extent of parenchymal hypoxia was assessed by immunofluorescence. The expression of HIF-1α and HIF-2α was measured by western blot. Pulmonary inflammation was measured by western blot of C-reactive protein (CRP).

Results
Pulmonary tissue from all three groups demonstrated prenatal hypoxia. However, pulmonary parenchyma from prenatal CDH-pups displayed nearly 10x more hypoxia compared to control lungs (FIGURE) (p=0.01). No significant difference in hypoxia was seen between pups from the control-hypoxia group and the nitrofen-normoxia group (p=0.40) or the control-normoxia group (p=0.11). Lungs from nitrofen-normoxia and control-normoxia pups showed no difference in HIF1a or HIF2a expression (p=0.95, p=0.75, respectively). CDH-lungs had over twice as much CRP expression as control lungs (p=0.002).

Conclusion
We conclude that pulmonary changes and inflammation related to congenital diaphragmatic hernia-associated hypoxia are initiated in utero. This identifies a previously unknown, but critical time point for early, hypoxia and/or inflammation-targeted intervention among infants with congenital diaphragmatic hernia.

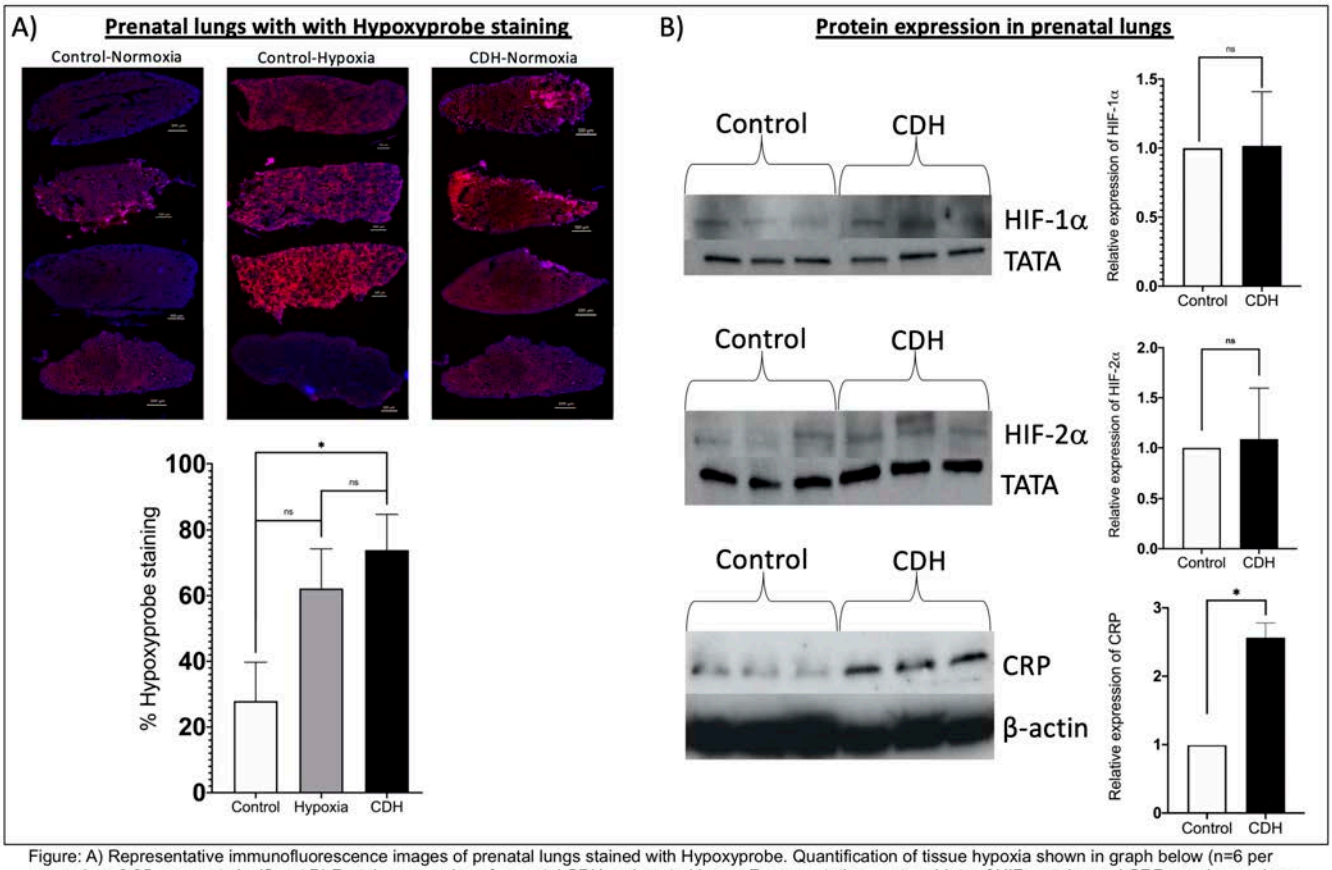

Figure: A) Representative immunofluorescence images of prenatal lungs stained with Hypoxyprobe. Quantification of tissue hypoxia shown in graph below (n=6 per group, *=p<0.05, ns = not significant B) Protein expression of prenatal CDH and control lungs. Representative western blots of HIF proteins and CRP are shown along with quantification (n=4 per group). *=p<0.05, ns = not significant.

95

HEPARIN AND ENOXAPARIN IMPAIR PULMONARY FUNCTION AFTER MURINE LEFT PNEUMONECTOMY

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Purpose

Neonates with congenital diaphragmatic hernia (CDH) suffer from pulmonary hypoplasia (PH) and may require extracorporeal membrane oxygenation (ECMO) and anticoagulation. Expeditious pulmonary growth on ECMO is required to reduce mortality, which approaches 50%. Additionally, many patients with developmental lung diseases receive low molecular weight heparin (LMWH, enoxaparin) or subtherapeutic anticoagulation to treat or prevent venous thrombosis. Previously, our lab demonstrated that therapeutic unfractionated heparin (UFH) impairs compensatory lung growth (CLG) following murine left pneumonectomy. We now investigate the effects of subtherapeutic and therapeutic heparin and enoxaparin on post-pneumonectomy pulmonary functional outcomes.

Methods

C57BL/6 mice were treated with saline control, subtherapeutic (low-dose, 250U/kg), or therapeutic (high-dose, 500U/kg) UFH via intraperitoneal injection every 12 hours, or with saline control or LWMH (10U/kg) via subcutaneous injection daily. Plasma anti-factor Xa levels and PTT were measured after three doses. Another cohort of mice underwent baseline treadmill exercise tolerance testing (TETT) followed by pneumonectomy and treatment with saline, low- or high-dose UFH, or LMWH for eight days. TETT was repeated on post-operative days (POD) four and eight.

Results

High-dose UFH significantly increased plasma PTT and anti-factor Xa levels, while low-dose UFH and saline did not (A, B). LMWH significantly increased PTT and anti-factor Xa level, though to lesser degree than high-dose UFH (B). Mice had similar exercise tolerance at baseline (C), but those treated with LMWH ran for significantly less time and shorter distance compared to control on POD4 (D). On POD8, UFH impaired exercise tolerance in a dose-dependent manner; the detrimental effects of LMWH were persistent (E).

Conclusion

Therapeutic UFH, subtherapeutic UFH, and LMWH impair murine post-pneumonectomy exercise tolerance. These data suggest that heparin and enoxaparin may worsen functional outcomes for neonates with CDH and pulmonary hypoplasia. Accordingly, the choice of drug, dose, and duration of anticoagulation for neonates with hypoplastic lung disease should be reconsidered.

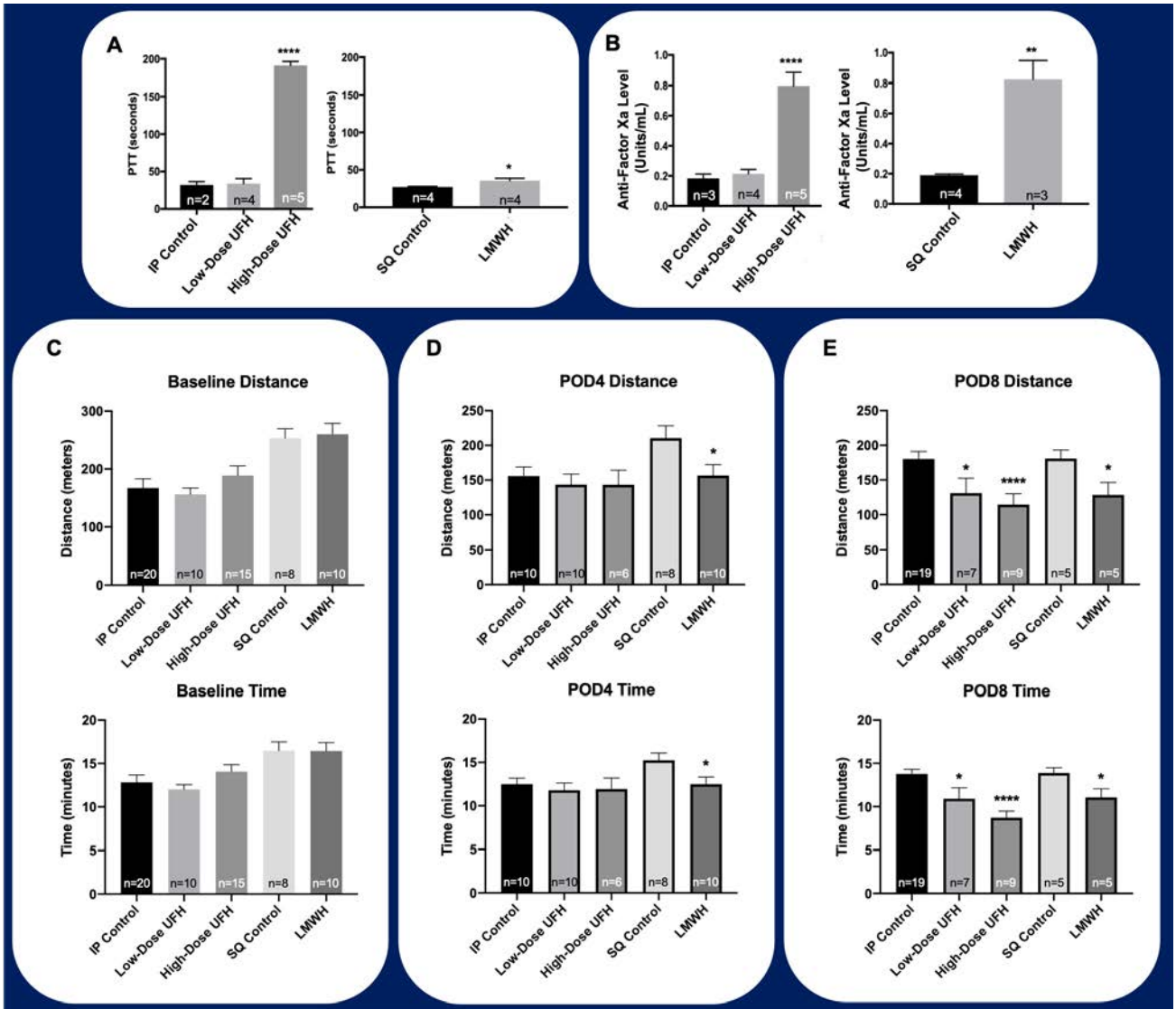

Figure 1. Therapeutic and subtherapeutic unfractionated heparin, low molecular weight heparin impair exercise tolerance after murine left pneumonectomy.
Compared to controls, high-dose unfractionated heparin (UFH), but not low-dose UFH, achieved therapeutic anticoagulation, represented as significantly elevated PTT **(A)** and anti-factor Xa level **(B)**. Low molecular weight heparin (LMWH), induced significantly elevated PTT and anti-factor Xa level, although to lesser degree than high-dose UFH **(A, B)**. At baseline, exercise tolerance was similar across groups, as measured by distance run and time spent running **(C)**. On post-operative day (POD) 4, administration of LMWH significantly reduced distance run and time spent running compared to controls, while mice administered UFH were not affected **(D)**. However, by POD8, mice administered UFH experienced significant, dose-dependent reductions in exercise tolerance; those administered LMWH demonstrated persistent reductions in exercise tolerance **(E)**.
Results expressed as mean ± SE. Analyses were performed by one-way analysis of variance (ANOVA) with Dunnet correction for multiple comparisons for the IP groups, or with student's t-test for the SQ groups. Significance represented by * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$), **** ($p<0.0001$).

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HIGH RAS EXPRESSION IS ASSOCIATED WITH POOR NEUROBLASTOMA PATIENT SURVIVAL AND REQUIRED FOR TUMOR FORMATION IN AN ORTHOTOPIC MOUSE MODEL

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Purpose
MYCN amplification predicts poor neuroblastoma (NBL) outcome but is only present in 22% of tumors, suggesting additional contributing pathways. Recently, RAS activity has been implicated in NBL. We hypothesize: 1) high HRAS expression results in poor patient survival, 2) RAS inhibition delays tumor formation. To test this, a RAS monobody, NS1, was used to inhibit HRAS- and KRAS-mediated signaling.

Methods
GSE62564 dataset (498 patients) was divided according to MYCN amplification, HRAS expression, and overall survival. SK-N-FI NBL cells (low MYCN, high HRAS expression) were infected with lentivirus encoding a doxycycline (DOX)-regulated NS1 expression construct that allowed for chemically regulated NS1 expression (and RAS inhibition) both in vitro and in vivo. The resulting SK-N-FINS1 cells were treated -/+DOX to determine the effects of RAS inhibition on cell proliferation, and ERK MAPK activity by Western blot analysis for pERK levels. Orthotopic NBL xenografts were generated by injecting SK-N-FI-NS1 cells into the left adrenal gland of immunocompromised mice. Mice received fresh water+/-DOX every other day for 2 months. Tumors were tracked with ultrasound.

Results
NBL patients with low MYCN expression can be divided into cohorts with high vs. low HRAS expression ($p < 0.0001$). High HRAS expression correlated with worse overall survival vs low HRAS expression ($p < 0.001$). DOX-induced NS1 expression in SK-N-FINS1 decreased RAS activity, pERK level, and proliferation. Mice injected with SK-N-FINS1 cells began to develop adrenal tumors at 13 days post injection however, treatment of SK-N-FINS1 mice with DOX delayed tumor development to day 30. On post-cell injection day 34, all non-DOX-treated animals had developed tumor, while only 60% of DOX-treated animals did.

Conclusion
Patients with high HRAS expression have worse overall survival. RAS inhibition delays NBL tumor formation suggesting that the RAS-MAPK pathway may be potential therapeutic target for NBL treatment.

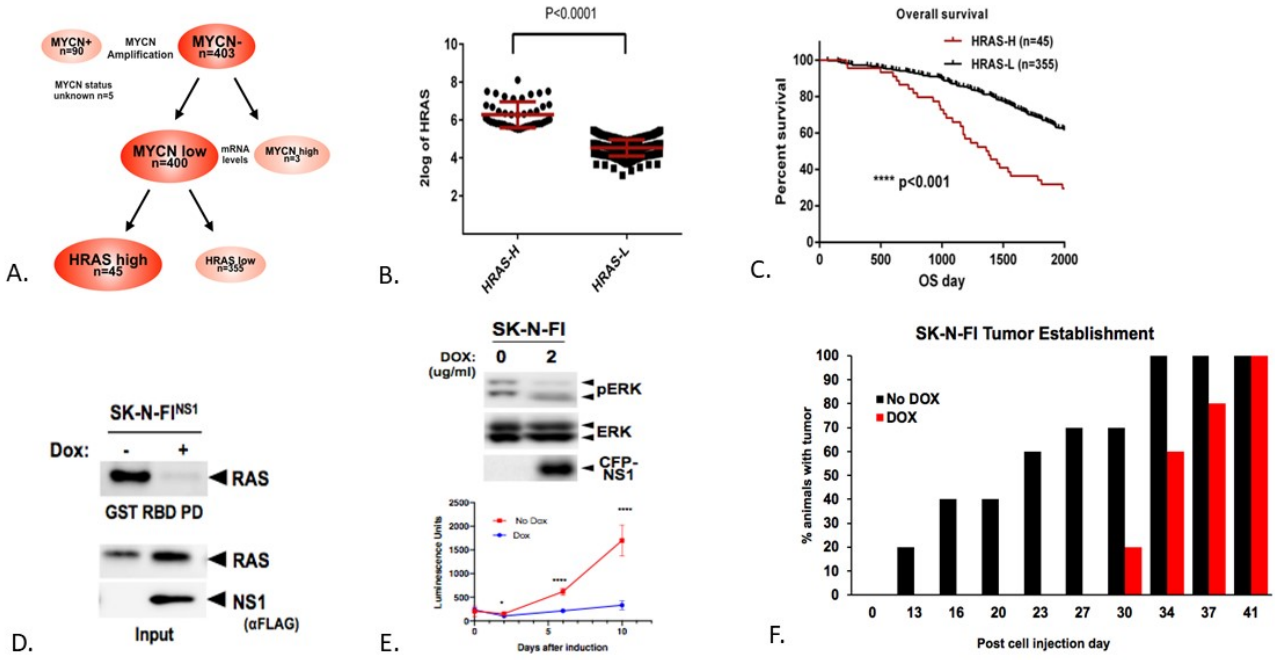

Figure 1. (A) Selection of patients from GSE62564 dataset with non-MYCN amplified, low MYCN and high HRAS expression NBL tumors. (B) Plot of log2 expression of *HRAS* in the MYCN-, low *MYCN* expression cohort. (C) Overall survival of the *HRAS* high vs *HRAS* low cohort. Patients with high *HRAS* expression exhibited significantly worse overall survival compared to those with low *HRAS* expression. (D) SK-N-FI cells with stable doxycycline (DOX)-inducible NS1 expression were treated +/-DOX for 2 days then lysed. Equivalent amounts of lysate were incubated with GST-RAF RBD to pulldown active RAS (top panel). Total RAS input and NS1 expression shown in bottom 2 panels. NS1 expression decreased RAS GTP levels. (E) Expression of NS1 inhibited pERK levels in SK-N-FI cells and NS1 expression reduced proliferation of SK-N-FI cells. (F) Days to tumor establishment, demonstrating longer time for tumor establishment in animals injected with SK-N-FI-NS1 cells and treated with DOX.

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HUMAN AMNIOTIC FLUID STEM CELL DERIVED EXTRACELLULAR VESICLES RESTORE BRANCHING MORPHOGENESIS AND EPITHELIAL PROGENITOR CELLS IN A NOVEL MODEL OF HUMAN PULMONARY HYPOPLASIA

Kasra Khalaj, PhD, MSc[1], Rebeca Figueira[1], Lina Antounians, MSc[2], Augusto Zani[2]

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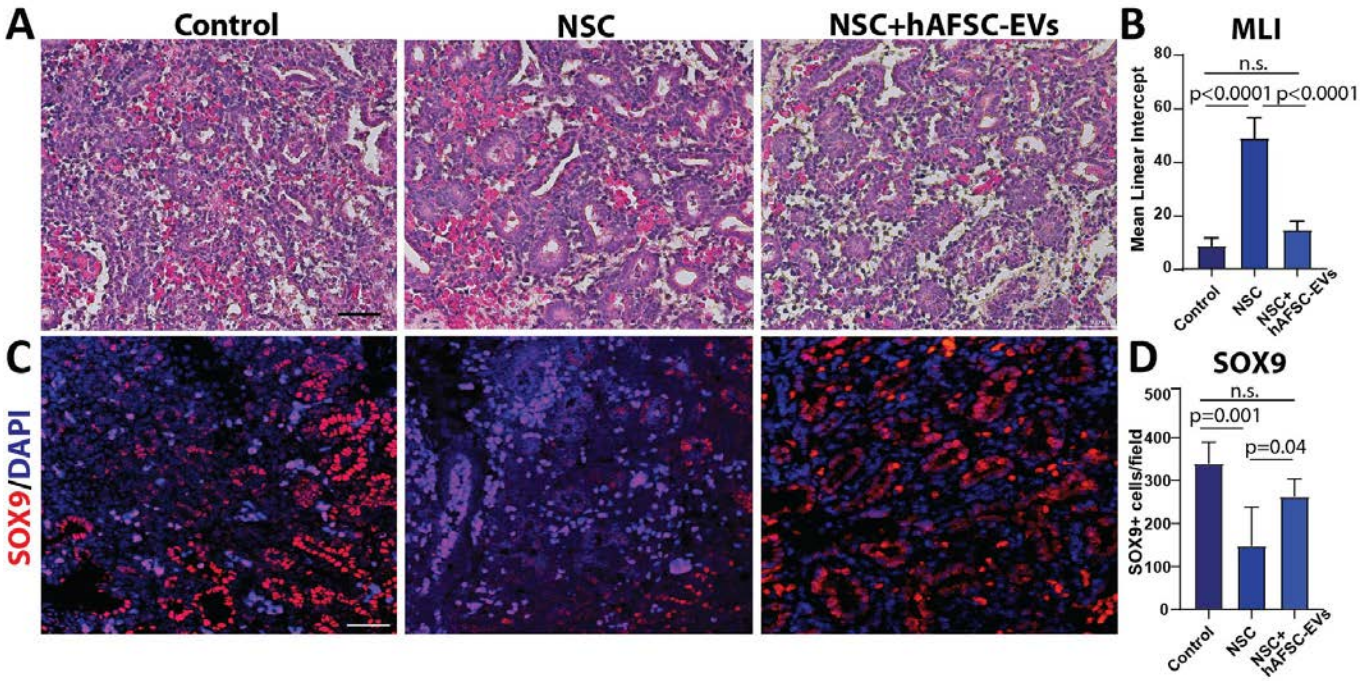
Purpose
Pulmonary hypoplasia secondary to congenital diaphragmatic hernia (CDH) is characterized by decreased airway branching morphogenesis and immature epithelium. We recently showed that administration of extracellular vesicles derived from rat amniotic fluid stem cells (rAFSC-EVs) rescues lung growth and maturation in the nitrofen rat model of CDH. Herein, we assessed whether EVs derived from human AFSCs (hAFSC-EVs) could restore branching and epithelial progenitor cells in a novel human fetal lung explant model.

Methods
hAFSC-EVs: hAFSCs were obtained under Good Manufacturing Practice guidelines and EVs isolated from hAFSC conditioned medium using ultracentrifugation.
Human lung explants: following approval (REB:#10-0128-E), left lower lobe samples were harvested from two medical terminations conducted at 18 and 19 weeks of gestation (canalicular stage). 1-2mm3 pieces were cultured separately at air-liquid interface and treated with NSC23766 (RAC-1 inhibitor) at 0h and 24h to induce pulmonary hypoplasia. Explants were treated with medium alone (NSC group) or hAFSC-EVs at 48h and 72h and harvested at 96h (NSC+hAFSC-EV group). Untreated explants served as control.
Outcome measures: 1) airway branch density (hematoxylin/eosin) using mean linear intercept (MLI; stereological method to estimate the mean free distance between lung gas exchange surfaces, recommended by ATS); 2) distal airway epithelial progenitor cell (SOX9) density (immunofluorescence). Groups were blindly compared and analyzed using One-way ANOVA.

Results
Compared to control, NSC23766-injured explants had lower RAC1 levels (p=0.03), airway branch and SOX-9+ cell density (Figure). Conversely, hAFSC-EV-treated hypoplastic fetal lung explants had airway branching and SOX9+ cell expression similar to control (Figure).

Conclusion
This is the first study to describe a novel model of pulmonary hypoplasia in human fetal lungs at canalicular stage and demonstrate that administering extracellular vesicles derived from human amniotic fluid stem cells restores branching morphogenesis and epithelial progenitor cells. Extracellular vesicles are a promising cell-free therapy for fetuses with CDH and hypoplastic lungs.


A
Control
NSC
NSC+hAFSC-EVs
B
MLI
n.s.
p<0.0001
p<0.0001
Mean Linear Intercept
80
60
40
20
0
Control
NSC
NSC+ hAFSC-EVs
C
SOX9/DAPI
D
SOX9
n.s.
p=0.001
p=0.04
SOX9+ cells/field
500
400
300
200
100
0
Control
NSC
NSC+ hAFSC-EVs

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INDUCTION OF SHMT2 PROMOTES TUMORIGENESIS IN HIGH-RISK NEUROBLASTOMA

Rachael A. Clark, MD, Dai H. Chung, MD, Jingbo Qiao, PhD, Sora Lee, PhD

UTSW, Dallas, TX, USA

Purpose

The high-risk group of neuroblastoma (NB) remains very difficult to cure with < 50% overall survival. It is associated with MYCN gene amplification. Serine metabolism is affected in a myc-dependent manner by the mitochondrial enzyme SHMT2 (serine hydroxyl-methyltransferase 2), which is upregulated in several cancers and is associated with tumor aggressiveness. We have previously demonstrated that SHMT2 expression is associated with MYCN amplification in patients with NB and that SHMT2 silencing regulates N-myc at the post-transcriptional level via decreased activation of Akt-2. However, the exact functional role of SHMT2 in NB tumor behavior is relatively unknown.

Methods

Two human NB cell lines were examined: a MYCN amplified cell line, BE(2)-C, and a non-MYCN amplified cell line, SK-N-AS. SHMT2 silencing and overexpression were performed using the transfection of shRNA (shSHMT2 and shCTL) and p-coSHMT2 plasmid, respectively. Cellular proliferation was measured using a CCK-8 assay. Cell migration was examined by scratch test assay. Colony counts were performed after 7 days.

Results

SHMT2 silencing decreased cellular proliferation in both cell lines. Conversely, SHMT2 over-expression increased cellular proliferation compared to control. SHMT2 overexpression led to an increased colony count, while SHMT2 silencing decreased colony formation. Wound healing capacity, as measured by cell migration assay, was significantly greater in the SHMT2 overexpressing NB cells and impaired in the SHMT2-silenced cell lines, compared to control.

Conclusions

SHMT2 plays an important role in NB tumorigenesis by contributing to cell growth, migration, and colony formation in vitro. Our results suggest that SHMT2 may serve as a potential therapeutic target for patients with high-risk NB.

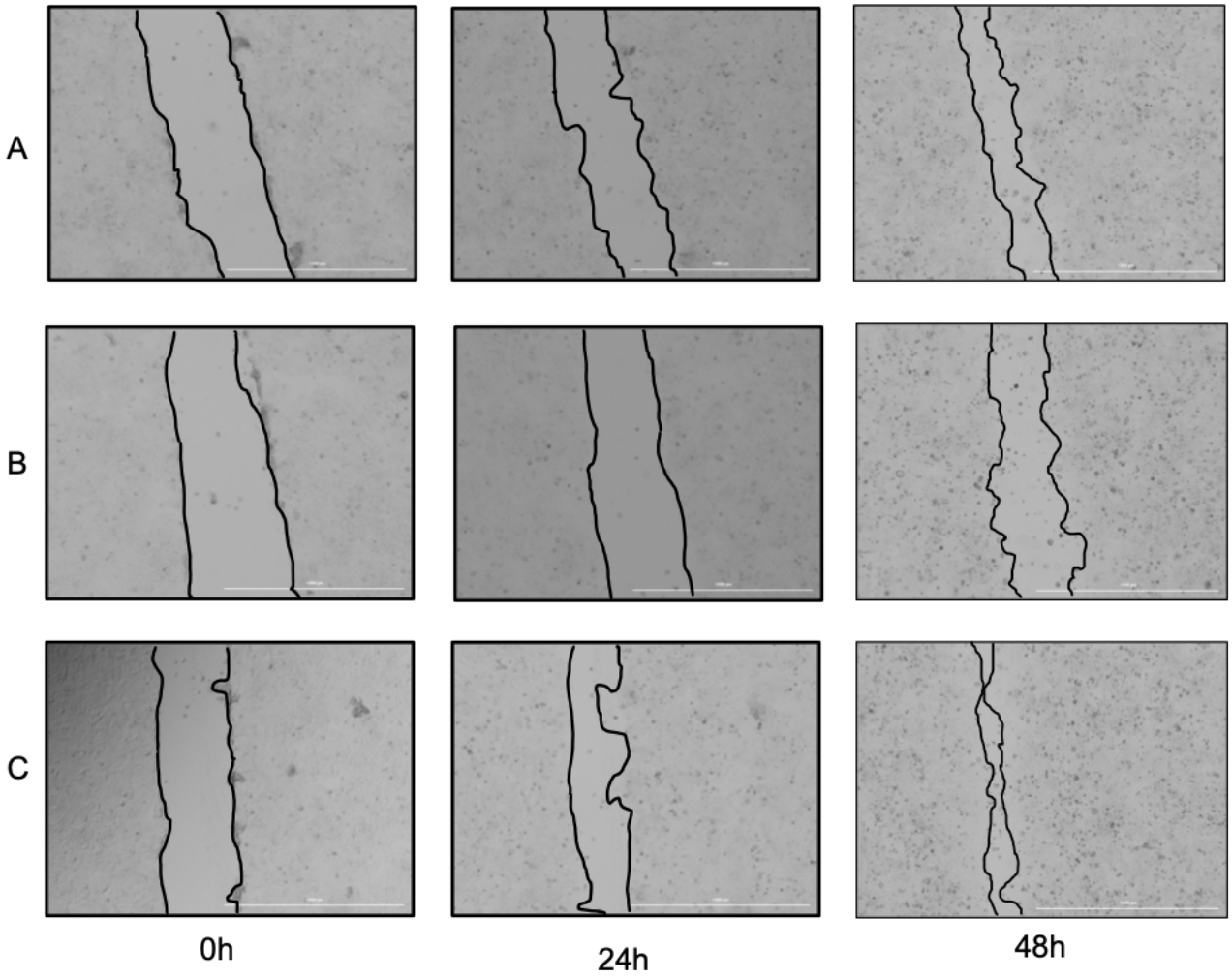

Figure 1: SHMT2 induction enhances cellular migration. Scratch Test assay performed on transfected SK-N-AS cells plated in 6-well dish at 100% confluency. Images obtained at 0, 24 and 48 hours after wound creation. A) Cellular migration of control cells. B) Decreased cellular migration of SHMT2 silenced cells at 24 and 48 hours. C) SHMT2 overexpression demonstrating increased cellular migration at 24 and 48 hours compared to control.

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ONCOLYTIC HERPES SIMPLEX VIRUS EFFECTIVELY TARGETS AND KILLS NEURAL CREST PATIENT-DERIVED XENOGRAFTS

Colin H. Quinn, BS[1], Raoud Marayati, MD[1], Laura V. Bownes, MD[1], Jamie Aye[2], Jerry E. Stewart, BS[1], Elizabeth Mroczek-Musulman[2], Karina J. Yoon, PhD[3], Elizabeth A. Beierle, MD[1]

[1]Division of Pediatric Surgery, Department of Surgery, University of Alabama at Birmingham, Birmingham, AL, USA, [2]Children's Hospital of Alabama, [3]University of Alabama at Birmingham, Birmingham, AL, USA

Purpose

Childhood neural crest-derived tumors include neuroblastoma and neuroendocrine tumors (NETs). Patients with high-risk neuroblastoma and NETs with unknown primaries continue to have a dismal survival, and innovative therapies are desperately needed. Oncolytic herpes simplex viruses (oHSV) have shown efficacy in other tumor types and we have demonstrated their efficacy in long-term passage neuroblastoma cell lines. This study aimed to determine the efficacy of oHSV in neural crest patient-derived xenografts (PDXs), a crucial next step before advancing to clinical trials.

Methods

PDXs were established from four patient tumors: two high-risk neuroblastoma, one MS neuroblastoma, and one NET. M002, a genetically engineered oHSV with deletions in both copies of the γ134.5 gene and an insertion of a murine IL-12 producing gene, was employed. Cell surface expression of the viral entry receptors CD111, CD112, syndecan, and herpesvirus entry mediator (HVEM) was detected by flow cytometry. Single step and multi-step viral recovery assays assessed viral production and replication rates, respectively. IL-12 production following M002 infection was determined using ELISA. Cytotoxicity of M002 was measured with alamarBlue® reagent.

Results

All PDXs expressed CD111, CD112, syndecan, and HVEM. At a multiplicity of infection (MOI) of 10 plaque forming units (PFU)/cell, the viral titer increased in all PDXs. Replication rates were highest in the NET and greater in high-risk than MS neuroblastoma. Significant IL-12 production was seen with an MOI of 0.1 PFU/cell in high-risk neuroblastoma and the NET. At an MOI of 1 PFU/cell, M002 significantly decreased cell viability by at least 50% in all PDXs (Figure 1).

Conclusions

M002 effectively replicated within and killed neural crest-derived PDX cells, which coincided with expression of viral entry receptors. These findings validate M002's capacity to infect pediatric neural crest-derived tumors and produce anti-tumor immune cytokines, suggesting the potential for translation of this therapy into the clinical arena.

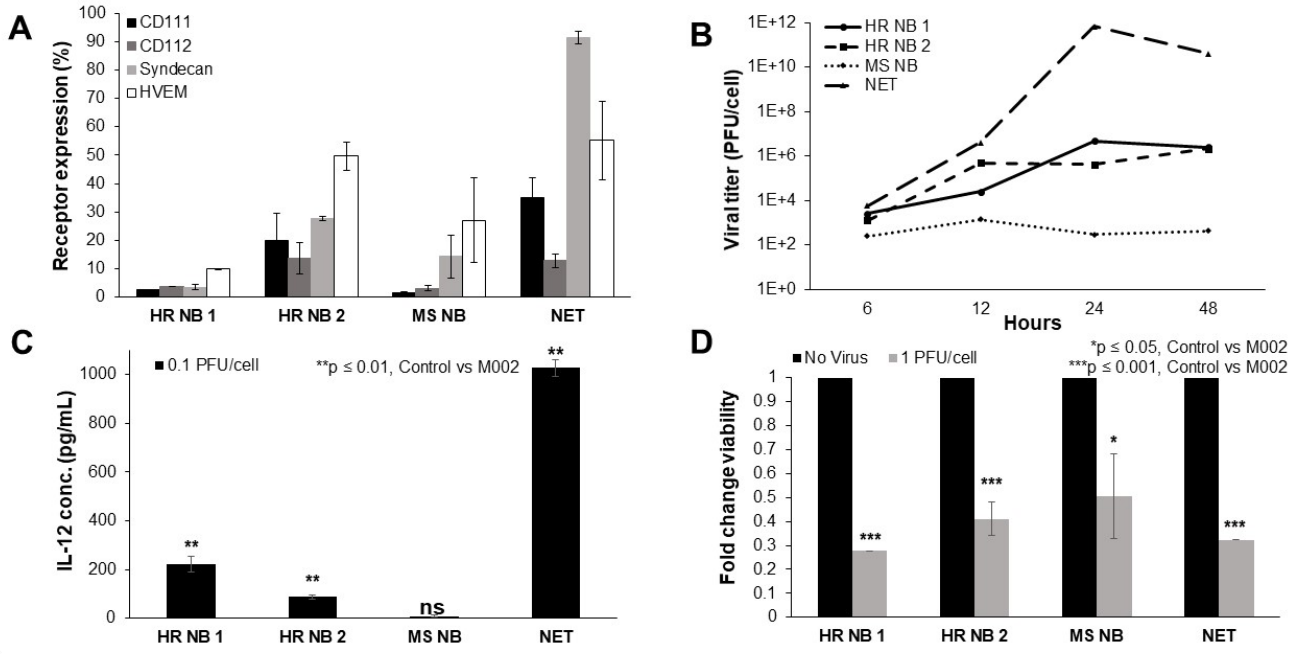

Figure 1. A) There was notable cell surface expression of the four viral receptors in each PDX (HR: High-risk; NB: Neuroblastoma). **B)** The production of IL-12 was significant in the NET and high-risk neuroblastoma. **C)** Viral replication increased over time as shown in the multi-step analysis. **D)** M002 significantly decreased PDX tumor cell viability in all lines at 1 PFU/cell.

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PROTEIN PHOSPHATASE 2A ACTIVATION DECREASES TUMORIGENICITY IN NEUROBLASTOMA PATIENT DERIVED XENOGRAFTS

Laura V. Bownes, MD[1], Raoud Marayati, MD[1], Colin H. Quinn, BS[1], Andee Beierle, BS[2], Jerry E. Stewart, BS[1], Michael Ohlmeyer, PhD[3], Elizabeth A. Beierle, MD[1]

[1]Division of Pediatric Surgery, Department of Surgery, University of Alabama at Birmingham, Birmingham, AL, USA, [2]Division of Pediatric Surgery, Department of Surgery, University of Alabama at Birmingham, [3]Icahn School of Medicine at Mount Sinai

Purpose

Protein Phosphatase 2A (PP2A) is a known tumor suppressor that has been found to be down-regulated in multiple cancers. Our laboratory has previously shown that PP2A activation decreased the malignant phenotype in neuroblastoma long-term passage cell lines. Patient-derived xenografts (PDXs) are thought to more closely recapitulate the human condition as they retain the original tumor histology and gene expression. To adequately investigate PP2A activating compounds in the pre-clinical setting, we wished to determine the effects of two novel PP2A activators, ATUX-792 (792) and DBK-1154 (1154), on human neuroblastoma PDXs.

Methods

Three human neuroblastoma PDXs (PDX3, PDX6, PDX129) were utilized. PDX cells were treated with increasing doses of 792 or 1154 for 24 hours, and proliferation and viability were investigated using CellTiter96® and alamarBlue® assays, respectively. To study cell motility, PDX129 cells were treated with 792 or 1154 for 24 hours and allowed to migrate through a Transwell® membrane for 7 days. Extreme limiting dilution analysis was utilized to assess the effect of treatment on tumorsphere formation, a measure of cancer cell stemness

Results

Proliferation of PDX3, PDX6, and PDX129 (figure A, B) was significantly decreased following treatment with 792 or 1154. Viability was significantly decreased following 5μM treatment in PDX3 (792: 61 ± 6%, 1154: 49 ± 2%, $p \leq 0.001$) and PDX6 (792: 75 ± 8%, $p \leq 0.05$; 1154: 40 ± 0.1%, $p \leq 0.001$) and 2μM treatment in PDX129 (792: 68 ± 3%, 1154: 35 ± 6%, $p \leq 0.001$). Treatment of PDX129 with 792 or 1154 significantly decreased the ability of cells to migrate (figure C) and form tumorspheres (figure D).

Conclusion

The novel PP2A activators, 792 and 1154, decreased tumorigenicity and stemness in neuroblastoma PDXs. These findings indicate the potential for these novel PP2A activators to serve as potential therapeutic agents in neuroblastoma.

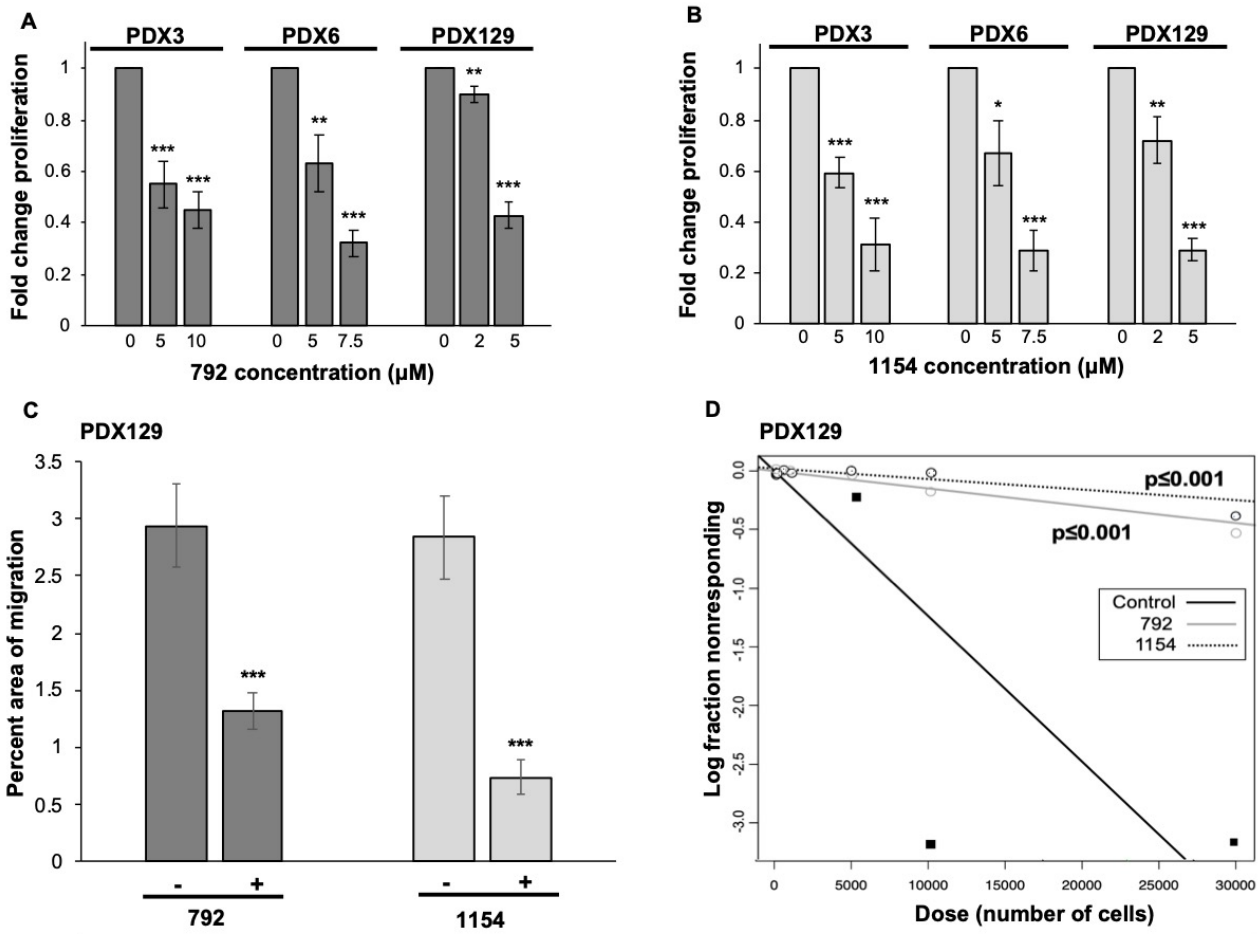

Figure 1. Protein phosphatase 2A (PP2A) activation decreases tumorigenicity in neuroblastoma patient-derived xenografts. PP2A activation with (**A**) 792 or (**B**) 1154 decreases proliferation in three neuroblastoma patient-derived xenografts. Treatment of PDX129 with 792 or 1154 resulted in (**C**) decreased migration and (**D**) decreased ability to form tumorspheres. *p≤0.05, **p≤0.01, ***p≤0.001

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WHAT'S WRONG WITH HYPOPLASTIC LUNGS OF FETUSES WITH CONGENITAL DIAPHRAGMATIC HERNIA? TRANSCRIPTOMIC PROFILING OF THE PULMONARY EPITHELIUM FROM FETAL HYPOPLASTIC LUNGS

Lina Antounians, MSc, Huayun Hou, Cadia Chan, Michael Wilson, Augusto Zani

The Hospital for Sick Children, Toronto, ON, Canada

Purpose

In congenital diaphragmatic hernia (CDH), a hallmark of pulmonary hypoplasia is the impairment in epithelial homeostasis, characterized by reduced cell proliferation and differentiation. Several studies reported individual factors involved in the pathogenesis of pulmonary hypoplasia, but a comprehensive analysis of the responsible signaling pathways is missing. Herein, we profiled the gene expression of fetal lung epithelium using an experimental model of CDH.

Methods

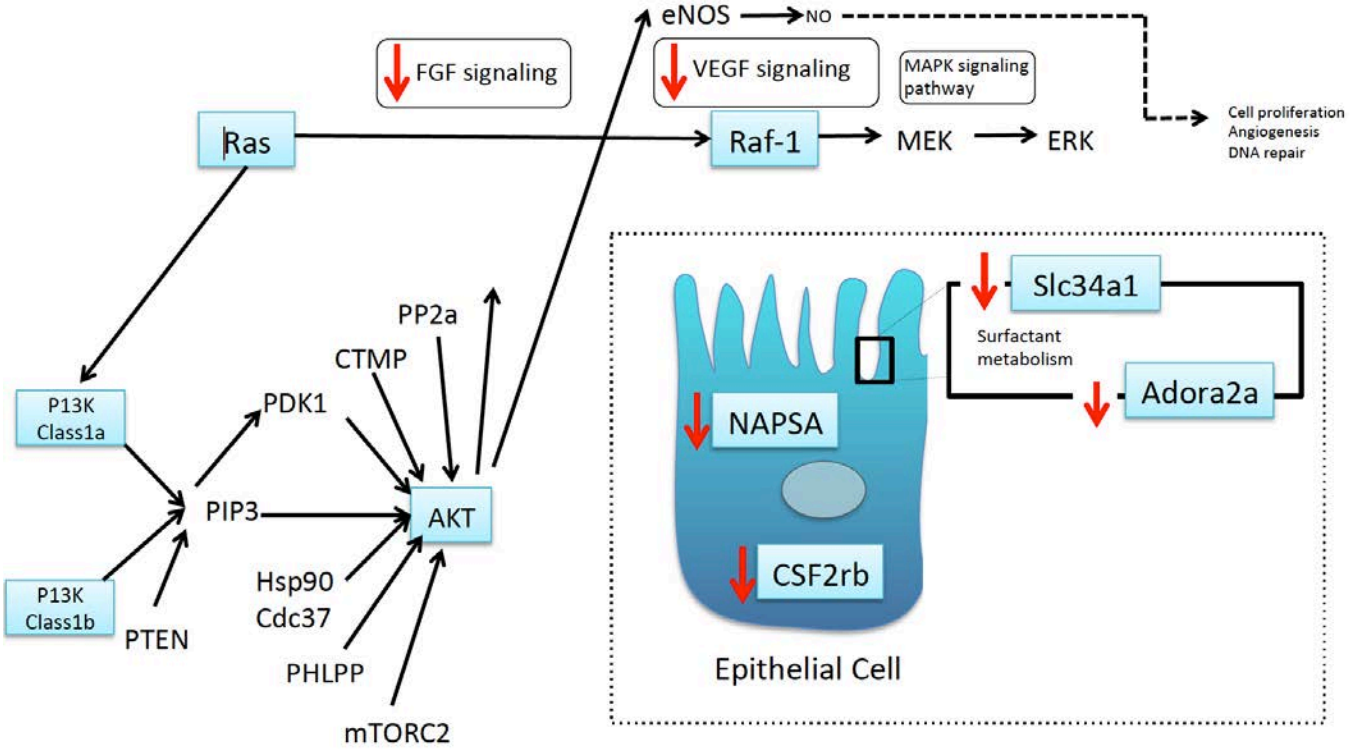
Following ethical approval (protocol #49892), at embryonic day (E) 9.5 dams were gavaged with either nitrofen to induce CDH or olive oil (control). At E14.5, lung epithelial cells were isolated from hypoplastic lungs nitrofen-injured (n= 6) or control (n= 6) fetuses. Total RNA was isolated using NucleoSpin RNA kit. Paired-end sequencing libraries were prepared with NEBNext RNA kit and sequenced using the Novaseq S2 flowcell. Differentially expressed mRNAs were identified using DESeq package (FDR < 0.01). gProfiler was used for gene set enrichment analysis to compare mRNA with log fold change >2 between nitrofen-exposed vs. control fetal lung epithelial cells.

Results

Nitrofen exposure altered the expression of 983 (661 down-regulated and 322 up-regulated) genes in fetal lung epithelial cells compared to control. Dysregulated genes were enriched for signaling pathways responsible for airway branching morphogenesis, surfactant metabolism, and vasculogenesis, such as Ras (p >0.0001), Rap1 (p >0.0004), and PI3K-Akt (p >0.0001; Figure). Gene set enrichment analysis showed that collectively these dysregulated genes enriched for Gene Ontology terms: epithelial cell differentiation (p= 6.9x10-6), proliferation (p= 2.3×10-2), and cell migration (p= 2.3×10-2).

Conclusions

This study links together for the first time the dysregulated factors in the epithelium and the signaling pathways that contribute to pulmonary hypoplasia secondary to CDH. This implies that an ideal therapy for babies with CDH should address these pathways to effectively improve the morphology and function of the hypoplastic lungs.


eNOS
NO
FGF signaling
VEGF signaling
MAPK signaling pathway
Ras
Raf-1
MEK
ERK
Cell proliferation
Angiogenesis
DNA repair
PP2a
CTMP
P13K Class1a
PDK1
PIP3
AKT
P13K Class1b
PTEN
Hsp90
Cdc37
PHLPP
mTORC2
Slc34a1
Surfactant metabolism
Adora2a
NAPSA
CSF2rb
Epithelial Cell

Scientific Session 2 - Education, Advocacy, DEI, General Surgery

6:00 PM – 8:00 PM

P7

THE PEDIATRIC SURGERY MATCH FROM THE APPLICANT PERSPECTIVE

Jonathan Roach, MD[1], S Chistopher Derderian, MD[2], Jill Ketzer, BS[2], Michael Benge, MHA[2], Alexander Kaizer, PhD[3], Andrea Bischoff, MD[4]

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Purpose

The fellowship application and interview process is bi-directional whereby both applicants and programs evaluate each other seeking the best match. Previous publications have highlighted applicant attributes associated with matriculation but none have delved into priorities applicants use to evaluate training programs.

Methods

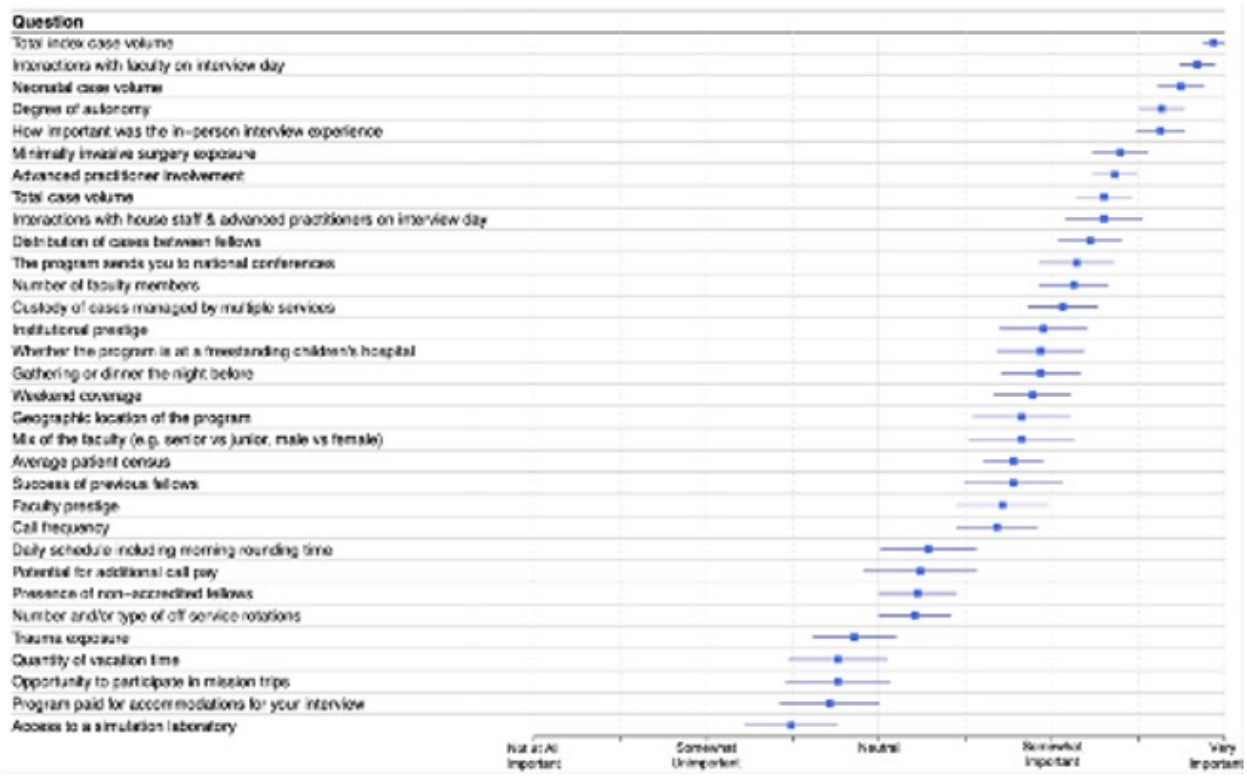
Those who applied for a fellowship position between 2018 and 2020 at our institution and matched during the same cycle were identified. Eligible participants were emailed a 49-question survey querying the importance they placed on specific program attributes when evaluating training programs. Responses between those who matched in their top three were compared to those who matched out of their top three.

Results

There were 130 eligible participants and 63 (48%) completed the survey. A summary of select survey responses is presented in the Figure. Number of index cases was considered to be very important to 94% of applicants. Neonatal case volume and interaction with faculty on interview day were also considered to be very important to a majority of applicants. Access to a simulation center and ability to participate in a mission trip were considered somewhat unimportant or not at all important to >40% of participants. Eighty-nine percent of participants made significant changes to their rank list after completing interviews, and 76% preferred an in-person interview over a virtual one. Those who matched into one of their top three choices put less emphasis on institutional and faculty prestige, success of previous fellows, and advanced practitioner involvement, compared to those who matched lower on their rank list.

Conclusion

These data identify training program attributes applicants consider important. Programs should highlight their strengths that align with applicant’s interests during the application and interview process.


Question
Total index case volume
Interactions with faculty on interview day
Neonatal case volume
Degree of autonomy
How important was the in-person interview experience
Minimally invasive surgery exposure
Advanced practitioner involvement
Total case volume
Interactions with house staff & advanced practitioners on interview day
Distribution of cases between fellows
The program sends you to national conferences
Number of faculty members
Custody of cases managed by multiple services
Institutional prestige
Whether the program is at a freestanding children's hospital
Gathering or dinner the night before
Weekend coverage
Geographic location of the program
Mix of the faculty (e.g. senior vs junior, male vs female)
Average patient census
Success of previous fellows
Faculty prestige
Call frequency
Daily schedule including morning rounding time
Potential for additional call pay
Presence of non-accredited fellows
Number and/or type of off service rotations
Trauma exposure
Quantity of vacation time
Opportunity to participate in mission trips
Program paid for accommodations for your interview
Access to a simulation laboratory
Not at All Important
Somewhat Unimportant
Neutral
Somewhat Important
Very Important

P8

IS THE CHANGING LANDSCAPE OF FELLOWSHIP RECRUITMENT DURING COVID-19 IN PEDIATRIC SURGERY FELLOWSHIP HERE TO STAY?

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Background

The 2020 PS fellowship recruitment was complicated by restrictions related to COVID-19, requiring many programs to rapidly transition to virtual interviews. The purpose of this study was to evaluate the perception of virtual interviews by PD and applicants of PS fellowship programs.

Methods

Data was obtained using 28-question surveys of PS fellowship PDs and 44-question surveys of PS fellowship applicants in the US and Canada. Dichotomous, multiple choice and open-ended questions about changes in process, virtual platforms, interview format, comparison to on-site interviews, and overall satisfaction with the virtual process were used for objective and subjective feedback.

Results

95% participation was recorded for the PD survey. 24 out of 55 programs (44%) changed their on-site interviews to virtual format. Most PDs (66%, 16/24) described their overall impression of the virtual format as satisfactory. Majority of PDs felt the virtual process did not impact the applicant's success in the match and did not affect the final rank list. However, many PDs (18/24) also reported they did not get to know applicants as well or observe their interactions with others. Half of PDs preferred to have on-site interviews with virtual screening in the future. Zoom was the preferred platform for 18/24 programs and all applicants. While applicant participation was lower (26/70, 37%), results were similar. 61% of applicants preferred on-site interviews alone (11/18) and 6 preferred virtual screening with on-site interviews. Applicants reported greatest hardship during on-site interviews on coworkers/program as well as financially with an average cost of $7016.67 ($1500-15,000).

Conclusion

COVID-19 forced a sudden change in the PS recruitment process. Although the virtual interview was acceptable, many preferred in-person interviews or a hybrid approach. The virtual process offered benefits in terms of time, stress, and expense. This experience should help to guide changes in interview structure to optimize the experience for all participants.

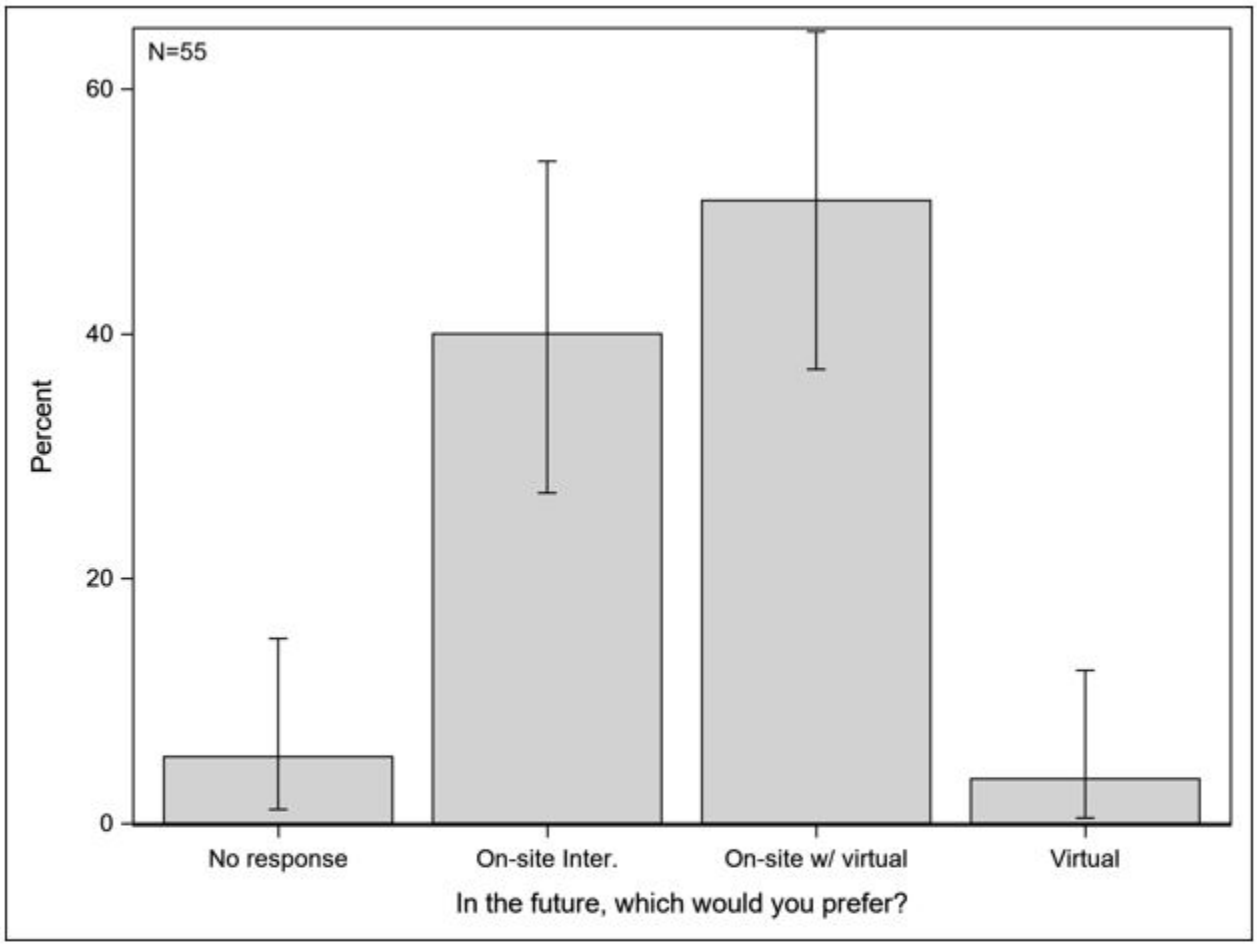

Figure. Program Directors' Future Interview Preference

Most respondents chose 'On-site w/ virtual screening' (28/55 or 50.9%; 95% CI: 37.1%, 64.7%) with 'On-site interview' as a close second (22/55 or 40.0%; 95% CI: 27.0%, 54.1%). Only 3.64% (2/55; 95% CI: 0.44%, 12.5%) chose 'Virtual interview alone'.

P9

AWARENESS OF BOTH POSITIVE AND NEGATIVE ASPECTS OF PARENTAL MENTAL HEALTH IN A LEVEL IV NICU

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Introduction

While Neonatal Intensive Care Unit (NICU) parents are frequently described as under great stress, there is little objective data on their mental health profile. This report summarizes a prospective acquisition of both negative mental health concerns and positive psychological characteristics in NICU parents.

Methods

NICU parents of children requiring greater than a two-week NICU stay were enrolled. Parents completed seven validated psychological instruments, including the Center for Epidemiological Studies-Depression Scale (CES-D), Parental Stressor Scale: NICU, Stanford Acute Stress Questionnaire, The Brief COPE Inventory, Psychological Well-Being Scale and Quality of Life Inventory.

Results

One hundred thirty-nine families completed all the measures. Seventy parents reported that their child was unplanned, and 95 children were born premature. Eight-five parents rated the overall NICU experience as “very” to “extremely” stressful. Seventy-five parents endorsed clinical levels of depression (> 16 on CES-D). Parents endorsing depressive symptoms were also more likely to endorse clinical levels of acute stress disorder (ASD) ($p < .001$). Parents used emotion-focused coping significantly more than problem-focused coping ($p < .001$). In terms of psychological well-being, the highest endorsement of mastery was reported for personal growth, while the lowest was for environmental mastery. The overall quality of life was surprisingly high, with only 12.8 % falling in the Very-Low or Low category.

Conclusion

Our prospective study provides a unique, comprehensive psychological profile of NICU parents. It confirmed that NICU parents demonstrate significant stress, high levels of depression and common ASD symptomatology. Surprisingly it also demonstrated that parents exhibit a number of psychological strengths, which may enhance resilience and balance the stress of a NICU stay. Pediatric surgeons should be aware of these complex parental mental health issues and facilitate psychological interventions when needed, which may benefit not only the parents but potentially their infants as well.

P10

IMPROVING SATISFACTION, COMPREHENSION, AND APPREHENSION IN PEDIATRIC SURGICAL POPULATIONS: THE USE OF COMPREHENSIVE CHILDREN'S BOOKS

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Purpose

Pediatric surgery generates high anxiety and stress for children and caregivers which can have a direct negative effect upon patient health and outcomes and adversely affect informed consent. We assessed whether use of educational, illustrated children's books would improve comprehension, satisfaction, and anxiety of caregivers.

Methods

A prospective randomized trial was initiated at a tertiary care children's hospital. All pediatric patients (≤ 18 years old) with caregiver present and diagnosis of 1) uncomplicated appendicitis (English or Spanish speaking); 2) pyloric stenosis; 3) need for a gastrostomy tube; or 4) umbilical hernia were eligible. Conventional consent was obtained followed by a validated survey with 17 questions addressing apprehension, satisfaction, and comprehension. Randomization (2:1) occurred after consent and prior to operative intervention with the experimental group (EG) receiving an illustrated comprehensive children's book outlining anatomy, pathophysiology, hospital course, and postoperative care (Figure 1). A second identical survey was completed prior to discharge. Primary outcomes were caregiver apprehension, satisfaction, and comprehension.

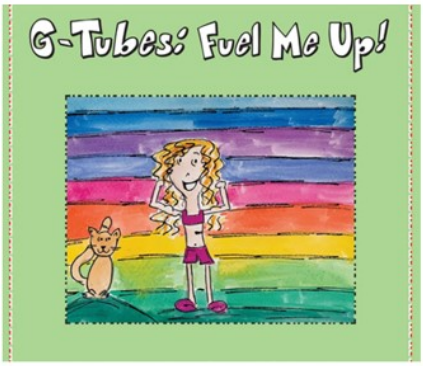
Results

A total of 31 caregivers were included; 20 in the EG and 11 in the control group (CG). There were no significant differences in patient or caregiver demographics between groups. Most of the patients had appendicitis (54.6% CG; 75.0% EG) followed by need for gastrostomy tube (27.3% CG; 15.0% EG). The baseline survey demonstrated no difference in comprehension, satisfaction, or apprehension between the EG and CG groups (all p-values NS). After the intervention, the EG had significant improvement in 11 out of the 17 questions in comparison to the CG. When tabulated by content, there was a significant improvement in questions that addressed comprehension ($p = 0.05$), satisfaction ($p = 0.0001$), and apprehension ($p < 0.0001$).

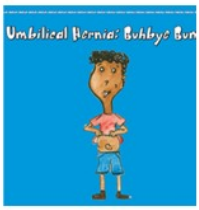
Conclusion

The use of illustrated, educational children's books to explain pathophysiology and surgical care may improve comprehension, satisfaction, and anxiety of caregivers. This could benefit informed consent, patient understanding, and postoperative outcomes.


Appendicitis: One Angry Worm


G-Tubes: Fuel Me Up!


Pyloric Stenosis:
That Time My Stomach Flexed


Umbilical Hernia: Bubbye Bur

P11

THE EVOLVING EFFECTIVENESS OF BIOLOGICS IN AVOIDING SURGERY IN CHILDREN WITH ULCERATIVE COLITIS

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Purpose

Pediatric ulcerative colitis (UC) treatment has changed dramatically with the introduction of multiple biologics in recent years. The purpose of this study was to assess effectiveness of biologic agents in achieving remission and incidence of surgery.

Methods

We retrospectively analyzed UC patients that were seen at gastroenterology clinic between January 2012-August 2020. We analyzed demographic characteristics, colonoscopy, clinic and hospital records. Patients were divided into four groups: 1) patients treated medically without biologics or surgery; 2) patients treated with one biologic; 3) patients treated with multiple biologics; and 4) patients that underwent colectomy. Pearson Chi-square test was used to analyze statistically significant factors.

Results

There were 115 patients with UC with a mean follow-up of 5.9±3.7 years(1 mo-15.3 yrs.). On initial colonoscopy, there were 25 patients(21.7%) with mild, 51 patients(44.3%) with moderate and 22 patients(19.1%) with severe colitis. Initial colonoscopy records were not available for the remaining 17 patients. There were 48(41.3%) in group 1 with 54.1% remission, 34(29.6%) in group 2 with 55.8% remission, 24(20.8%) in group 3 with 29.2% remission and only nine(7.8%) in group 4 with 100% remission. Statistically significant factors for avoidance of biologic therapy were mild(p=0.002) or moderate(p=0.024) Pediatric Ulcerative Colitis Activity Index(PUCAI) score at diagnosis, pancolitis(p=0.001) or gross mild disease(p=0.04) on initial colonoscopy. Patients in group 3 were more likely to have left-sided disease(p=0.05) and were less likely to have remission(p=0.04) compared to group 2. Group 2 or 3 patients with severe colitis on initial colonoscopy pathology were statistically less likely to have remission(p=0.003). Patients requiring surgery were statistically more likely to have history of smoking(p=0.03), severe PUCAI(p=0.004) and achieve remission(p=0.003) as compared to patients without surgery.

Conclusions

New biologics are changing the landscape in maintaining remission from ulcerative colitis. The modern need for surgical intervention is much lower than prior published studies.

P12

REDUCTION OF SURGICAL SITE INFECTIONS IN PEDIATRIC PATIENTS WITH COMPLICATED APPENDICITIS: UTILIZATION OF ANTIBIOTIC STEWARDSHIP PRINCIPLES AND QUALITY IMPROVEMENT METHODOLOGY

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Background

Obtaining peritoneal fluid cultures at the time of appendectomy is an uncommon practice. Due to a high organ space infection (OSI) rate for complicated appendicitis (CA), we implemented a care bundle that included obtaining intraoperative cultures, hypothesizing that the data gathered would help tailor antibiotic choice and reduce post-operative OSI.

Methods

The bundle (intervention) implemented for CA included administration of parenteral piperacillin/tazobactam (given minimum of 72 hours post-operatively), obtaining intra-operative peritoneal fluid cultures, and using culture data to tailor in-hospital parenteral and discharge oral antibiotics. We compared outcomes to a pre-intervention cohort who empirically received post-operative piperacillin/tazobactam, with no specific minimum duration of therapy, and amoxicillin/clavulanate at discharge.

Results

During the fifteen month pre-intervention period, sixty-six children underwent appendectomy for CA compared to 39 patients in 9 months post-intervention. None of the pre-intervention patients had intraoperative cultures compared to 95% of the post-intervention patients. Culture results altered the choice of oral antibiotics in 14 of 37 patients (38%): 8 Pseudomonas, 5 multi drug-resistant E. coli, and 1 Citrobacter. In comparing the two time periods, we saw a trend towards decreased post-operative OSI (25.4% pre versus 10.2% post, p=0.056, Figure). All-cause morbidity (surgical site infection, emergency department visit, or readmission to hospital) decreased significantly from 33.3% to was 10.2% (p=0.008). Post-intervention there were no readmissions; all patients who had an OSI were diagnosed before discharge. Despite a mandatory minimum duration of 72 hours of postoperative parenteral antibiotics, the median length of stay (5 vs 4 days, p=0.30) was statistically unchanged.

Conclusions

Obtaining peritoneal fluid cultures changed antibiotic therapy in 38% of patients with CA. Utilization of a care bundle for CA that included peritoneal culture was associated with improved outcomes without prolonging hospital length of stay. This simple strategy improves antibiotic stewardship and may decrease post-operative morbidity in children with CA.

29

DOES ACCESS TO CARE INFLUENCE A CHILD'S PRESENTATION WITH APPENDICITIS?

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Introduction

Racial demographic and health care coverage impact how and when patients seek care. Previous studies have documented that minority children present with higher rates of perforated appendicitis. We aimed to identify if racial and coverage disparities were associated with the timing and mechanism of appendicitis presentation.

Methods

We performed a prospective study of children (≤ 18 years old) who underwent laparoscopic appendectomy from May 2018 - September 2020. Prior to discharge, the patient's parent/guardian completed a survey focused on health care encounters within the past year. Surveys were collected using RedCap®; data were analyzed using STATA®.

Results

In total, 178 patients completed the questionnaire. The median age at appendectomy was 11 years (IQR 8, 14); 67.4% were Caucasian, 14.0% Hispanic, 9.0% African American (AA), and 5.1% identified as multiracial. More Hispanics presented with perforated appendicitis (68% vs 22-27.5% for other groups, p=0.02). We then performed a sub-analysis of survey data from patients with perforated appendicitis (n=68) to identify factors associated with this difference.
A far greater percentage of AA, Hispanic, and multiracial patients had Medicaid insurance ($p < 0.001$). All minority ethnicities were more likely to have been previously seen in the emergency room (ER) for their current symptoms prior to diagnosis than Caucasians (p=0.01, Table 1). More AAs and Hispanics also utilized the ER 2+ times in the past year (p=0.01); however, there was no difference among groups in the ability to find a child provider (p=0.66) or being able to afford a child's medications (p=0.99).

Conclusion

A greater percentage of Hispanic and AA patients utilized the ER multiple times in the year before being diagnosed with appendicitis, including been seen in the ER more than once for their appendicitis symptoms. Further studies are needed to help mitigate these missed opportunities and improve efficient health care utilization.

30

GOOD WISHES AREN'T ENOUGH: DISPARITY IN SURGICAL OUTCOMES DESPITE INSTITUTIONAL MISSION

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Purpose

The NSQIP database demonstrated worse surgical outcomes in apparently healthy African American (AA) patients as compared to white peers, with 3.43 times odds of death postoperatively. Causality is likely multifactorial, but poorly understood. Our center's Mission includes improving the health status of our rural, underserved, and relatively high population of minority patients, and training of minority physicians. We assessed pediatric surgical patients using the NSQIP Pediatric Surgical Risk Calculator (PSRC) to compare actual outcomes with those expected based on case severity and comorbidities, inclusive of stratification by risk. A secondary outcome was to assess whether care in an institution with these missions led to better outcomes for minorities than nationally reported.

Methods

Records from 2015-2018 in a single children's hospital were queried for Pediatric NSQIP inclusion criteria (Nf 2,650). PSRC variables, CPT codes, and post-operative complications within 30 days were collected and entered into the PSRC. Outcome predictions were stratified by race and compared with actual outcomes. Odds ratios with 95% confidence intervals were used to compare post-operative outcomes and receiver operator characteristics (ROC) analysis was used to estimate the accuracy of actual versus expected outcomes as estimated by area under the curve (AUC).

Results

For patients of all health categories, AA children had 2.98 times the odds of dying within 30 days after surgery (95% CI: 1.1, 8.08) as compared to white peers. Additionally, AA children had 1.76 times the odds of experiencing any complication (95% CI: 1.3, 2.39) as compared to white peers. The odds of dying were less than national data, despite including healthy and seriously ill children.

Conclusion

Minority children remained at significantly greater risk of post-operative complications and mortality. This disparity was not explained by pre-operative acuity and comorbidity. Dedicated institutional mission and focused minority physician training may improve outcomes in minority children.

31

FECAL CONTINENCE DISPARITIES IN PATIENTS WITH ANORECTAL MALFORMATIONS TREATED AT REFERRAL INSTITUTIONS FOR PEDIATRIC COLORECTAL SURGERY

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Purpose

Fecal incontinence is a problem for many patients born with an anorectal malformation (ARM) and can significantly impact quality of life. Racial, ethnic, and socioeconomic disparities have been demonstrated in many areas of pediatric healthcare, but it is unknown whether such disparities affect fecal continence in children with ARM. We sought to examine potential disparities using a multicenter specialty specific database.

Methods

We performed a multicenter retrospective study of children with ARM evaluated at sites participating in the Pediatric Colorectal and Pelvic Learning Consortium (PCPLC). The PCPLC hosts a registry of patients with colorectal and pelvic disorders, providing demographic and clinical information. We included all patients with ARM 3 years and older (2016-present). The primary outcome was fecal continence. Continence was categorized as complete (no accidents), daytime (accidents at night), partial (rare or occasional accidents), and none (completely incontinent). We evaluated for associations between fecal continence and race, sex, age, and insurance status, employing Kruskal-Wallis and trend tests. P-value < 0.05 was considered significant.

Results

A total of 509 patients with ARM from 11 institutions were included. Overall, 23% reported complete fecal continence at their first clinical evaluation after age 3 years, and continence was associated with greater age ($p < .001$). For school aged children (aged 5-10 years old) 27% reported complete continence while 53% reported none. Patients with combined private and public insurance showed higher rates of incontinence when compared to those with private insurance (85% vs. 59.9%; $p=0.02$). Associations with race and gender were not observed.

Conclusion

We observed data that suggest differences in fecal continence rates based on payor status. There were no clear disparities related to sex and race. Further investigation is needed to determine if these observations are due to access to care or other factors.

32

MANAGEMENT OF DIFFERENCES IN SEXUAL DEVELOPMENT: THE EVOLUTION OF A PRAGMATIC APPROACH FOR A RESOURCE-LIMITED SETTING

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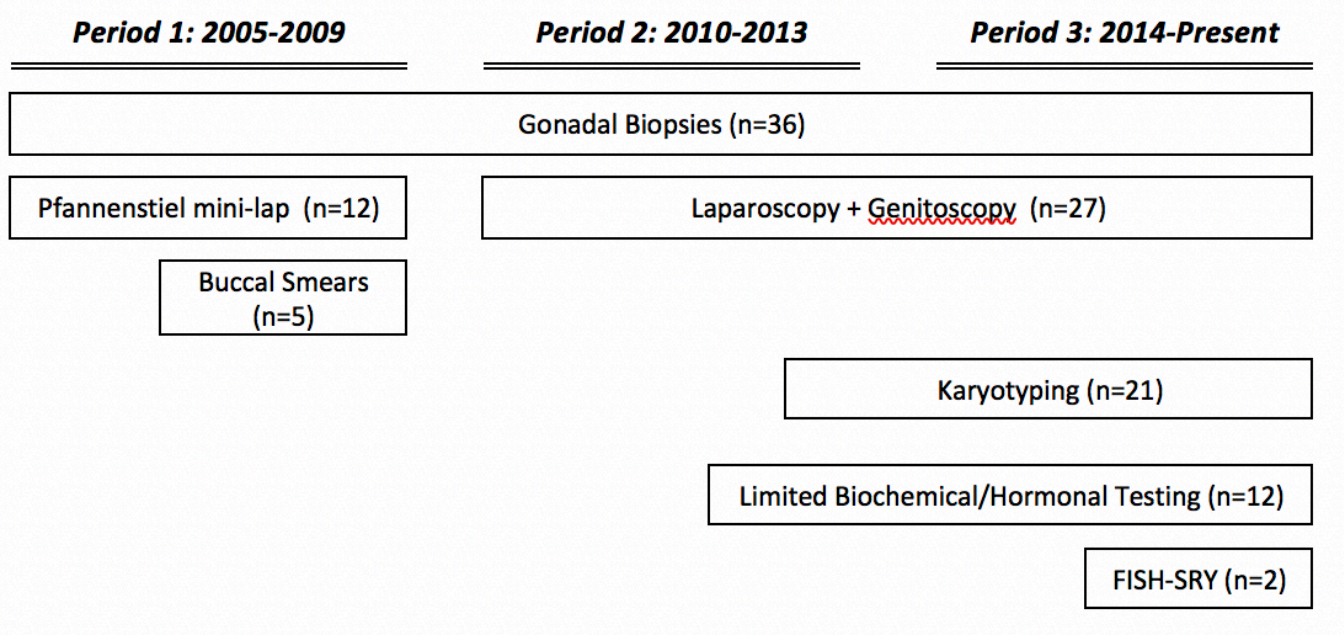
Background
The approach to diagnosis and management of patients with differences in sexual development (DSD) has been refined over the past two decades especially in high income countries (HIC). We aimed to categorize the types of DSD managed in a referral hospital in Kenya and to elucidate the evolution and development of a pragmatic approach to diagnosis and management of DSD within low and middle-income (LMIC) context.

Methodology
We conducted a retrospective chart and administrative database review of patients with DSD between January 1, 2005, and July 31, 2018. In addition to clinical findings, types and availability of diagnostic modalities were collected to identify changes over time.

Results
Forty-four patients with DSD, presenting at a median age of 6.5y (0-34y) were identified. Thirty (68%) and 14 (32%) patients had male and female gender assignments at presentation, respectively. Ovotesticular DSD was the most common clinical diagnosis (55%), followed by congenital adrenal hyperplasia (11%) and cloacal exstrophy (7%). Twenty-seven underwent gender confirming surgery. Six complications occurred in 4 patients. Diagnostic and therapeutic management was practical based on access to available resources as no patient had access to complete biochemical, radiographic and cytogenetic testing. Three periods in the evolution of DSD management were identified culminating in a pragmatic multidisciplinary team (MDT) approach that utilized minimally invasive diagnostic procedures and limited histologic, biochemical and cytogenetic testing.

Conclusion
We conclude DSD management remains a challenge in an LMIC like Kenya, but a pragmatic MDT approach is feasible.

Diagnostic Testing Modalities Available Over Time



33

UTILIZATION TRENDS AND DISPARITIES IN ADOLESCENT BARIATRIC SURGERY IN THE US 2009-2016

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Purpose

Mounting recent evidence supports the use of adolescent bariatric surgery to manage severe obesity, yet the latest national utilization estimates are based on 2009 data. We examined contemporary national trends in adolescent bariatric surgery and assessed previously described ethnoracial, insurance and income-based disparities.

Methods

A retrospective, cross-sectional analysis of adolescents aged 10-19 years who underwent bariatric surgery from 2009-2016 was conducted. Data were obtained from the Healthcare Cost and Utilization Project's Kids' Inpatient Database. Annual rates of bariatric surgery were assessed using trend analysis and stratified by patient, hospital and regional characteristics.

Results

A total of 3,834 (weighted) adolescents underwent bariatric surgery from 2009-2016. The overall rate of bariatric surgeries per 1,000,000 adolescents (24 to 39 cases) and per 1,000,000 severely obese adolescents (227 to 331 cases) increased. Roux-en-Y gastric bypass (695 to 306) and gastric band (324 to unmeasurable) significantly decreased ($p < 0.001$), while sleeve gastrectomy (0 to 1348) became the most common bariatric procedure ($p < 0.001$). Surgeries were increasingly performed in urban teaching hospitals (54.4 to 77.9%, $p < 0.001$) and in the Northeast (34.4%) and South (40.9%). In 2016, patients were predominately 18-19 years (77.3%), female (77.5%), white non-Hispanic (48.9%) and privately-insured (58.0%). The proportion of black patients (12.1 to 15.8%) demonstrated an increased trend ($p= 0.0601$), though Hispanic patients did not significantly change. Publicly-insured patients significantly increased (17.0 to 30.7%, $p < 0.001$), though no changes were observed based on income (Figure).

Conclusion

Utilization of bariatric surgery is increasing, though remains inadequate to address the growing adolescent obesity epidemic. While incremental improvements were made in ethnoracial minority and insurance-based disparities, these vulnerable patient populations, including those of low-income, have the highest rates of obesity, yet undergo bariatric surgery at disproportionately lower rates. Efforts to address disparities and barriers to care are urgently needed to care for the growing population of severely obese adolescents.

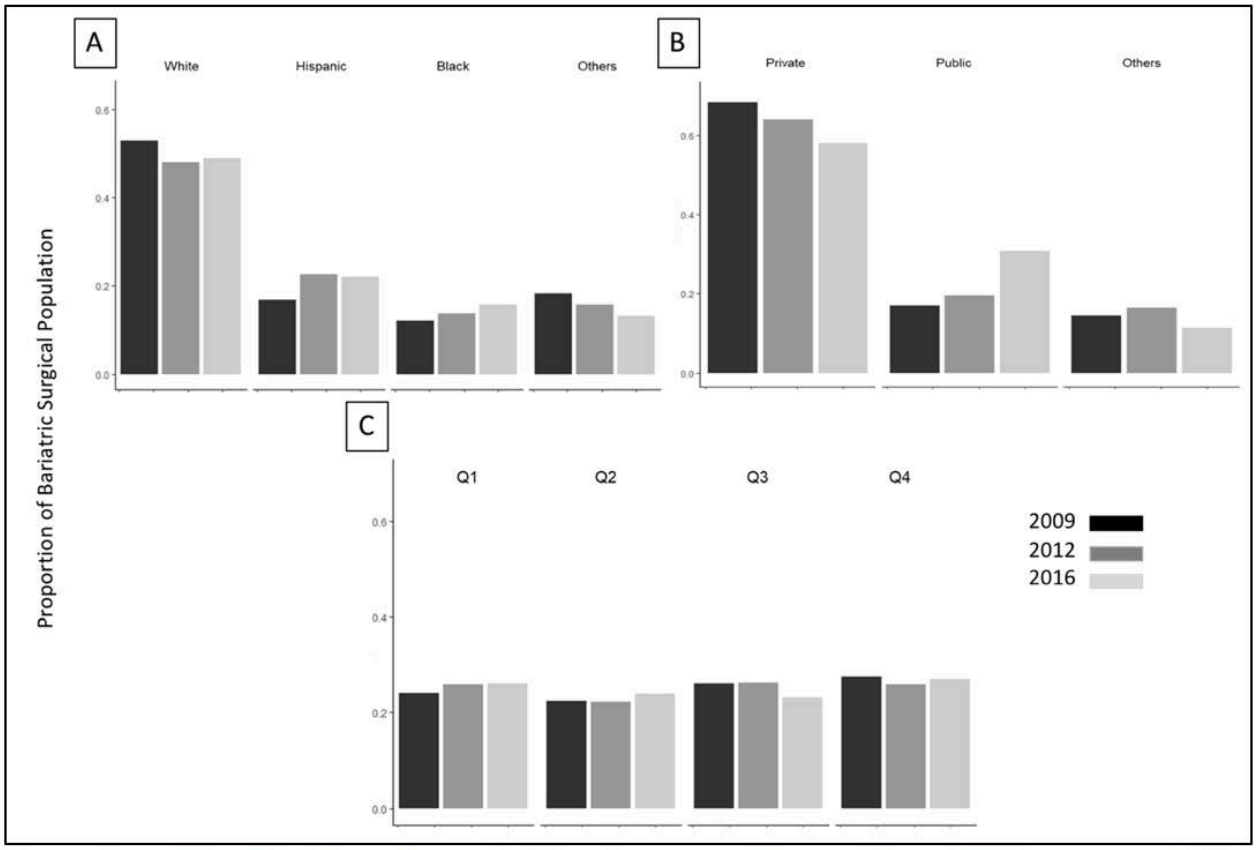

Figure: Proportion of adolescent inpatient bariatric surgery by race/ethnicity (A), payer type (B) and median household income (C) in 2009, 2012 and 2016 from the Kids' Inpatient Database (KID). Median household income is divided by quartiles, with Q1 as the lowest and Q4 as the highest income.

34

CONFLICTS IN SHARING CURRENT PROCEDURAL TERMINOLOGY (CPT) CODES BETWEEN ADULT AND PEDIATRIC PATIENTS

Roxanne L. Massoumi, MD[1], Christopher P. Childers, MD[1], Steven L. Lee[2]

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Purpose

The Relative Value (RVU) system was designed and implemented by Medicare to standardize physician payment for a given CPT code. Since Medicare primarily cares for older adults, many index pediatric CPT codes are shared with adults. Adult and pediatric operations with shared CPT codes are billed identically despite differences in the technical details of the operations and patient populations. We hypothesized that key components in calculating RVUs for shared CPT codes vary between adults and children.

Methods

Index pediatric operations that share a CPT code with adults and were included in the National Surgical Quality Improvement Program (NSQIP) database were used in the analysis. Average operative time and length of stay (LOS) for adult and pediatric patients were collected. Non-parametric comparisons of the median using rank sum tests were performed and a $p < 0.05$ was considered significant.

Results

Eleven index pediatric CPT codes met our criteria (figure). Overall, 55% (6/11) of the operations had different operative times. Pediatric surgeons had longer operative times in four of these CPT codes and general surgeons in two. LOS was different in 73% (8/11) of shared CPT codes. Both pediatric surgeons and general surgeons were each responsible for longer LOS in four of these CPT codes.

Conclusions

Although many pediatric and adult operations share a CPT code, the majority of these operations have varying operative times and LOS when performed in pediatric and adult patients. Operative time and LOS comprise a large portion of physician reimbursement and thus these findings support separating codes between adults and children in order to improve billing accuracy.

CPT Code	CPT Code Description	Median Operative Time Adult (min)	Median Operative Time Pediatric (min)	P - Value	Median LOS Adult (days)	Median LOS Pediatric (days)	P - Value
42815	Excision branchial cleft cyst, vestige, or fistula, extending beneath subcutaneous tissues and/or into pharynx	79	41	<0.001	0	0	n/a
43279	Laparoscopy, surgical, esophagomyotomy (Heller type), with fundoplasty, when performed	123	167.5	<0.001	1	2	0.01
43280	Laparoscopy, surgical, esophagogastric fundoplasty (eg, Nissen, Toupet procedures)	99	104	0.01	1	3	<0.001
43281	Laparoscopy, surgical, repair of paraesophageal hernia, includes fundoplasty, when performed; without implantation of mesh	114	123	0.02	1	2	<0.001
44050	Reduction of volvulus, intussusception, internal hernia, by laparotomy	65	56	NS	4	3	<0.001
44055	Correction of malrotation by lysis of duodenal bands and/or reduction of midgut volvulus (eg, Ladd procedure)	77	79.5	NS	4	5	NS
44120	Enterectomy, resection of small intestine; single resection and anastomosis	89	101	0.001	6	4	<0.001
44130	Enteroenterostomy, anastomosis of intestine, with or without cutaneous enterostomy (separate procedure)	102	99	NS	6.5	10.5	NS
44140	Colectomy, partial; with anastomosis	116	109	NS	5	4	<0.001
50220	Nephrectomy, including partial ureterectomy, any open approach including rib resection	129	115	NS	4	2	<0.001
60280	Excision of thyroglossal duct cyst or sinus	78	72	0.01	0	1	<0.001

Figure: Index pediatric current procedural terminology (CPT) codes shared with adults, as well as the CPT code description and mean operative time and length of hospital stay (LOS) for both adult and pediatric patients.

35

IT'S TIME TO DECONSTRUCT TREATMENT-FAILURE: A RANDOMIZED CONTROLLED TRIAL OF NONOPERATIVE MANAGEMENT OF UNCOMPLICATED PEDIATRIC APPENDICITIS WITH ANTIBIOTICS ALONE

Sofia Perez[1], **Julia Metzger**[1], Beatrix Choi[2], Akila B. Ramaraj, MD[3], Jun Tashiro[1], Keith A. Kuenzler[4], Howard B. Ginsburg[4], Sandra S. Tomita[4], Jason C. Fisher, MD[4]

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Purpose
Published data demonstrate that management of uncomplicated pediatric appendicitis with antibiotics-alone is safe and frequently successful. Randomized controlled trial (RCT) data comparing antibiotics-alone to appendectomy are lacking, alongside insight into drivers of failure. We sought to further validate the antibiotics-alone approach and identify barriers to success using the gold standard of RCT design.

Method
Patients aged 6-17 years with uncomplicated appendicitis across 3 hospitals were randomized to appendectomy or intravenous piperacillin/tazobactam for 24–48 hours followed by 10 days of oral ciprofloxacin and metronidazole. Inclusion criteria included < 48 hours of symptoms, WBC < 18, appendiceal diameter < 11mm, and radiographic absence of perforation. Antibiotic failure was defined as lack of clinical improvement or persistently elevated WBC after 24-48 hours, resulting in subsequent appendectomy. Primary outcomes were 1-year success rate of antibiotics-alone and quality-of-life measures (Parent PedsQL), including missed school/parental-work days.

Results
Among 39 children enrolled over 31 months, 20 were randomized to antibiotics-alone and 19 to surgery. At 1 year follow-up, 6 nonoperative patients underwent appendectomy (70% success). Four cases were not true antibiotic failures but instead reflected “pragmatic” challenges to successfully executing this algorithm in real-world scenarios (Table). Therefore, only 2 cases represented recurrent/refractory appendicitis, suggesting a true 1-year success rate of 90%. Parental PedsQL scores were similar between antibiotic and surgery cohorts (95.1 vs 90.2, P=0.19). Children in the antibiotic cohort had faster median return to full activity (2.0 vs 12 days, P < 0.001) and fewer median parental missed work days (0.0 vs 2.5, P=0.03).

Conclusion
These RCT data corroborate findings from non-randomized studies suggesting that 70-90% of uncomplicated pediatric appendicitis can be successfully treated with antibiotics-alone, with fewer family disability days. Antibiotic failures appear multifactorial, often reflecting practical hurdles and not antibiotic limitations. As surgeons consider nonoperative protocols for uncomplicated appendicitis, these data further inform the variability of treatment success.

36

FREQUENCY AND FISCAL IMPLICATIONS OF POTENTIALLY AVOIDABLE SURGICAL REFERRALS FOR ASYMPTOMATIC UMBILICAL HERNIAS IN CHILDREN

Katherine He, MD, MS[1], Jonathan L. Hills-Dunlap, MD, MPH[2], Mark Kashtan, MD, MPH[3], Heather Riley, MS[4], Owen Henry, BS[4], Dionne Graham, PhD[3], Shawn J. Rangel, MD, MSCE[3]

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Purpose

Choosing Wisely guidelines endorsed by the American Academy of Pediatrics and its Section on Surgery recommend delaying referral of asymptomatic umbilical hernias (UHs) until 4-5 years of age to allow for spontaneous closure. The purpose of this study was to assess compliance with these guidelines by referring providers in order to estimate the proportion of children at risk for potentially avoidable visits.

Methods

Retrospective analysis of new UH referrals evaluated at a single pediatric surgery clinic over a five-year period (10/2014-2/2020). Management was consistent among all 17 pediatric surgeons in delaying repair of asymptomatic UHs until 4-5 years of age. Demographic characteristics, referral indication, and disposition following the clinic visit were assessed. A potentially avoidable visit (PAV) was defined as an asymptomatic, non-enlarging UH referral in a child 3 years of age or younger without a history of incarceration.

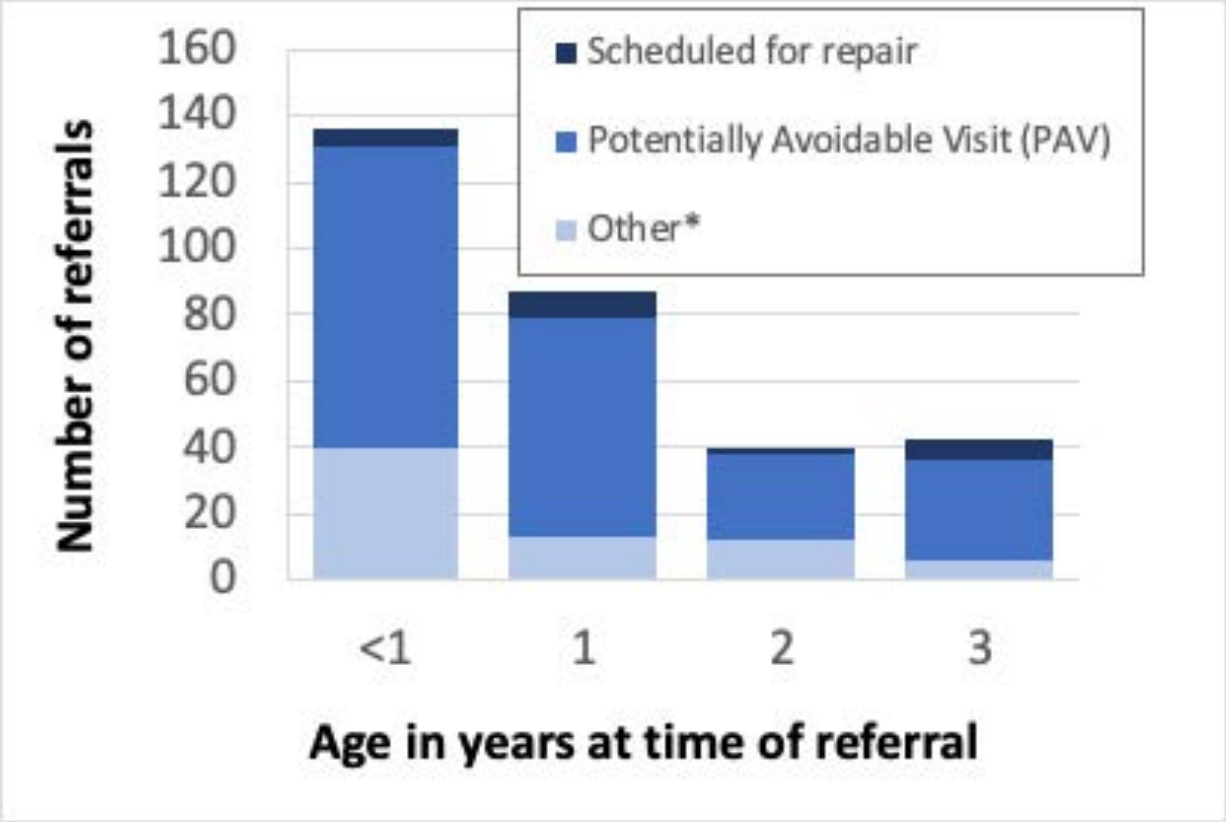
Results

643 UH referrals were reviewed, of which 47% were in children 3 years of age or younger ("early referral" cohort). In the early referral cohort, the most common referral indications were failure of spontaneous closure (76%), enlargement (19%), subjective discomfort without incarceration (5%), and history of incarceration (3%). Thirty-three percent of all UH referrals and 71% of early referrals were categorized as a PAV (Figure). Forty-four percent of identified referring providers and pediatrician practice groups referred at least one PAV. The median billed charge associated with a PAV was $684, and cumulative charges associated with all PAVs during the study period was $144,018.

Conclusion

Based on current guidelines, one third of new visits for umbilical hernia evaluation are potentially avoidable. Efforts to educate and align expectations surrounding management of asymptomatic UHs between surgeons and referring providers may reduce unnecessary visits, lost productivity on behalf of caregivers, and exposure to potentially unnecessary surgery.

Figure. Disposition by Age Following Initial Referral for Umbilical Hernia Evaluation in Children Three Years of Age and Younger



PAV - An asymptomatic, non-enlarging umbilical hernia referral in a child 3 years of age or younger without a history of incarceration

*Referred for symptoms or enlargement but these were felt to be clinically insufficient to justify repair

APSAsode - Global - Expanding the Global Workforce for Children's Surgical Care: Challenges and Solutions; Humanitarian Award Presentation

7:00 PM – 8:30 PM

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RETROSPECTIVE REVIEW OF GASTROSCHISIS IN A LOW-RESOURCE SETTING: CAN IMPROVED ANTIBIOTIC STEWARDSHIP REDUCE LATE INPATIENT DEATHS?

Thomas M. Diehl, MD[1], Edmond Ntaganda[2], James Davis[3], Alice Nsengiyumva[4], Deborah Igiraneza[2], Kyung Hong[3], Rosine Umutoni[4], Dan Neal[5], Robin Petroze[5]

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Background
Gastroschisis has a < 4% mortality rate in high-income countries, but 75-100% mortality in LMICs. While early deaths (48hrs) are often secondary to sepsis and slow gastrointestinal recovery with resultant malnutrition. Anti-microbial resistance is a widely acknowledged problem across Africa; however, exact patterns of resistance are not well understood. This study aimed to understand the gastroschisis population and antibiotic management at a low-resource hospital in Rwanda to identify modifiable factors for increased survival.

Methods
Data was collected retrospectively for all gastroschisis patients presenting from 1/2016—6/2019 to Centre Hospitalier Universitaire de Kigali, which receives all of Rwanda's gastroschisis referrals. Descriptive and univariate analyses were conducted with primary outcome being survival to discharge. Secondary analysis evaluated antimicrobial usage, time to enteral nutrition, and mortality in patients surviving to abdominal closure.

Results
92 gastroschisis patients were identified during the study period. Overall mortality was 77.2% (n=71). 8.7% (n=8) died within 48 hours and 51% (n=47) died before silo removal and bedside abdominal closure. 95.7% (n=88) were treated for sepsis on arrival. There was no difference in antibiotic usage between survivors and non-survivors. Antibiotic selection included 90% penicillin, 63% aminoglycosides, 35% cephalosporins, 32% carbapenem, and 21% vancomycin. Of patients surviving to abdominal closure (n=44), there was no difference in time to closure, time to enteral feeds, or length of stay between survivors and non-survivors (Table 1).

Conclusions
Mortality from gastroschisis remains high in Rwanda. Early survival is improving, but frequent late deaths highlight the need for larger prospective studies to evaluate nutritional support and antimicrobial stewardship. The high proportion of hospital days on antibiotics and frequent use of vancomycin and carbapenems in this retrospective study raise concern for antibiotic resistance and will affect data collected in an upcoming prospective registry.

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CHILDHOOD MORBIDITY AND MORTALITY IN FRANCOPHONE AFRICA DUE TO TYPHOID INTESTINAL PERFORATION

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[1]University of Maryland School of Medicine, [2]PAACS Bethany Kids/ Kijabe Hospital, [3]CHU Gabriel Touré, [4]Koutiala Women's and Children's Hospital, [5]Center for Vaccine Development - Mali, [6]Center for Vaccine Development and Global Health, University of Maryland School of Medicine

Purpose
Typhoid fever disproportionally affects low-and middle-income countries, with an estimated 10.9 million cases and 116,800 deaths annually. Intestinal perforation related to this disease continues to be an important cause of mortality, especially in sub-Saharan Africa. This study will update the literature on typhoid intestinal perforation (TIP) in children living in Francophone Africa and present TIP data from a remote hospital in Niger.

Methods
A literature review was conducted for studies reporting mortality rates due to TIP in children in Francophone Africa published since January 1995. In addition, we included unpublished prospective data collected by one of our authors from a remote tertiary hospital in Niger from July 1 to December 31, 2015. Data abstracted included hospital length of stay, mortality, postoperative complications, and longer-term complications seen during outpatient follow-up visits.

Results
A total of seven studies, including prospective data from Niger, reporting on 650 children up to 20 years of age were included. Overall mortality rates ranged from 6-29%. The most common postoperative complications reported were surgical site infection (14-65%), wound dehiscence (about 22%), enterocutaneous fistula (1-12%), evisceration (2-5%), and incisional hernias (3-10%). Average hospital length of stay ranged from 11-30 days. Prospective data from Niger included morbidity and mortality rates of 43.8% and 15.7%, respectively.

Conclusion
Little progress has been made in reducing mortality rates related to TIP among children in sub-Saharan Africa over the past 50 years. Additionally, surgical site infections continue to account for the majority of post-operative morbidity in low resource settings. Consequently, these complications lead to an increase in the overall hospital length of stay. Improvements in access to care are vital but difficult in this region, therefore prevention of typhoid fever through access to vaccinations and improvements in water, sanitation, and hygiene are essential to help decrease mortality rates and reduce the financial impact on families.

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DEFINING THE GLOBAL SURGICAL WORKFORCE TO MEET UNDER-5 CHILD MORTALITY RATE TARGETS IN THE AGE OF THE SUSTAINABLE DEVELOPMENT GOALS

Paul Truche, MD, MPH[1], Stephen W. Bickler[2], John Meara[3], Henry E. Rice, MD[4], Emily Smith[5], Adesoji Ademuyiwa[6], Alexandra Buda[3], Mary Nabukenya[7], Neema Kaseje[8], Emmanuel Ameh[9], Sarah Greenberg[10], Faye Evans[11]

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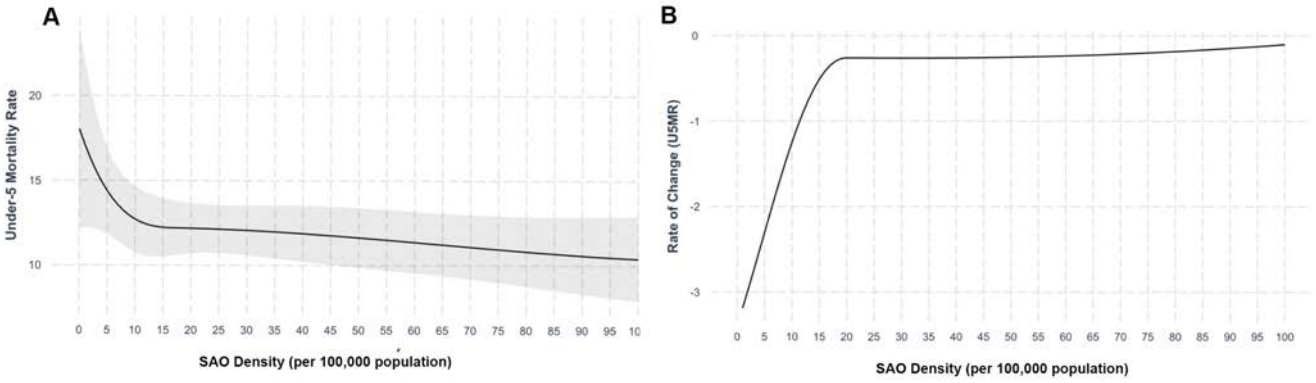
Background: Investment in surgical care may help reach the UN Sustainable Development Goals (SDGs) for under-5 mortality rate (U5MR) and neonatal mortality rate (NMR). We defined the association between the surgical workforce and childhood mortality globally, and estimated the surgical workforce required to meet the SDG targets.

Methods: We modeled the association between the density of surgeons, anesthesiologists and obstetricians (SAO) per 100,000 population and U5MR and NMR for 192 countries using log-linear regression. We adjusted for non-surgical confounders, including physician and nurse/midwife density, gross national income per capita, poverty levels, percent of urban population, surgical volume, hospital bed density, and deaths due to diarrheal diseases, prematurity and acute lower respiratory infections. Unadjusted B-spline models were used to determine threshold SAO density associated with meeting SDG mortality targets. Adjusted B-spline models were used to determine SAO densities associated with the maximal rate of change of mortality reduction. Multiple imputation was used for missing data, and sensitivity analysis was performed.

Results: We found that increased SAO density is independently associated with decreased U5MR and decreased NMR ($P < 0{\cdot}05$). A minimum SAO density of 10 providers per 100,000 population (95% CI: 7-13) is associated with an U5MR of < 25 per 1,000 live births. A minimum SAO density of 12 (95% CI: 9-20) is associated with an NMR of < 12 per 1,000 live births.

Conclusion: Scale-up to 10-12 SAO per 100,000 population may reduce child mortality to help meet the SDG goals for child and neonatal mortality. Scale up of the surgical workforce beyond the LCoGS minimum recommendation of 20 may continue to have significant reductions in infant mortality. Surgical workforce expansion should be included within national health plans for countries seeking to achieve the SDG child mortality goals.

Figure 2: Surgical, Anaesthetic, and Obstetric (SAO) Workforce Density and Under-5 Mortality
Adjusted Spline Model



81

GLOBAL SURGICAL COLLABORATION IN CROATIA

Marko Mesic, MD[1], Iva Hojsak[2], Sanja Kolacek[3], Andrija Car[4], Ana Tripalo[5], Zoran Bahtijarevic[5], Stjepan Visnjic[5], Kaylene Barrera[6], Francisca Velcek[7]

[1]Department of Pediatric Surgery, Children's Hospital Zagreb, Croatia, Croatia, [2]Children's Hospital Zagreb, Croatia, [3]Children's Hospital Zagreb, Croatia, Croatia, [4]Department of Pediatric surgery, Children's Hospital Zagreb, Croatia, Croatia, [5]Children's Hospital Zagreb, Croatia, Croatia, [6]Downstate Medical Center, New York, New York, NY, USA, [7]Downstate Medical Center, State University of New York, New York, USA

Purpose

To show the benefit of global surgical collaboration training and help in Croatia, an underserved country in Eastern Europe

Methods

For many years, pediatric surgical patients with complicated problems that went beyond the available resources were sent to specialized centers in other countries, including the United States and Italy at a tremendous cost to the National Health System. Over the last 3 to 4 years, a collaboration with the National Children's Hospital was started so that children with complex anorectal malformations and short gut syndrome and other complex cases could be managed in Croatia with visits about 3-4 times a year. During these occasions, these cases were done by the local pediatric surgeons under the guidance and mentorship of a pediatric surgeon from a tertiary university hospital in New York. The perioperative management was done by local pediatric surgeons and pediatric GI service.

Results

Many complicated anorectal malformations including Hirschsprung's disease, imperforate anus, common cloaca, motility disorders, and urogenital malformations were assessed. The technique of sphincter saving anorectoplasty was implemented instead of posterior midsagittal anorectoplasty with excellent results.

The biggest turning point in pediatric surgery in Croatia happened in 2019 when on January 29, 2019, the first serial transverse enteroplasty (STEP) procedure was performed. Seven procedures in 6 patients were completed, with excellent results with patients liberated from hyperalimentation.

Conclusion

A collaboration between the pediatric surgical staff at the National Children's Hospital and the pediatric surgeon in the USA has led to the improvement of pediatric surgical care, in anorectal malformations and short gut syndrome, in a system where previously complex cases were sent abroad.

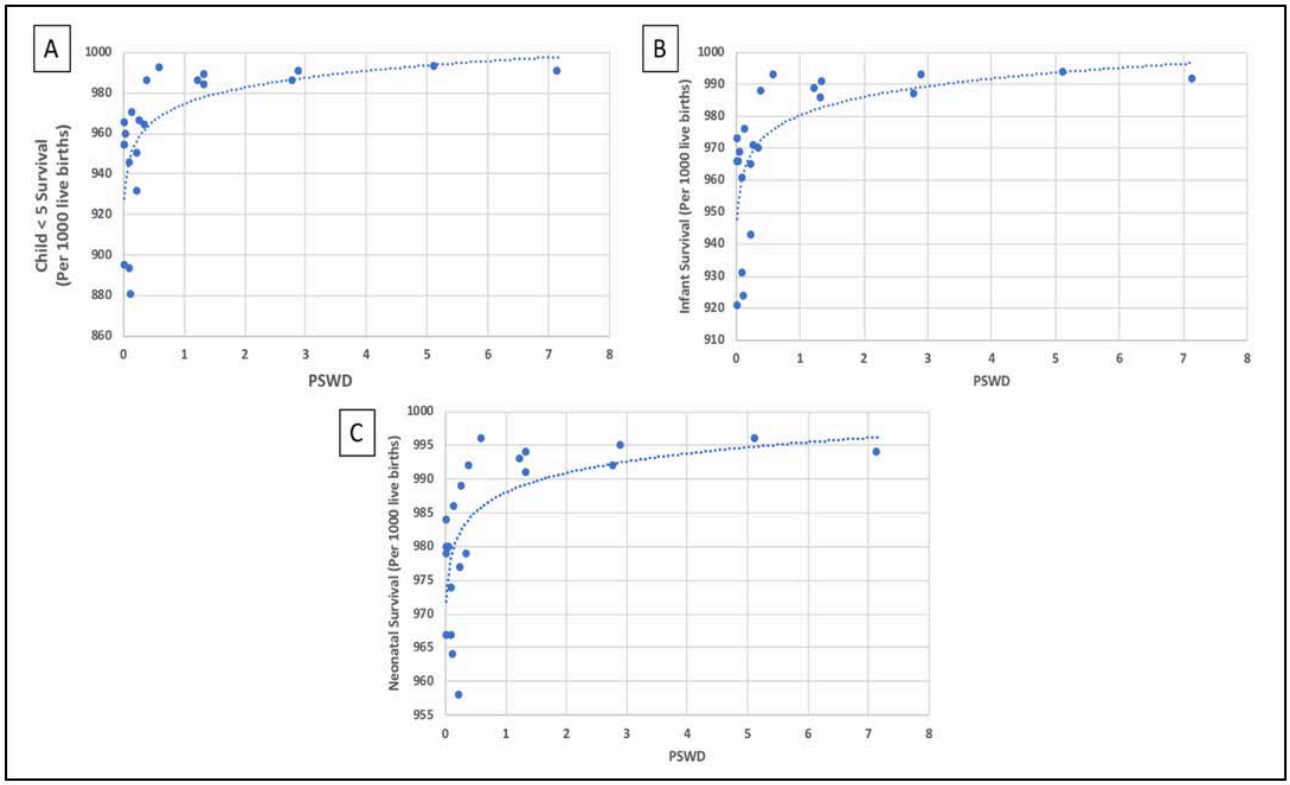


Figure 1: Child < 5 years old (A), infant (B) and neonatal (C) survival rates plotted as a function of PSWD. Abbreviation- PSWD: pediatric surgical workforce density.

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ESTIMATED NUMBER OF PREVENTABLE DEATHS IN THE FIRST 8000 DAYS OF LIFE BY SCALING UP SURGICAL CARE AT FIRST-LEVEL HOSPITALS WORLDWIDE

Alicia G. Sykes, MD[1], Romeo C. Ignacio[2], Benjamin A. Keller[2], Hariharan Thangarajah[2], David A. Lazar, MD[3], Karen M. Kling, MD[4], Stephen W. Bickler[5]

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Background

There is growing appreciation for the importance of health spanning the first 8000 days of life. An estimated 1.7 billion children and adolescents in this age group currently do not have access to basic, lifesaving, and safe surgical care (Bull WHO, 2019). This study aimed to estimate the number of deaths in the under-20 year age group that could be averted if quality surgical services were universally accessible at first-level hospitals.

Methods

We used epidemiological data from the GBD 2017 Study and a counterfactual method developed for DCP3 (World Bank) to estimate the number of preventable surgical deaths. Our model included three digestive diseases, four maternal conditions, and eight common traumatic injuries. The World Bank super-region with lowest death rate was considered to represent the best possible state of full surgical coverage and treatment, with differences between regions being the number of preventable deaths. Corrections were made to account for regional differences in access to health care and variable effects of surgery.

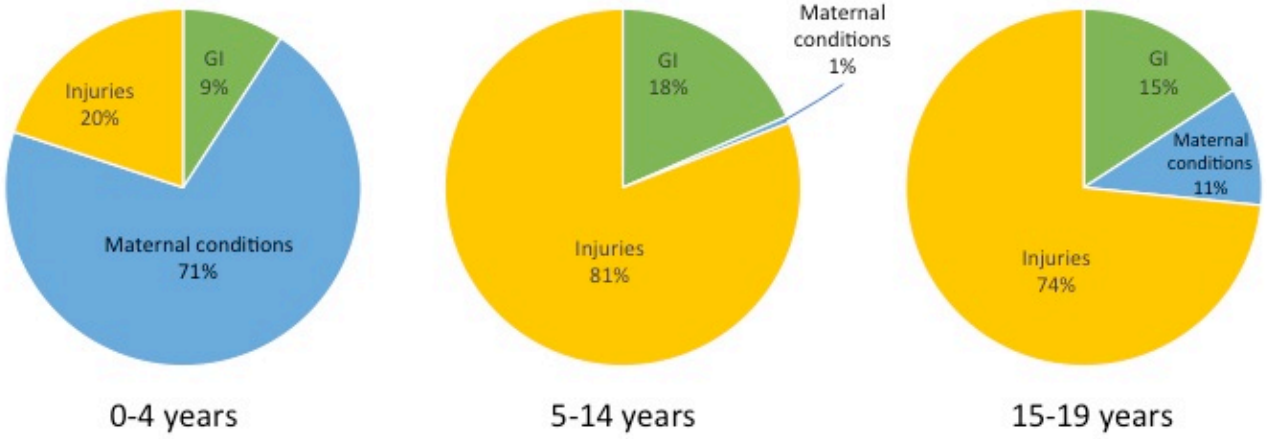
Results

Overall, 899,852 deaths per year in the under 20-year age group could be prevented if surgical care would be scaled up at first-level hospitals worldwide. The greatest numbers of preventable deaths were in the maternal conditions (56%) and injury categories (33%). Sub-Saharan Africa (37%) and South Asia (36%) regions had the great number of preventable deaths. Preventable deaths in the under 20-year age group represent almost two-thirds of the previously estimated 1.4 million deaths that could be averted by scaling up surgical care at first-level hospitals in LMICs.

Conclusion

Improving the capacity of surgical services at first-level hospitals in LMICs has the potential to prevent a large number of deaths within the first 8000 days of life. Particular attention should be given to improving surgical care of pregnant females and injured children at first-level hospitals worldwide.

Figure 1. Causes of Avertable Surgical Deaths by Age Group



0-4 years 5-14 years 15-19 years

Scientific Session 3 - Fetal, Innovation, Oncology, Trauma

6:00 PM – 8:00 PM

P13

CARDIAC EFFECTS OF TRANSAMNIOTIC STEM CELL THERAPY IN THE NITROFEN MODEL OF CONGENITAL DIAPHRAGMATIC HERNIA: TRANSCRIPTIONAL ANALYSIS OF MULTIPLE REMODELING MARKERS

Daniel F. Labuz, MD[1], Stefanie P. Lazow, MD[1], Ashlyn E. Whitlock, MD[2], Ina Kycia, PhD[1], Steven J. Staffa[2], David Zurakowski, MS,PhD[3], Dario O. Fauza, MD, PhD[1]

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Purpose

Pulmonary hypertension and cardiac dysfunction are among the most relevant manifestations of congenital diaphragmatic hernia (CDH). Transamniotic stem cell therapy (TRASCET) has been shown to minimize the impact of CDH in the Nitrofen model, particularly in the fetal pulmonary vasculature. We sought to determine the effects of TRASCET on multiple markers of cardiac remodeling in that model.

Methods

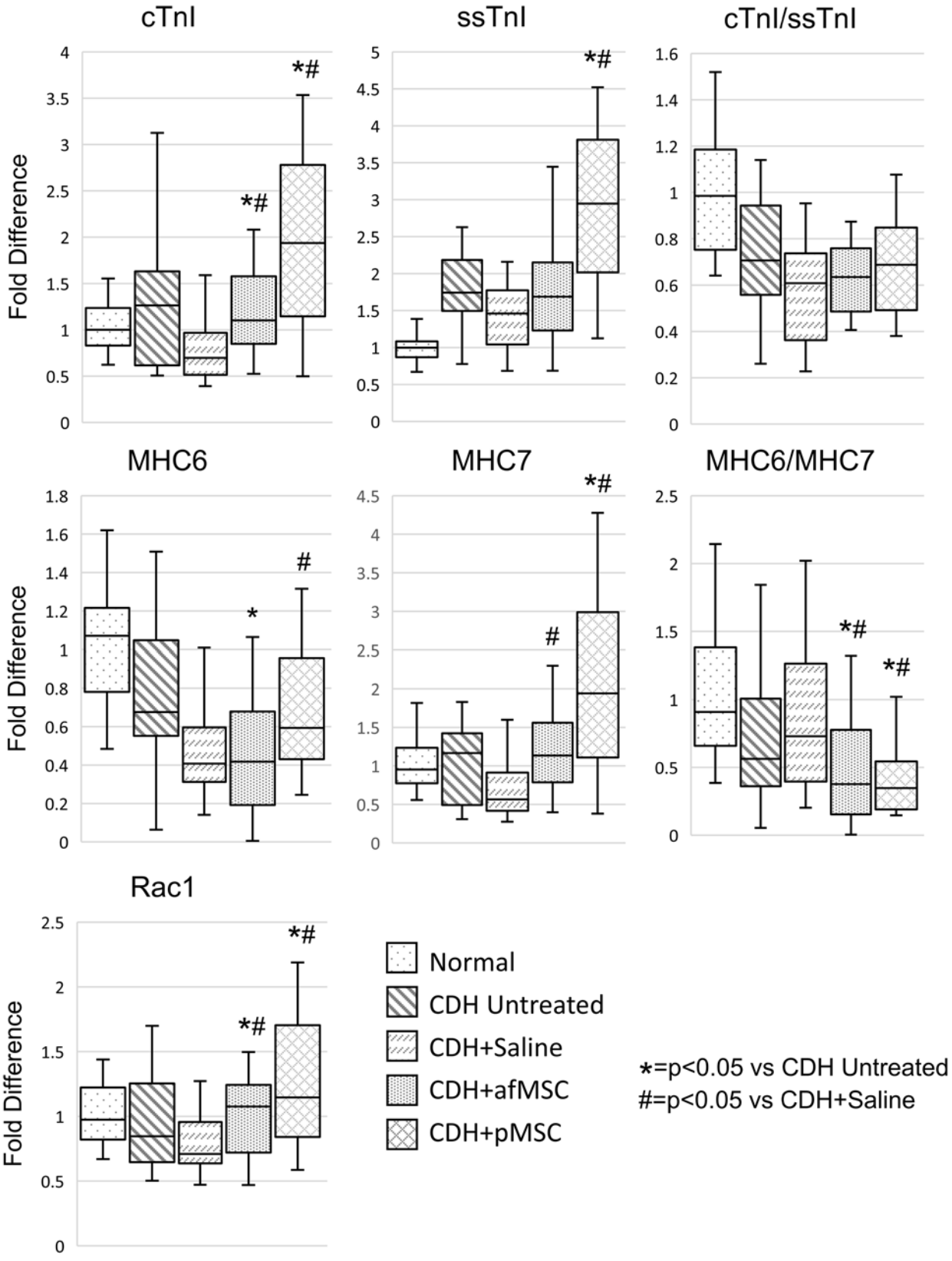
Following IACUC approval, pregnant dams (n=39) received Nitrofen on gestational day 9.5 (E9; term=22 days) to induce fetal CDH. Fetuses (n=527) were divided into four groups: untreated undergoing no further manipulations (n=123) and three groups receiving volume-matched intra-amniotic injections of either saline (n=113), or a suspension of mesenchymal stem cells (MSCs) derived from either amniotic fluid (afMSCs; n=200) or placenta (pMSCs; n=91) on E17. Infused MSCs consisted of syngeneic Lewis rat cells with phenotype confirmed by flow cytometry. At term, expression of preproendothelin-1 (Edn1), endothelin receptor A (EdnRA), collagen-1 (Col1), elastin, Ras-related C3 botulinum toxin substrate (Rac1), connexin-43 (Cnx43), myosin heavy chain 6 and 7 (MHC6/MHC7), and slow skeletal and cardiac troponin I (ssTnI/cTnI) were quantified by qRT-PCR in all hearts. Relative mRNA expression was controlled by normal fetuses (n=23). Statistical analysis was by the Mann-Whitney U-test ($p < 0.05$).

Results

Among 96 survivors with isolated CDH, when compared to both the untreated and saline groups, afMSC- and/or pMSC-based TRASCET led to statistically significant upregulation of the cardiomyocyte contractile components ssTnI, cTnI and MHC7, and of the developmental signal Rac1 ($p=0.041$ to < 0.001), along with significant downregulation of the MHC6/MHC7 ratio ($p=0.02$ to 0.006) (figure). Among those, the effects of pMSCs were significantly more pronounced compared to afMSCs for ssTnI, cTnI, and MHC7 expressions ($p=0.008$ to 0.003).

Conclusions

Transamniotic stem cell therapy affects cardiac remodeling in experimental congenital diaphragmatic hernia. Investigation into the functional impact of this novel therapeutic strategy is warranted.


cTnI
ssTnI
cTnI/ssTnI
MHC6
MHC7
MHC6/MHC7
Rac1
Fold Difference
Normal
CDH Untreated
CDH+Saline
CDH+afMSC
CDH+pMSC
*=p<0.05 vs CDH Untreated
#=p<0.05 vs CDH+Saline

P14

MATERNAL-TO-FETAL LEUKOCYTE TRAFFICKING IN FETAL MALDEVELOPMENT

Katherine Ott, Catherine Redden, Hee Kap Kang, Lucas Turner, Amir Alhajjat, Aimen Shaaban

Center for Fetal Cellular and Molecular Therapy, Ann and Robert H. Lurie Children's Hospital

Introduction

The evolutionary advantage for the natural trafficking of maternal leukocytes to the fetal circulation remains unexplained. A role in the surveillance of early embryogenesis has recently been proposed. No previous study has examined the influence of abnormal development on maternal cell trafficking. To address this knowledge gap, we hypothesized that maternal cell trafficking to the fetal circulation is increased in response to abnormal development.

Methods

We challenged this hypothesis using a murine model of neural tube teratogenesis in which pregnant dams received intraperitoneal valproic acid (VPA) on E8. Quantitative changes in maternal leukocyte trafficking were compared between VPA groups and controls. Studies were performed in both immunologically matched (B6.Ly5.1 female x B6.Ly5.2 male) and immunologically mis-matched (B6.Ly5.1 female x Balb/c male) maternal-fetal hybrid matings. All litters were harvested on E14 and maternal chimerism measured in the circulating blood of individual fetuses.

Results

Maternal cell chimerism was higher in the blood of immunologically-matched fetuses that were exposed to VPA when compared to saline-injected controls (18.2% vs 7.7%, $p < 0.05$). Similarly, maternal cell chimerism was higher in immunologically mismatched fetuses exposed to VPA when compared to controls (8.1% vs 5.1%, $p < 0.05$). A higher overall rate of fetal absorption was also seen in the VPA-treated litters when compared to controls (8.2% vs 1.3%, $p < 0.05$).

Conclusion

Collectively, these results support that maternal cell chimerism to the fetus is significantly affected by abnormal fetal development. Furthermore, the higher rates of fetal resorption in abnormal litters support a link between maternal leukocyte trafficking and the surveillance of fetal fitness. Future experiments will clarify the specific cell phenotypes and mechanisms regulating this process.

P15

DEVELOPING REBOA CATHETERS FOR USE IN PEDIATRIC PATIENTS: UNDERSTANDING VARIABILITY

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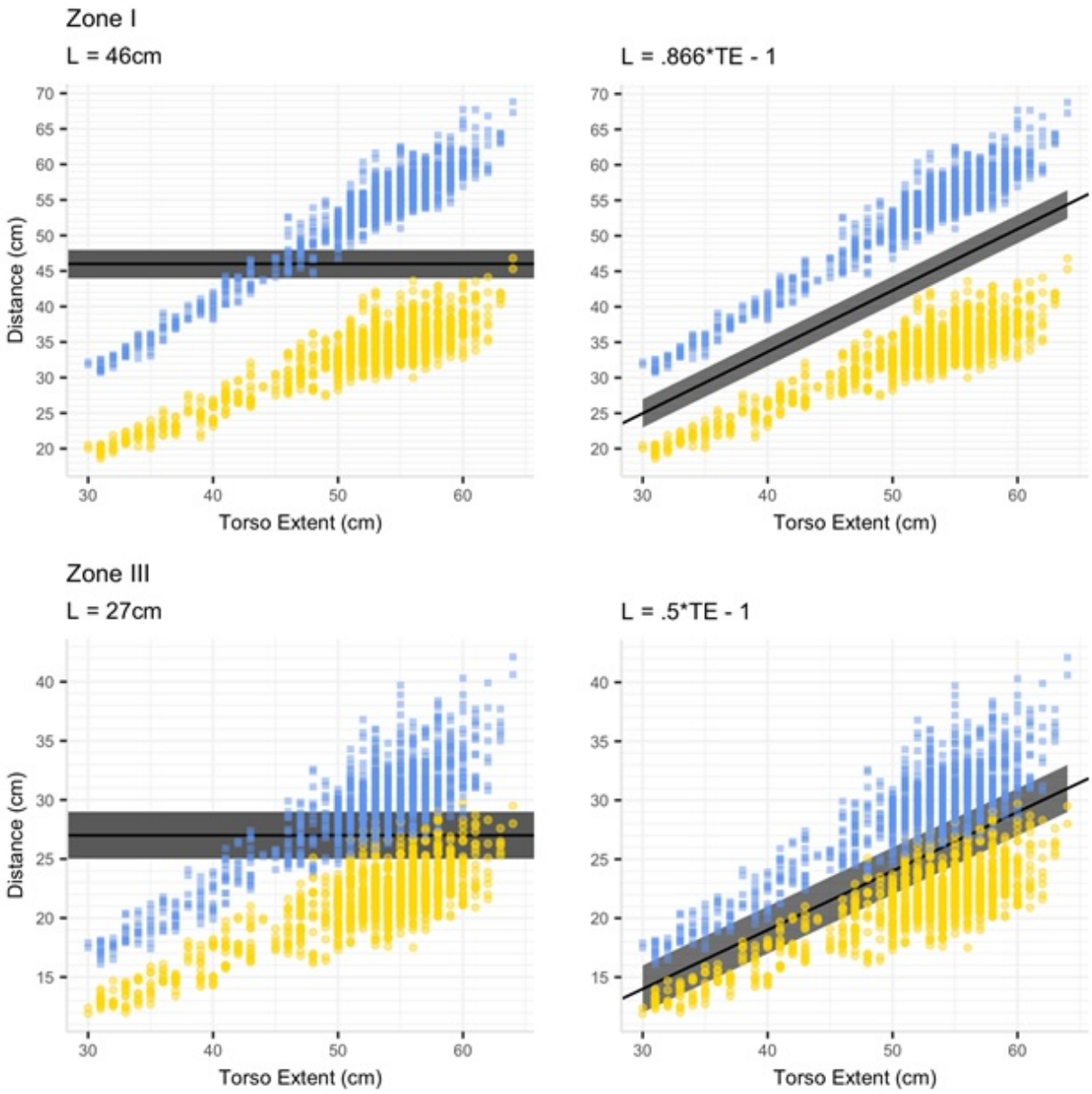
REBOA insertion length guidelines are based on military population of adult males. We previously showed in adults that there is a strong correlation between Torso Extent (TE) and vascular lengths. To understand potential REBOA use in the pediatric population we examined TE, age, gender and developed models for placement of REBOA catheters that minimize Zone errors.

Youth < 21 who had CT imaging of the arterial system in the chest, abdomen, and pelvis were identified. Scans were analyzed using MATLAB software, with image algorithms applied to correlate centerline vascular anatomy with musculoskeletal landmarks. TE was defined as the straight-line distance from the sternal notch to the pubic tubercle. Catheter insertion was assumed to be in the common femoral artery (CFA) at the mid-femoral head. Zone 1 is the aortic centerline span between the distal aspect of the left subclavian artery origin and the proximal aspect of the celiac branch, whereas zone 3 is between the lowest main renal artery and the aortic bifurcation. Total catheter insertion length measured from the skin at the access site to the center of the inflated balloon, assuming 4cm balloon length.

547 CTs were analyzed. Mean TE increased with age from 31 to 56cm. Using fixed catheter insertion lengths, modeled placement errors in Zone III were 49.4% from the left, 44.1% from the right CFA and Zone 1 were 17.9% left vs. 17.4% right (Table 1). The majority errors in both zones were from inserting too far, especially in youth < 16 (Figure 1). Modeled catheter placement errors were minimized when catheter insertion lengths were adjusted based on TE. Optimal equations, L=.866*TE-1 (Zone 1) and L=0.5*TE-1 (Zone 3), eliminated modeled placement errors in Zone1 but not Zone 3.

Adjusting catheter insertion lengths for TE improved catheter placement accuracy. Guidelines specific to pediatric patients would be beneficial.


Zone I
L = 46cm
L = .866*TE - 1
Zone III
L = 27cm
L = .5*TE - 1
Distance (cm)
Torso Extent (cm)

P16

CLINICAL OUTCOMES IN NEUROLOGICALLY INTACT CHILDREN WITH SMALL INTRACRANIAL BLEEDS AND SIMPLE SKULL FRACTURES

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Purpose

Children with minor intracranial hemorrhages (ICH) and/or simple skull fractures are often hospitalized for monitoring; however, most of these patients do not require any surgical or critical care interventions. The purpose of this study was to determine the rate of significant clinical sequela (SCS) in this patient population and to identify patient-specific factors that are predictive of clinical deterioration requiring closer monitoring.

Methods

We performed a retrospective review of patients in a single, Level I Pediatric Trauma Center. Children (< 3 years of age) presenting with closed head trauma and documented head injuries on initial neuroimaging (ICH ≤5mm and/or skull fracture) with a GCS of ≥14, were identified between January 2015 to January 2020. We collected demographics, resource utilization, and patient outcomes variables. SCS was defined as any radiologic progression, clinically important medical or neurological deterioration. Analysis of variance with significance set to p = 0.05 was conducted between three patient groups: isolated skull fractures (n = 115), isolated ICH (n = 21), and combined (n = 69).

Results

We identified 205 patients (65.4% male, Mage = 7.6 months). Repeat neuroimaging was obtained in 41/205 patients (20%) with radiologic progression noted in 5/205 (2.4%). Isolated ICH (33%) and combined group (36%) were more likely to receive repeat imaging than the skull fracture group (4%; p < .05). Thirteen of 205 patients (6.3%) experienced SCS (15% ICH only; 38% Skull fracture; 47% Combined) and 3/205 (1.4%) patients required neurosurgical intervention (33% each group). Isolated ICH group reported higher rates of GCS deterioration, readmission, and admission length of stay than the other two groups (Table 1).

Conclusions

Results show that neurologically intact children with minor ICH and/or skull fractures are at low risk for developing SCS during their stay. We therefore conclude that this patient population may not require ICU admission.

P17

APPLICATION OF MACHINE LEARNING MODELS TO THE PREDICTION OF BLUNT CEREBROVASCULAR INJURY IN CHILDREN

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Purpose

Blunt cerebrovascular injury (BCVI) is a rare but potentially devastating injury. The Denver and Memphis criteria are the current standard but have been shown to be flawed in the pediatric trauma population. We sought to improve the detection of BCVI in children and to make it accessible through an online clinical calculator.

Methods

The NTDB database was queried from 2007 to 2015. ICD9/ICD10 codes were used to identify cases of pediatric BCVI. 105,787 pediatric patients with complete ICD9/ICD10 data from this period were used to build a random forest model predicting BCVI. Except for those defining BCVI, all ICD9/ICD10 features (2,268) were included. A random forest model of 1,000 decision trees trying 47 variables at each node was applied to training data (50%) and validated with test data (50%). Random forest seed was set at (1234).

Results

Our random forest model identified multiple new variables related to BCVI in the pediatric trauma population including age, GCS, blood pressure, and specific injuries of the head, neck, spine, thorax, abdomen, pelvis and bones. Both the Denver-Memphis criteria and our model were applied to the NTDB validation set for comparison. The Denver-Memphis criteria demonstrated sensitivity 13.4%, specificity 99.1%, positive predictive value (PPV) 2.6%, negative predictive value (NPV) 99.8%, and area under curve (AUC) 50.3%. Our model: sensitivity 84%, specificity 86%, PPV 3.9%, NPV 99.8%, AUC 92.8%.

Conclusion

In comparison to the current standard, our risk prediction model can better identify which patients should be screened for BCVI. It can be accessed at https://choc-trauma.shinyapps.io/BCVI_Calculator/.

P18

NOVEL TOOL (BIS) HERALDS THE NEED FOR BLOOD TRANSFUSION AND/OR FAILURE OF NON-OPERATIVE MANAGEMENT IN PEDIATRIC BLUNT SOLID ORGAN INJURIES

Jenny Stevens[1], Ryan C. Phillips, MD[2], Shannon Acker, MD[3], Niti Shahi, MD[4], Gabrielle Shirek[1], Maxene Meier[5], Steven L. Moulton, MD[5], Denis Bensard[5], Marina Reppucci[1]

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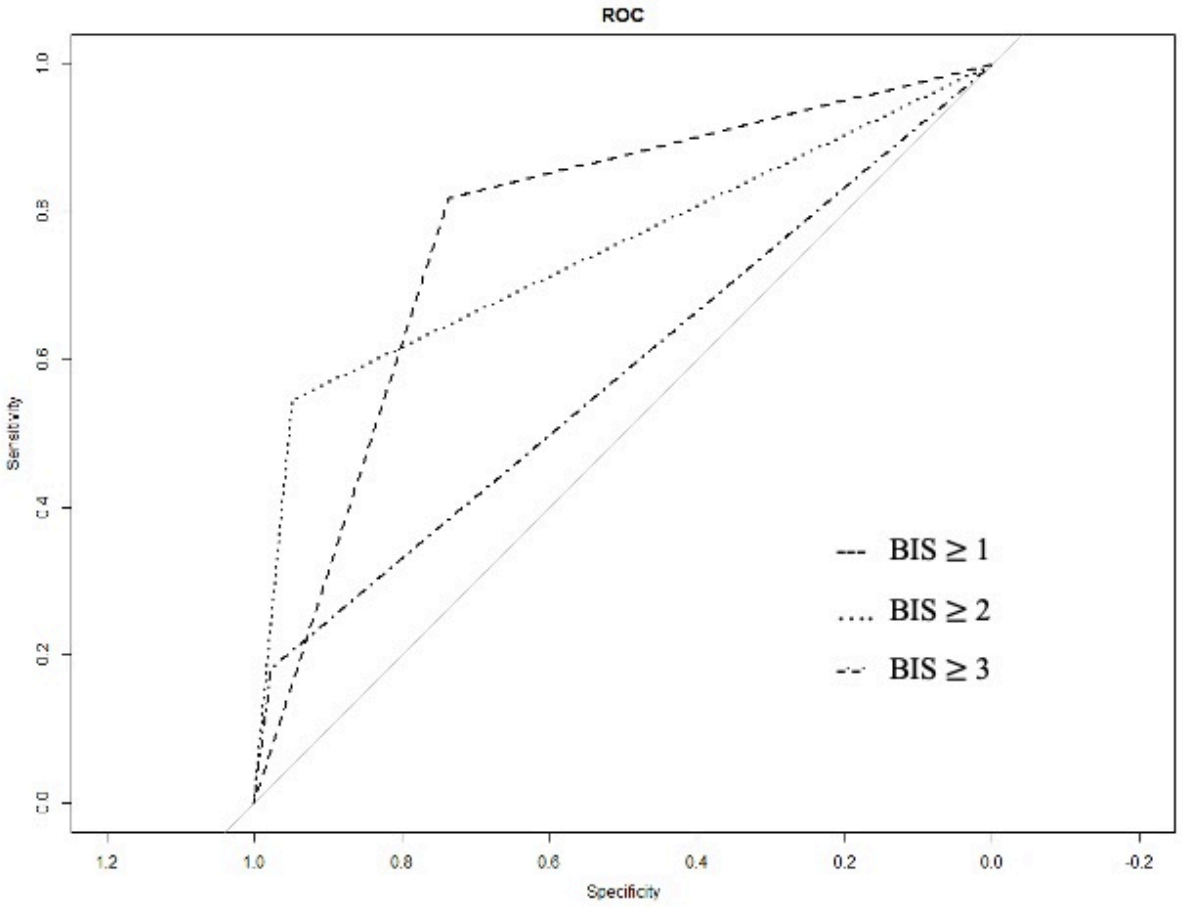
Purpose
Non-operative management (NOM), including blood transfusions, is the standard of care in the majority of children with blunt liver and spleen injuries (BLSI). Previously, the shock index pediatric age-adjusted (SIPA) was shown to predict the need for blood transfusion in pediatric trauma patients who sustained BLSI. We combined SIPA with two easily measurable indicators of shock: base deficit (BD) and International Normalized Ratio (INR) to create the BIS score. We hypothesized that the BIS score would predict the need for blood transfusion and failure of NOM in children with blunt solid organ injury.

Methods
Pediatric trauma patients ≤ 18 years old who presented to our level-1 trauma center with evidence of BLSI between 2009-2018 were identified. BIS scores were calculated by giving 1 point for each of the following: base deficit > -8.8, INR > 1.5, or elevated SIPA. Receiver operating characteristic curves (ROC) were generated for BIS scores of ≥ 1, ≥ 2, and ≥ 3. Area under the curve (AUC), sensitivity, specificity, and accuracy of each score were calculated for ability to predict need for blood transfusion and/or failure of NOM.

Results
Of 477 children included, 19.9% required a blood transfusion and 6.7% failed NOM. A BIS score ≥1 was the best predictor of the need for blood transfusion with an AUC of 0.81 and a sensitivity of 96%. A BIS score ≥1 was also the best predictor of failure of NOM with an AUC of 0.72 and a sensitivity of 97%.

Conclusion
We found that the novel BIS score is a reliable bedside scoring tool that is sensitive at identifying pediatric patients with BLSI who are at risk for blood transfusions and failure of NOM. Our findings demonstrate that like adults, children with BLSI with concomitant shock, acidosis, and coagulopathy are more likely to require early trauma interventions.

Figure 1: Accuracy of BIS score at predicting failure of non-operative management in blunt solid organ injuries



P19

AN EVALUATION OF THROMBELASTOGRAPHY AND TRANSFUSION PATTERNS IN PEDIATRIC BLUNT SOLID ORGAN INJURY

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Introduction
Thrombelastography (TEG) has emerged as a useful tool in the evaluation of coagulopathy and guidance of resuscitation in trauma patients. While the use of TEG in pediatric trauma has increased in recent years, whether TEG parameters are being utilized to guide resuscitation in such patients remains uncertain. We sought to evaluate the correlation between TEG-directed transfusion indications and blood product administration in pediatric trauma patients with blunt solid organ injury.

Methods
Pediatric patients (≤18 years) who presented as trauma activations to our institution with blunt solid organ injury and received admission rapid-TEG (r-TEG) from 2015-2018 were included. Abnormalities in r-TEG parameters including R-time, alpha-angle, maximum amplitude (MA), and LY30 were evaluated to determine indications for blood product administration. The rates of correct TEG-based resuscitation and red blood cell (RBC) transfusion were calculated and compared using Pearson correlations.

Results
Of 36 patients, 41.7% (15) had prolonged R-times (>0.7 min), 8.3% (3) had a decreased alpha-angle (3%). There was no significant association between r-TEG indications and transfusion of fresh frozen plasma (FFP), cryoprecipitate, or platelets. Based on r-TEG indications, transfusion of FFP was correctly administered only 55.6% of the time compared to 86.1% and 69.4% for cryoprecipitate and platelets, respectively. Tranexamic acid (TXA) was not transfused in any patients, including those with r-TEG indications. There was a significant correlation between correct r-TEG-directed resuscitation and correct RBC transfusion (0.56, 95% CI, 0.29, 0.75, p= 0.0004).

Conclusion
Our study, one of the first to report on the use of TEG in blunt solid organ injured pediatric trauma patients, revealed that r-TEG-directed resuscitation was administered in the majority of patients. However, the variability in FFP transfusion elucidates an area of potential process improvement which may guide future goal-directed blood product allocation.

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PASSIVE PERINATAL IMMUNOTHERAPY VIA TRANSAMNIOTIC ANTIBODY DELIVERY

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Purpose

Fetal administration of immunoglobulin can mitigate perinatal infections, including in association with surgical disease, as well as fetal alloimmune disorders. Indirect delivery via the mother is limited by poor and selective placental transfer and direct fetal administration is invasive and morbid. We sought to determine whether the amniotic cavity/fluid could be an attainable route of administration of therapeutic antibodies to the fetus and neonate.

Methods

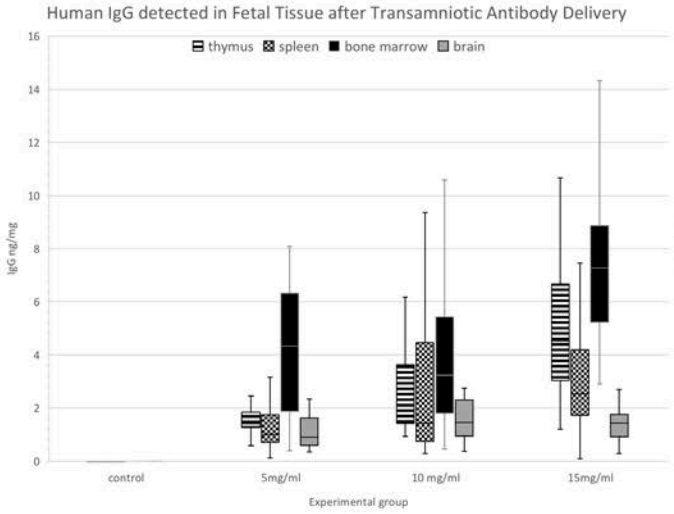
After IACUC approval, fetuses (n=109) from time-dated pregnant Sprague-Dawley dams (n=9) received volume-matched intra-amniotic injections on gestational day 18 (E18; term=21-22 days) of either saline (n=29), or different concentrations of a suspension of IgG antibodies pooled from human serum: 5mg/mL (n=28), 10mg/mL (n=28), or 15mg/mL (n=24). The human IgG used was ≥95% homogeneous and confirmed to lack homology with rodents. At term, the presence of human IgG was quantified by ELISA in the serum, bone marrow, spleen, thymus, and brain of all neonates, as well in the maternal serum. Statistical analysis was by median regression with significance set at Bonferroni-adjusted $p < 0.008$.

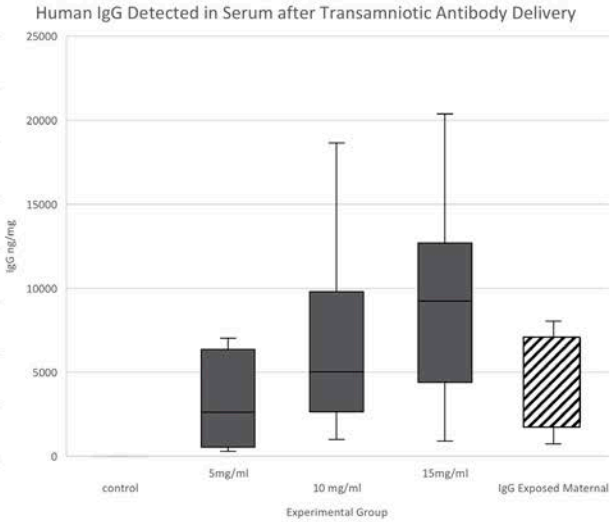
Results

Overall survival was 83% (90/109), with no significant difference between the groups. Human IgG was detected in the serum, bone marrow, spleen, thymus, and brain of all fetuses for all three injected concentrations, but not in the saline injected controls (figure; $p < 0.001$). A dose dependent relationship between injection concentration and final IgG load was noted in the bone marrow, spleen, and thymus ($p=0.004$ to < 0.001 in different pairwise comparisons). Human IgG was also detected in maternal serum (figure).

Conclusions

IgG antibodies can reach high levels in the fetal/neonatal circulation after simple intra-amniotic administration in a healthy rodent model. Delivery concentration affects antibody load at select anatomical sites. Targeted transamniotic antibody delivery may become a practicable strategy of passive immunotherapy for fetuses and neonates, possibly enhancing their protection against alloimmunity and infections.


Human IgG detected in Fetal Tissue after Transamniotic Antibody Delivery
thymus
spleen
bone marrow
brain
IgG ng/mg
16
14
12
10
8
6
4
2
0
control
5mg/ml
10 mg/ml
15mg/ml
Experimental group


Human IgG Detected in Serum after Transamniotic Antibody Delivery
IgG ng/mg
25000
20000
15000
10000
5000
0
control
5mg/ml
10 mg/ml
15mg/ml
IgG Exposed Maternal
Experimental Group

38

IN UTERO BASE EDITING AMELIORATES PATHOLOGY IN A MOUSE MODEL OF MUCOPOLYSACCHARIDOSIS TYPE I

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Purpose

Mucopolysaccharidosis I (MPS-IH) is a congenital disease caused by a G-to-A mutation in the IDUA gene which results in non-functional IDUA enzyme and the buildup of glycosaminoglycan (GAG). MPS-IH causes significant progressive musculoskeletal morbidity often requiring multiple orthopedic surgeries. Children develop these pathologies early in life. Current treatments include enzyme replacement therapy and hematopoietic stem cell transplantation both of which have significant morbidity and cost. Investigative postnatal gene therapies are limited by inefficient skeletal correction. In contrast, prenatal gene correction offers the potential to correct the mutation before the onset of debilitating pathology.

Methods

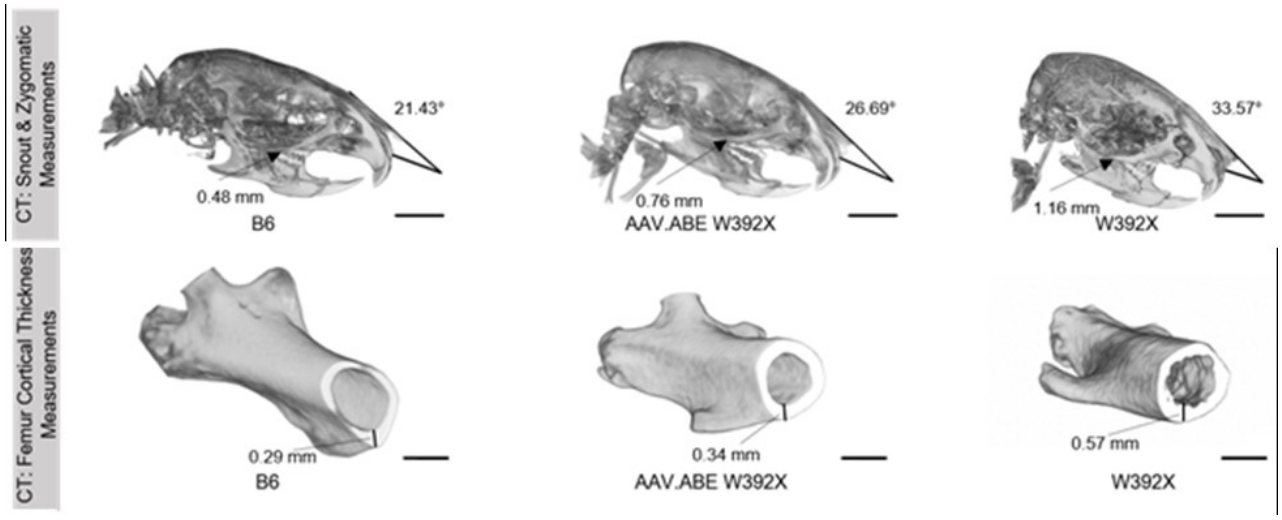
We delivered an adenine base editor and guide RNA targeting the murine MPS-IH mutation in embryonic day 15.5 fetuses (n=10) via the vitelline vein. Micro-computed tomography (μCT) of the whole skeleton was conducted at 6 months-of-age. Analysis of the CT scans was performed using Dragonfly v4.1. Bone and muscle tissue were assayed for editing, IDUA enzyme function, and GAG levels. Forelimb grip strength was assessed using a force gauge. Controls included age and sex-matched MPS-IH disease mice (n=14) and healthy C57Bl/6 mice (n=14).

Results

Next generation sequencing at 6 months demonstrated gene editing in the muscle (1.65%) and bone (0.29%). Compared to untreated Idua-W392X mice, treated mice had increased bone and muscle IDUA enzyme levels and decreased bone and muscle GAG levels ($p < 0.0001$). μCT demonstrated statistically significantly improved parameters of skull and femur cortical bone deposition such as cortical and zygomatic thickness, snout angle, and skull width/length (Figure 1). Finally, grip strength demonstrated significant improvement ($p < 0.0001$).

Conclusion

Correction of the pathologic mutation in the MPS-IH mouse via in utero base editing leads to improvement in musculoskeletal parameters. Due to early onset of musculoskeletal pathology associated with significant morbidity, in utero treatment of MPS-IH has significant relevance for clinical translation.



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MUSE: A NOVEL TECHNIQUE FOR REAL-TIME INTRAOPERATIVE IMAGING FOR HIRSCHSPRUNG DISEASE

Jordan E. Jackson, MD[1], Austin Todd, Arshia Rangchi[2], Sarah C. Stokes, MD[3], Laura A. Galganski, MD[3], Farzad Fereidouni[2], Karen Matsukuma[2], Richard Levenson[2], Payam Saadai, MD[3]

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Purpose
The diagnosis and surgical management of Hirschsprung Disease (HD) depends on the ability to accurately identify ganglion cells with histopathology. Difficulties associated with a histological diagnosis result in repeat operations and prolonged operative times. Microscopy using Ultraviolet Surface Excitation (MUSE) is a novel, slide-free imaging technique which can be used on tissue without traditional processing, and has the potential to incorporate artificial intelligence (AI) technology. This purpose of this study was to evaluate the ability of MUSE to image all layers of normal human colonic tissue.

Methods
Human colon was harvested with IRB approval during pediatric colorectal operations and stored in saline. The tissue was processed by microwave irradiation for rapid fixation with phosphate-buffered saline, stabilized in agarose, and hand sectioned. Tissues were then stained with readily available fluorescence stains, and the stained tissue was evaluated with MUSE and converted to “virtual-H&E” images in real-time with a modified color-mapping software. All images were reviewed by a gastrointestinal pathologist with expertise in HD.

Results
Time from tissue collection to imaging estimated 5 minutes: 30 seconds for rapid fixation, 2 minutes for fluorescence staining, 2 minutes for sectioning, and 30 seconds for capturing images. We were readily able to identify the following colonic structures: mucosa, muscularis mucosae, submucosa, muscularis propria (inner circular and outer longitudinal layers), and myenteric plexus with proposed ganglion cells in the MUSE images. The ability to identify colonic structures in the MUSE images was comparable to the corresponding virtual H&E images (Figure 1).

Conclusion
We were able to identify important colonic structures in human colon with a novel imaging technique. Furthermore, this imaging is fast and requires minimal processing rendering it potentially useful for intraoperative management of patients with HD. Future studies will include the incorporation of AI technologies to aid in the identification of ganglion cells.

40

POTENTIAL GLIAL CELL EFFECTS AFTER REPETITIVE TREATMENT WITH OPIOID, DEXMEDETOMIDINE, AND BENZODIAZEPINE: A NOVEL MODEL OF PEDIATRIC INTENSIVE CARE SEDATION IN EARLY CHILDHOOD APPROXIMATE RATS

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Purpose

Critically ill children requiring pediatric intensive care often develop neurological sequelae. Common sedatives contribute to these phenomena, however, there is scarce preclinical modeling to identify cellular mechanisms for targeted study. We hypothesized that glial cells in the developing brain are affected by repeated treatment with commonly used sedatives. We report a new preclinical model of morphine and dexmedetomidine, with comparison to morphine and midazolam.

Method

Injections of saline vehicle (n=22), morphine (n=21), dexmedetomidine (n=14), midazolam (n=12), morphine+dexmedetomidine (n=11), and morphine+midazolam (n=13) were administered twice daily to early childhood-approximate male and female Long Evans rat pups on postnatal days 18-23. Brain homogenates were analyzed with western blot for markers of glial reactivity: glial fibrillary acidic protein (GFAP), S100 calcium-binding protein B (S100B) and ionized calcium-binding adaptor molecule 1 (Iba1). Data analysis used Kruskal-Wallis with Dunn's posttest, with $p < 0.05$ significance.

Results

Compared to saline controls, the dexmedetomidine group expressed significantly more GFAP ($p=0.05$) and numerically less S100B, while midazolam treated pups expressed numerically less GFAP and significantly more S100B ($p=0.007$). Comparatively, GFAP levels were statistically different between midazolam vs. dexmedetomidine ($p < 0.001$), midazolam vs. morphine+dexmedetomidine ($p=0.02$), dexmedetomidine vs. morphine+midazolam ($p=0.001$), and morphine+midazolam vs. morphine+dexmedetomidine ($p=0.01$). S100B levels were comparatively different across pups injected with morphine vs. dexmedetomidine ($p=0.02$), midazolam vs. dexmedetomidine ($p < 0.001$) and midazolam vs morphine+dexmedetomidine ($p < 0.001$).

Conclusion

Brain tissue analysis in these models of commonly used sedatives showed effects on cerebral proteins important to neurodevelopment and neuroinflammation. Further investigation is warranted, as these findings may have implications for critically ill children, and may inform additional studies for optimizing sedation strategies.

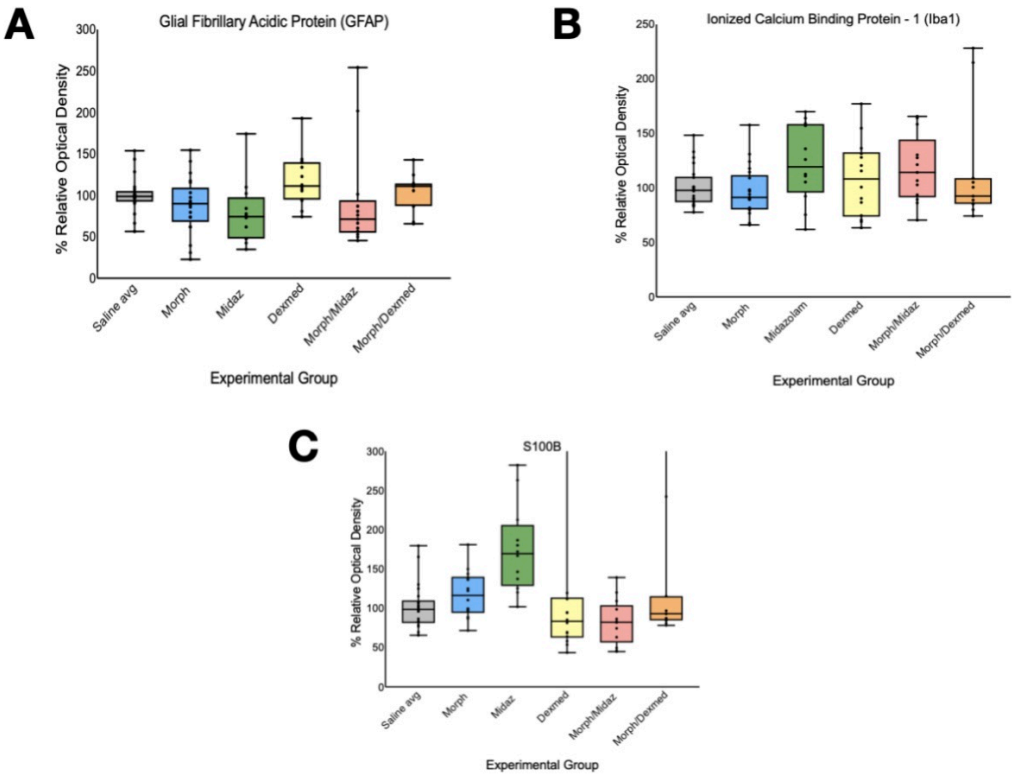

Figure 1: Representative combined sex group comparison *box whisker* plots for glial fibrillary acidic protein (GFAP), ionized calcium binding protein-1 (Iba1) and S100 calcium-binding protein B (S100B) concentrations in each experimental group

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A PUMPLESS ARTIFICIAL LUNG WITHOUT ANTICOAGULATION: THE NITRIC OXIDE SURFACE ANTICOAGULATION SYSTEM

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Purpose

Artificial lungs have the potential to provide children with end-stage lung disease dependent on extracorporeal life support a bridge to transplantation or recovery, but such devices currently require systemic anticoagulation. We describe our experience using the Nitric Oxide Surface Anticoagulation system with the Pediatric MLung—a low-resistance, pumpless artificial lung—without systemic anticoagulation in healthy animal subjects.

Methods

IACUC approval was granted. Cannulae (28 Fr), 50 cm of circuit tubing, and 2 connectors were coated with a nitric oxide (NO) donor (dibutylhexanediamine-N2O2) and argatroban. Sheep weighing 20-100 kg (n=6) underwent left anterior thoracotomy. Vascular access was obtained in the main pulmonary artery (device inflow) and the left atrium (device outflow). Animals received 100 U/kg heparin bolus at cannulation and cannulae were flushed once with 30 mL heparinized saline (10 U/mL) upon placement; no systemic anticoagulation was administered thereafter. NO was administered into the sweep gas at 100 ppm through an electrochemical NO generator. Animals were connected to the MLung under anesthesia for 24 hours. Laboratory and flow cytometry results were compared using paired student's T test ($p < 0.05$ considered significant).

Results

Three animals survived 24 hours; 3 were excluded due to issues with lung construction. In survivors, hemodynamics remained normal. Cardiac output was 3.8+/-1.8 L/min. MLung blood flow was 716+/-227 mL/min (Figure 1A), or 22.6+/-9.1% of cardiac output. Average outlet oxygen saturation was 98.3+/-2.6%. Pressure drop and resistance across the device were 6.3+/-2.9 mmHg (Figure 1B) and 10.2+/-7.4 mmHg/L/min, respectively. ACT was 151+/-24 seconds (Figure 1C; therapeutic anticoagulation = 240–280 seconds [shaded area]). Platelet count, plasma free hemoglobin, CD11b (leukocyte activation), and P-selectin (platelet activation) expression did not significantly change from baseline. There were no hemorrhagic or thrombotic complications.

Conclusion

We conclude that the Nitric Oxide Surface Anticoagulation system could allow a portable artificial lung such as the Pediatric MLung to be used without systemic anticoagulation.

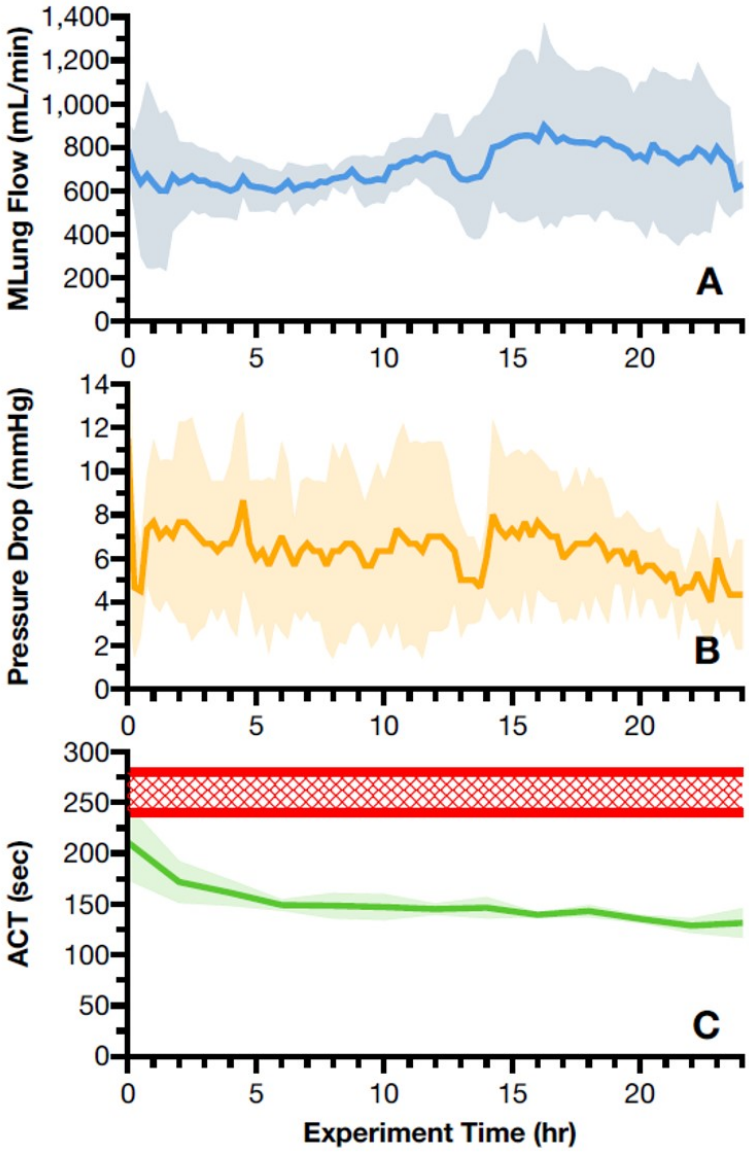

Figure 1. Performance of the Pediatric MLung with the NOSA system over 24 hours.
A. Blood flow through the MLung.
B. Pressure drop across the MLung.
C. Activated clotting time (ACT). The range of therapeutic anticoagulation for the sheep studied is 240–280 seconds (red shaded area).
Curves show mean, shaded areas show standard deviation for 3 animals.

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INTRAOPERATIVE ELECTROMAGNETIC NAVIGATION BRONCHOSCOPY (IENB): A NEW TECHNIQUE TO IMPROVE VIDEO ASSISTED THORACOSCOPIC BIOPSIES IN PEDIATRIC ONCOLOGY PATIENTS

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Purpose

The usefulness, diagnostic yield and accuracy of lung biopsies in pediatric oncology patients are variable. Here we describe our preliminary results using intraoperative electromagnetic navigation bronchoscopy (IENB) to increase the surgical yield and accuracy of lung biopsies in these patients.

Methods

From May 2018 until October of 2020 all lung biopsy for the pediatric oncology service were performed using IENB technology according to an IRB approved protocol. IENB tattooing using methylene blue, indocyanine green (ICG) or both, followed by Video-Assisted Thoracoscopic Surgery (VATS) were performed in the same operating room and during the same anesthetic. Data was collected retrospectively. Data points included diagnosis, technical success, pathologic diagnosis, alteration in treatment management and complications.

Results

A total of 10 procedures were performed on 8 patients during the time period of the study. Age at time of surgery ranged from 88 to 244 months. All had successful IENB with tattooing. All biopsies were diagnostic. No procedures had to be converted to open and there were no technical failures or procedure complications from either the IENB tattooing or the surgical biopsy. One patient had a total of 11 biopsies, 6 from the right lung and 5 from the left, performed at 2 separate procedures. Another had bilateral biopsies performed at the same operation. In 6 of the 8 patients treatment changes were made based on either pathologic or microbiologic results of their biopsy.

Conclusion

Here we present the first described experience of IENB tattooing of lung lesions in patients as young as 7 years old. We conclude that IENB is a safe and effective technique for guiding VATS lung biopsies in the pediatric oncology population with minimal morbidity. IENB can improve the diagnostic accuracy of lung biopsies in this population and adds little operative time to the procedure. Our preliminary findings warrant further investigation into this technique.

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PARTIAL HEPATECTOMY AND LIVER TRANSPLANTATION FOR THE MANAGEMENT OF MULTIFOCAL HEPATOBLASTOMA HAVE EQUIVALENT OUTCOMES

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Introduction

Multifocal hepatoblastoma (HB) has traditionally been associated with increased rates of local recurrence, unresectability after chemotherapy and has historically been treated with orthotopic liver transplantation (OLTx). We compared the outcomes of patients with multifocal HB treated at our institution with either OLTx or hepatic resection to determine superiority of treatment and risk factors for recurrence.

Methods

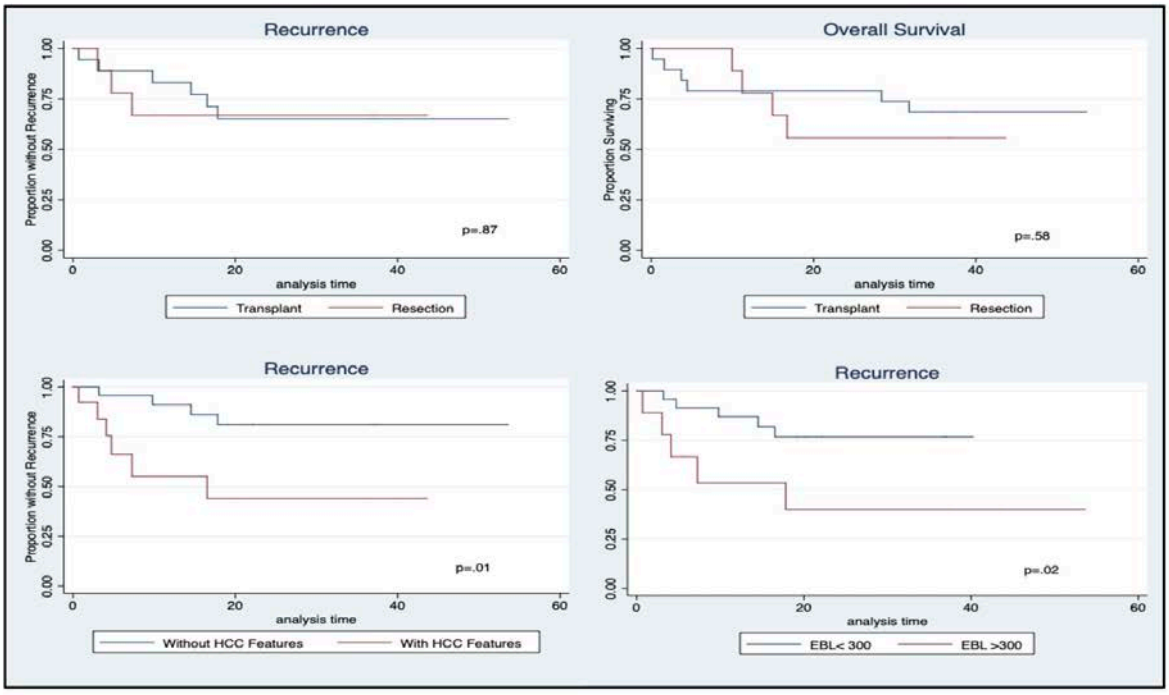
We performed a retrospective chart review on all patients < 18 years of age with multifocal HB treated at our tertiary center between 2002 and 2019. Patient demographics, operative procedure, pathological data, laboratory values, short- and long-term outcomes were analyzed.

Results

Thirty-eight patients were identified as having been treated for multifocal HB. Of this cohort, twenty-three (58%) underwent OLTx and sixteen (42%) underwent partial hepatectomy. Mean length of follow-up across all patients was 40.2 months. Pulmonary metastases at the time of surgery was noted to be higher in resections (37% vs 13%) and there was a higher number resection patients with pathology demonstrating hepatocellular carcinoma (HCC) like features t (56% vs 23%). Amongst recurrent patients, rates of intrahepatic relapse were similar between cohorts (57% vs 50%). Overall across all patients was 74%. There was no difference in recurrence rates (OLTx=32%, Resection=25%) or overall survival (OLTx=73%, Resection=75%) between the treatment cohorts (p=0.7 & p=0.6 respectively). Older patients (>72 months) experienced worse recurrence and survival (p=0.005 & p=0.003 respectively). Increased operative blood loss (> 300 cc EBL, p=0.03) and pathology demonstrating HCC features were associated with worse rates of recurrence (p=0.03).

Conclusions

Multifocal HB was adequately treated with both hepatic resection and OLTx with comparable results, even in higher-risk patients. In our series, hepatic resection was not inferior as compared to liver transplantation. HCC like features, increased patient age at diagnosis, and increased surgical blood loss for multifocal disease may be associated with worse outcomes.


Recurrence
Proportion without Recurrence
0.00
0.25
0.50
0.75
1.00
0
20
40
60
analysis time
p=.87
Transplant
Resection
Overall Survival
Proportion Surviving
p=.58
Transplant
Resection
Recurrence
Proportion without Recurrence
p=.01
Without HCC Features
With HCC Features
Recurrence
p=.02
EBL< 300
EBL >300

44

UTILIZATION OF INDOCYANINE GREEN FOR AUGMENTATION OF PULMONARY METASTASES RESECTION IN ADOLESCENT AND YOUNG ADULT SARCOMA PATIENTS

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Purpose
The lungs are the most common site of metastases in sarcoma patients. A survival advantage for resection of pulmonary metastases in patients with metastatic sarcoma has been well described for the resection of radiographically-confirmed and palpable pulmonary nodules. The use of fluorescent indocyanine green (ICG) imaging to improve visualization of lung lesions has been described. The aim of our study was to determine the efficacy and accuracy of diagnosis as well as any complications related to the use of ICG in adolescent and young adult patients with sarcoma.

Methods
An IRB-approved, institutional, retrospective review was performed on patients who received preoperative ICG prior to undergoing either video-assisted thoracoscopy or thoracotomy for pulmonary metastases resection between January 2018-June 2020. Patients with metastatic sarcoma to the lungs received ICG injection as an outpatient 24 hours prior to resection of their pulmonary metastasis. Demographic data, primary and metastatic tumor data, histology, number of lung nodules resected and whether the nodules were palpable, ICG positive, and positive for tumor was collected.

Results
Twelve patients underwent a total of 19 procedures, 155 specimens were resected. The median age was 21.9(IQR 17.3-32.1) years and ranged from 12- 41. Seventeen (89.5%) procedures were thoracotomies, 2(10.5%) were thoracoscopic. The most common diagnoses were osteosarcoma(26.3%), Leiomyosarcoma(21.1%),and Ewing's Sarcoma(21.1%). Mean number of ICG +, non-palpable, tumor + specimens was 1.4±4.2 for all tumor types. Median number of nodules resected was 6 (range 1-28), 46.5%(n=72) were ICG+, non-palpable. PPV=46.2, NPV=70. Sensitivity=85.9%, specificity=24.7%. There were no complications or side effects reported from ICG administration.

Conclusion
Utilization of ICG for pulmonary metastasectomy in sarcoma patients is well tolerated and may have clinical benefit in identification of non-palpable pulmonary metastases that may provide a survival benefit in the future for sarcoma patients. Further investigation with a prospective study is underway to further evaluate the technique and survival benefit.

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NEIGHBORHOOD-LEVEL SOCIAL DETERMINANTS OF HEALTH ASSOCIATED WITH PEDIATRIC APPENDICITIS OUTCOMES

Megan E. Bouchard, MD[1], Mia Casale[2], Tracie Smith[2], Yao Tian, MS, MPH[3], Christopher De Boer, MD MS[1], Sam Linton, MD[4], Kristin Kan[5], Hassan Ghomrawi[6], Fizan Abdullah, MD, PhD[7]

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Purpose

Complicated appendicitis may indicate a delay in care, partially due to patient-level social determinants of health (SDoH) such as race, insurance and income. Neighborhood-level SDoH have been associated with disparities in other pediatric health conditions, though their effect on appendicitis outcomes remains unknown. We examined the association between the Child Opportunity Index (COI), a validated, comprehensive measure of 29 neighborhood indicators that impact children's health, and the odds of presenting with complicated appendicitis.

Methods

We retrospectively identified patients ≤ 18 years old diagnosed with appendicitis between 2016-2018 from the Pediatric Health Information System (PHIS) database. Elective admissions were excluded to remove interval appendectomies. We linked PHIS to the COI Database at the zip code level. Nationally-normalized COI measurements are divided into quintiles (very low to very high opportunity) and its subdomains: education, socioeconomic and health/environment. Hierarchical logistic regression was used to assess the odds of complicated appendicitis as a function of COI. Covariates were age, sex, race/ethnicity, insurance, rurality and complex chronic conditions.

Results

A total of 17,297 patients were identified, of whom 6,495 (37.5%) were complicated. The highest proportion of patients were non-Hispanic white (41.2%), male (58.5%), publicly-insured (57.0%) and urban (93.2%), with a mean age of 10. In multivariate regression, a decreased odds of complicated appendicitis was associated with higher COI (Table). This pattern was also observed for the education and socioeconomic subdomains, though not for the health/environment subdomain.

Conclusion

Children from higher COI neighborhoods had a decreased risk of presenting with complicated appendicitis. The COI subdomain findings can inform interventions to increase community opportunity and promote equitable pediatric health outcomes across neighborhoods. Reducing appendicitis disparities should involve addressing SDoH, including patient-level screening to mitigate risk factors and policy-level interventions such as neighborhood-focused investment, reallocation of community resources and improved healthcare access to geographically underserved regions.

COI	N (% complicated appendicitis)	Unadjusted complicated appendicitis OR (95% CI)	Adjusted complicated appendicitis OR (95% CI)	Adjusted complicated appendicitis p-value
Very Low	4957 (41.2%)	*Reference*	*Reference*	*Reference*
Low	3335 (40.0%)	0.99 (0.89, 1.10)	1.00 (0.90, 1.11)	0.96
Moderate	2855 (37.2%)	0.89 (0.80, 1.00)	0.91 (0.81, 1.02)	0.10
High	2453 (35.7%)	0.84 (0.74, 0.95)	0.87 (0.77, 0.99)	0.03
Very High	3640 (31.9%)	0.71 (0.63, 0.79)	0.79 (0.70, 0.89)	<0.01

Table: Demonstrates the unadjusted and adjusted odds ratios (OR) for presenting with complicated appendicitis. The very low child opportunity index (COI) was used as the reference point. N (number of appendicitis patients) and CI (confidence interval).

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URINARY CONTINENCE DISPARITIES IN PATIENTS WITH ANORECTAL MALFORMATIONS

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Purpose

While fecal continence is a primary concern for many children with anorectal malformations (ARM), urinary incontinence is also prevalent in this population. Racial, ethnic, and socioeconomic disparities in urinary continence have been observed in individuals with conditions such as spina bifida but have not been previously evaluated in ARM. We aim to evaluate urinary continence and associated demographic characteristics in children and adolescents with ARM.

Methods

We performed a multicenter retrospective study of children with ARM evaluated at sites participating in the Pediatric Colorectal and Pelvic Learning Consortium (PCPLC). The PCPLC hosts a registry of patients with colorectal and pelvic disorders, providing demographic and clinical information. We included all patients with ARM 3 years and older (2016-present). The primary outcome was urinary continence. Continence was categorized as complete (no accidents), daytime (accidents at night), partial (rare or occasional accidents), and none (completely incontinent). We evaluated for associations between urinary continence and race, sex, age, insurance status, and adoption status, employing Kruskal-Wallis and trend tests. P-value < 0.05 was considered significant.

Results

A total of 525 patients with ARM from 13 institutions were included. Overall, 48% reported complete urinary continence, and continence was associated with greater age ($p < 0.001$). For school-aged children (age ≥ 5 years), 58% reported complete continence, while 30% reported none. Private insurance was associated with improved continence ($p=0.039$), and adopted status was associated with worse continence ($p = 0.041$). Associations with race and gender were not observed.

Conclusions

We observed a novel finding of disparities in urinary continence for children with ARM related to insurance and adoption status. Further investigation regarding the etiologies of these inequalities is needed in order to affect clinical outcomes in these patients.

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IN HEALTHY AFRICAN AMERICAN CHILDREN LACK OF HEALTH INSURANCE PREDICTS A POSITIVE CORONAVIRUS DIAGNOSIS

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Background

Among the SARS-CoV-2–associated deaths in persons aged < 21 years reported to CDC by July 31, 2020, Hispanic, non-Hispanic Black and non-Hispanic American Indian/Alaskan Native persons accounted for 78% of these deaths. In the US testing and contact tracing for African American (AA) parents has been elusive and even greater for their children, as many testing locations are not equipped to test pediatric patients. These are two critical tools to necessary mitigate spread, morbidity and mortality.

Methods

A pediatric surgeon recruited healthcare professionals and created a mobile testing unit, providing access to testing while collecting important policy changing data. Zip codes where the positivity rates were the highest were identified through the Philadelphia Department of Public Health (PDPH). Partnerships with faith based organizations allowed children (< 18 years) to be tested in church parking lots. Children were also tested in parks and playgrounds, all at no cost. FDA approved PCR nasal and nasopharyngeal tests were performed. Medical team notified parents of results. Descriptive statistics and bivariable analyses were performed.

Results

From April to September 2020, n=403 children were tested. Positivity rate was 10% (n=39). Most children were positive in April and May 2020. Children aged 6-10 had the highest positivity rate (12%) compared to children < 6 years (8%) and children 11-17 (9%). Co-morbid conditions were not significant predictors of a COVID19+ test. Greater than 75% of children had health insurance. However, lack of health insurance correlated with a higher odds of COVID19+ diagnosis, {OR=2.77; 95%CI (1.10, 6.99)}.

Conclusion

Lack of health insurance in children is a proxy for poverty and diminished access to quality healthcare. Our data demonstrate this fact and support more widespread barrier free testing for uninsured at risk children. As health care workers we must advocate and work toward equity in care and abolishing systemic barriers that contribute to health disparities.

Table 1. Bivariable associations between COVID19 positivity and patient characteristics.

Characteristic	Odds Ratio	95% CI		p-value
Race				
Black	1.28	0.16	10.23	
Hispanic/Latino	0.60	0.03	10.51	0.824
Other or Unknown	1.54	0.18	13.31	
White	Reference			
Age				
<6	Reference			
6-10	1.55	0.41	5.88	0.725
11-17	1.19	0.34	4.13	
No Insurance	2.77	1.10	6.99	0.031
PCP	0.79	0.22	2.83	0.721
Symptoms	1.63	0.82	3.23	0.163
Comorbidity				
None	Reference			
1	0.25	0.03	1.88	0.308
2 or more	0.57	0.07	4.42	

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IMPACT OF COVID PANDEMIC ON TELEMEDICINE UTILIZATION – TOWARD MAINTAINING ACCESS FOR RURAL AND LOWER SOCIOECONOMIC COMMUNITIES

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Purpose

To examine the utilization of telemedicine in pediatric surgery before and during the COVID pandemic.

Methods

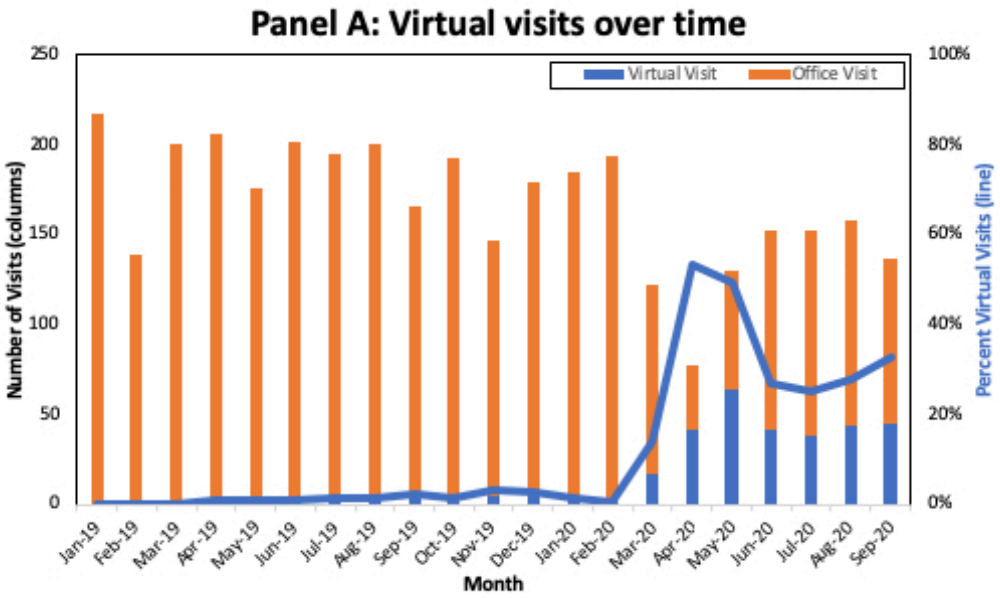
A retrospective single-center review was performed at a tertiary Children's Hospital from January 2019 to September 2020 evaluating Pediatric Surgical outpatient visits. Data were collected on the modality of visit (On-site versus Telemedicine) and compared before and during the pandemic. Detailed analysis was conducted on a 4-week period during peak stay-at-home orders and compared with same 4-week period one-year prior (pre-COVID-19). Socioeconomic and rural status were evaluated using patient residence zip codes and the 2010 US Census (income) and 2013 USDA Economic Research Service Rural-Urban Continuum Codes (population). Standard statistical analysis was preformed with a $p < 0.05$ deemed significant.

Results

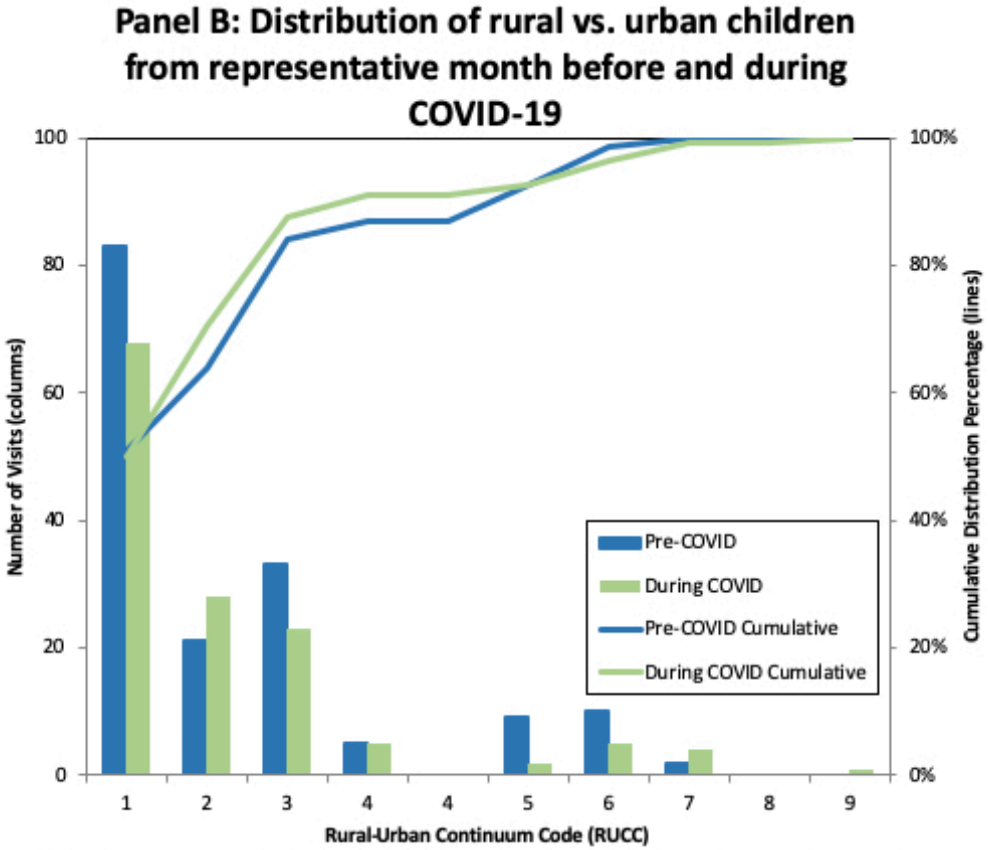
A total of 3524 total encounters were identified of which 323 were virtual visits. A significant increase in virtual visits (video and telephone) began after declaration of a pandemic on March 11, 2020 (Panel A). There was an overall decrease in total visits early in the pandemic with a return towards baseline as restrictions were eased. The proportion of virtual visits increased significantly during the early phase of the pandemic and persisted after restrictions were lifted ($p < 0.05$). When comparing access during a 4-week period at the peak of COVID-19 infections to a similar pre-COVID-19 period, there were no differences in socioeconomic status (median income, $p = 0.21$) or rural-urban distribution of children (Panel B, $p = 0.31$).

Conclusions

The COVID-19 pandemic continues to alter medical practice around the world with significant constraints for non-emergent visits. Access for patients from rural and lower socioeconomic communities can be maintained despite a transition to telemedicine. The utility of this technology represents a dramatic and likely lasting change in how care is delivered.



Panel A depicts the number of virtual (blue columns) and office (orange columns) visits in an outpatient pediatric surgery clinic from January 2019 to September 2020. The proportion of virtual visits is negligible until the COVID-19 pandemic, at which time the proportion of virtual visits peaks to 53% and then tends toward approximately 30% after easing of state-wide COVID-19 restrictions.



Panel B depicts the number of visits during a 4-week period at the peak of COVID-19 infections (green columns and line) to a similar pre-COVID-19 period (blue columns and line) as a function of rural-urban continuum code (RUCC). The RUCC is a USDA-determined graded rating ranging from 1 (metropolitan) to 9 (rural). There is no significant difference in the RUCC distribution between these two periods of time, indicating maintained access of rural children despite a shift to telemedicine.

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AN ANALYSIS OF AMERICAN PHYSICIAN PROFESSIONAL ASSOCIATION STATEMENTS ABOUT GUN VIOLENCE AGAINST CHILDREN

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[1]University at Buffalo, SUNY and Oishei Children's Hospital, Buffalo, NY, USA, [2]University at Buffalo, SUNY, [3]Oishei Children's Hospital of Buffalo, Soldiers Place, NY, USA

Purpose

We examine the content of physician professional association statements and assess the extent to which these statements kept gun violence, especially gun violence against children, on policymakers' agendas.

Methods

With the help of a medical librarian, we constructed a list of 49 physician professional associations that are primarily comprised of U.S. physicians. We then located position statements by consulting professional association websites, conducting a PubMed search, and reviewing the citations of identified statements. Once unique statements were identified (Nf24), two reviewers independently coded content such as major events, pediatric focus, firearm type, and policy recommendations. Additionally, data was collected on reaffirmations and endorsements.

Results

The earliest statement located was from August 1985. Early activity was driven by the American Academy of Pediatrics and the American College of Physicians. Statement volume appears to be timed following mass casualty events such as the Sandy Hook and Parkland school shootings (Table 1). Endorsing statements is a more common strategy than generating an original statement. Ten statements focused on the pediatric population, while an additional 10 made reference to the pediatric population. The most common recommendations were freedom of physician counseling (83%), increased gun violence research or research funding (79%), and identifying gun violence a public health epidemic (71%).

Conclusion

We conclude that most physician professional associations appear to be reacting to current events rather than keeping gun violence against children continuously on the agenda. The timing of statements and events referenced indicate that the motivation for such statements is mass casualties, rather than the thousands of children shot each year. Most statements recommended that additional gun violence research be conducted; pediatric firearm injury surveillance systems that generate ongoing data will be an important contribution to improving our evidence base and keeping the focus on these tragic and preventable injuries.

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ADVERSE CHILDHOOD EXPERIENCES (ACES) IN THE PEDIATRIC TRAUMA POPULATION: EVALUATION OF AN AT-RISK POPULATION

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Purpose

Adverse Childhood Experiences (ACEs) are known childhood events that increase risk of long-term adverse health outcomes such as obesity, cardiovascular disease, polysubstance abuse, depression, and suicide. In the United States, around 10% of children will experience 3 or more ACEs. In this study, we sought to identify the prevalence of ACEs in a pediatric trauma population.

Methods

Using the Pediatric ACEs and Related Life Events Screener (PEARLS) tool, all patients presenting to the trauma clinic from September 2019-July 2020 were screened. A positive screening test consisted of 2 or more ACEs for children ages 0-12 and 4 or more for children ages 13-18. Screening tests were given to the caregiver for patients less than 13 and to both the caregiver and the patient for older children. Patient demographics and details of initial trauma encounter were also recorded.

Results

The population was majority male (55%) and African American (60%). Insurance status was predominantly public (65%). The most common type of trauma was burn (80%) followed by blunt (13%). For children less than 13, 26% had a positive screen. For children ages 13 or older, 28% presented with a positive screen per their caregiver; however, 43% of these patients had a positive, self-reported screen. Those that presented with positive screens or by request were given referral to mental health services.

Conclusion

Overall, over a quarter of patients presenting to the pediatric trauma clinic reported a high prevalence of ACEs exposure. This number increased dramatically to nearly half for teenage patients. The trauma clinic provides an invaluable initial point of screening and potential intervention with both social and psychological support for this at-risk population. Future studies are needed to evaluate the effectiveness of intervention and treatment programs in this setting.

Scientific Session 4 - General and Thoracic Surgery

6:00 PM – 8:00 PM

P20

OPPORTUNITIES FOR IMPROVEMENT IN PEDIATRIC OVARIAN TISSUE CRYOPRESERVATION: EVALUATION OF TISSUE FRAGMENTS AND ROUTINE PUNCH BIOPSIES.

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Ovarian tissue cryopreservation (OTC) is the only fertility preservation option for pre-pubertal females. Current protocols are optimized for adults and preserve primordial follicles (ovarian reserve) within the superficial 1.5-2.0mm of ovarian cortex. Previous work revealed primordial follicles in pre-pubertal tissue removed during OTC processing, suggesting an opportunity to use knowledge gained from further characterization of pediatric ovaries to optimize an OTC process for pre-pubertal patients. Tissue fragments discarded during OTC processing and punch biopsies (PB) obtained for routine pathology at a tertiary children's hospital were collected. Fragments containing follicles (FCF) identified by transillumination microscopy (Nf9; 5 pre-pubertal, 4 post-pubertal) were fixed and stained with hematoxylin and eosin (H&E), to count and stage ovarian follicles. Remaining fragments (Nf3 patients) were incubated with Neutral Red (NR) to stain viable oocytes. H&E stained PB (Nf10; 6 pre-pubertal, 4 post-pubertal) were analyzed for corticomedullary demarcation and depth of deepest primordial follicle. Significance was determined using unpaired, two-tailed t-tests. Primordial follicle density in FCF was 4.25 follicles/mm2 in pre-pubertal samples vs. 0.11 follicles/mm2 in post-pubertal samples (p=0.19). 45.50% of pre-pubertal samples contained primordial follicles vs. 10.71% in post-pubertal samples (p=0.09). NR revealed additional follicles in fragments that were not previously identified to contain follicles. 2/6 pre-pubertal patients demonstrated a clear corticomedullary junction vs. 3/4 post-pubertal patients. In these patients, average cortical thickness was 1.35mm in pre-pubertal samples vs. 0.92mm in post-pubertal samples. Depth of deepest primordial follicle averaged 2.65mm in pre-pubertal patients and 0.62mm in post-pubertal patients (p=0.01). Pre-pubertal ovaries are less likely to display a clearly demarcated corticomedullary junction and contain primordial follicles in deeper layers of the ovary. This structural difference may lead to more primordial follicles present in fragments removed during standard OTC processing. Additional investigations will inform new standards that will maximize the fertility potential of tissue saved for pre-pubertal patients.

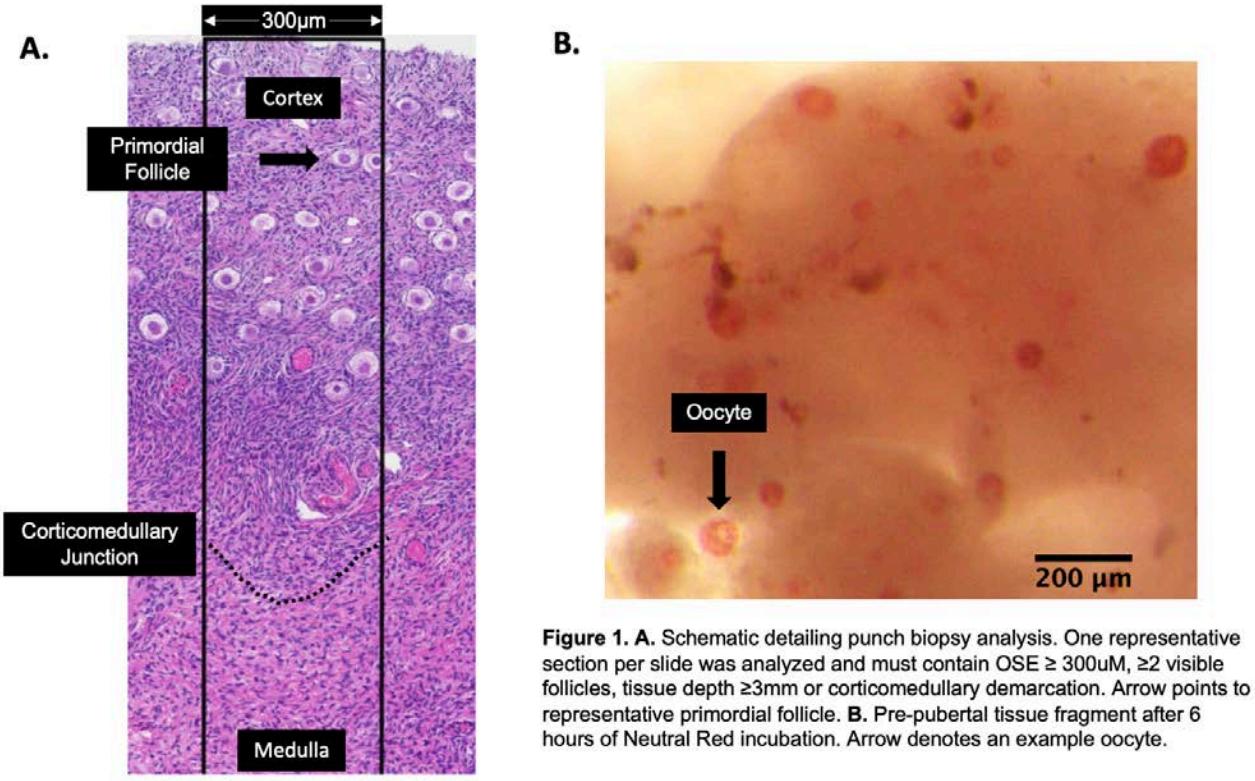

Figure 1. A. Schematic detailing punch biopsy analysis. One representative section per slide was analyzed and must contain OSE ≥ 300uM, ≥2 visible follicles, tissue depth ≥3mm or corticomedullary demarcation. Arrow points to representative primordial follicle. **B.** Pre-pubertal tissue fragment after 6 hours of Neutral Red incubation. Arrow denotes an example oocyte.

P21

DOES ROUTINE BOTULINUM TOXIN GIVEN AFTER A PRIMARY PULL-THROUGH DECREASE THE INCIDENCE OF HIRSCHSPRUNG ASSOCIATED ENTEROCOLITIS (HAEC)?

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Purpose
Patients with Hirschsprung disease (HD) are at risk of Hirschsprung associated enterocolitis (HAEC) following pull-through. The purpose of this study was to determine if routine Botulinum toxin (BT) injected one-month post pull-through decreases the incidence of HAEC.

Methods
We reviewed patients who underwent a primary pull-through operation for HD between 2014 to 2019. Over the most recent 18 months, BT was administered routinely one-month post-pull-through procedure. These patients were compared to the prior group that did not receive routine BT. A HAEC episode was defined as initiating treatment for obstructive symptoms in the inpatient or outpatient setting with antibiotics and irrigations. Categorical variables were compared using the nonparametric chi-square test or Fisher's exact test. Continuous variables were compared using the two-tailed Student's t-test. P-value < 0.05 was determined to be statistically significant.

Results
A total of 70 patients underwent primary Swenson pull-through during the study period (52% male). There was no statistically significant difference in demographics in the BT vs non-BT group. Routine post-pull-through BT was given in 28 patients and did not significantly change the incidence of HAEC (12/28, 43% vs. 16/42, 38%. P=0.691). The patients in the BT group developed HAEC significantly sooner than the patients in non-BT group (37.5 days vs. 253 days, p=0.029). More patients in the BT group (n=18, 64%) required subsequent BT injections compared to the patients in the non-BT group (n=11, 26%. P=0.001).

Conclusions
We conclude that routine postoperative botulinum toxin injection did not reduce the incidence of HAEC. Patients who received routine postoperative BT developed their first episode of HAEC sooner than the patients who did not. A prospective controlled study is necessary to confirm these findings.

P22

SINUSECTOMY – AN EFFECTIVE IN-OFFICE TREATMENT FOR PILONIDAL DISEASE IN ADOLESCENTS

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Background

Pilonidal disease affects adolescents and its surgical treatments are expensive, disruptive and typically require general anesthesia and a hospital stay. We report a series of adolescents who underwent sinusectomy under local anesthesia in an office treatment room without activity restrictions.

Methods

Demographics, disease severity, procedures, and outcomes were analyzed from December, 2015 to February, 2020. Procedures were performed in the office treatment room with local anesthesia or in the operating room with general anesthesia for patients with autism or anxiety. Ibuprofen and/or acetaminophen were advised as needed with no activity restrictions. Clinic visits continued until wound healing and resolution of hirsutism.

Results

300 sinusectomies were performed in 204 patients. 282 (94%) were performed in the clinic with local anesthesia, and 18 (6%) in the OR under general anesthesia. Mean age was 17 years (SD 2.5), mean BMI was 26.7 (SD 5.4), and 59% were male. Presenting disease severity was mild: 64 (31%), moderate: 103 (50%), or severe: 37 (18%). 135 (66%) patients underwent 1 sinusectomy, 49 (24%) underwent 2, and 20 (10%) underwent 3 or more, all in the office. 157 (77%) patients underwent laser epilation. Average follow-up was 11.8 months (SD 10.4). 145 (71%) experienced complete resolution of disease, 19 (9%) continue to receive care, and 41 (20%) were lost to follow-up.

Conclusions

Sinusectomy is an effective, well tolerated, minimally invasive procedure for pilonidal disease that can be safely performed in an office setting with local anesthesia and repeated as needed.

P23

THE EFFECT OF STANDARDIZED DISCHARGE INSTRUCTIONS AFTER GASTROSTOMY TUBE PLACEMENT ON POSTOPERATIVE HOSPITAL UTILIZATION

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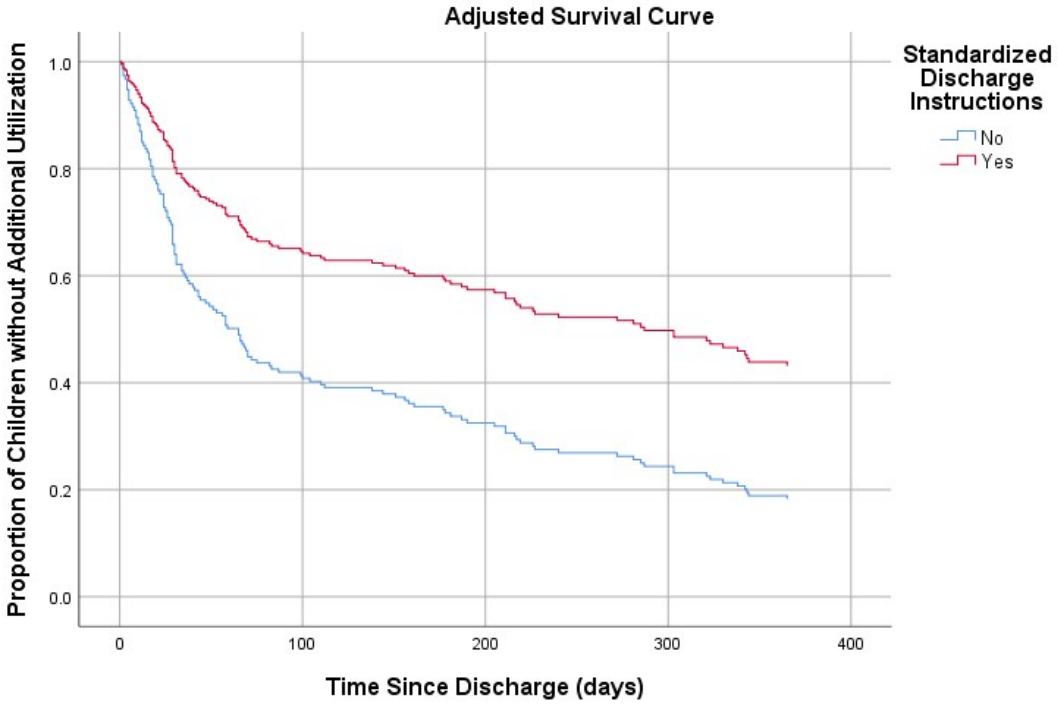
Purpose
Gastrostomy tube (g-tube) placement is a common procedure performed by pediatric surgeons with high postoperative resource utilization. We aimed to determine if the use of standardized postoperative discharge instructions (SPDI) reduced 30-day and 1-year healthcare utilization rates.

Methods
We performed a retrospective cohort study comparing postoperative hospital utilization of patients who underwent initial g-tube placement pre- and post-implementation of an SPDI protocol from 2014-2019. Our primary outcome was emergency department (ED) visits, office visits, phone calls and readmissions related to g-tube surgery at 30 days and 1-year post-discharge. We also determined the change in the rate of hospital resource utilization events and time to first event. Significance was determined via Chi-square tests, multivariable adjusted logistic regression models, adjusted Poisson regression, and adjusted Cox proportion hazard regression models when appropriate.

Results
197 patients met inclusion criteria, 102 (51.8%) before and 95 (48.2%) after implementation of our SPDI protocol. Compared to patients pre-SPDI, patients after implementation had significantly fewer ED (8.4 vs. 19.6%, p = 0.026) and office visits (11.6 vs. 25.5%, p=0.017) within 30 days of discharge. Patients that did not receive the SPDI had a greater odds of ED visits (OR2.7, 95%CI 1.3-5.9, p=0.01), office visits (OR3.7, 95%CI 1.7, 8.1, p=0.001) and phone calls (OR2.6, 95%CI 1.2, 5.7, p=0.016) at one year compared to those that did. They also had an adjusted incident rate ratio for any utilization event of 1.8 (95%CI 1.2-2.5, p=0.002) at 30 days and 1.9 (95%CI 1.5-2.4, p < 0.001) at 1-year post-discharge. The adjusted survival curve demonstrating the proportion of children without additional utilization events is shown in the figure (Hazard ratio 2.0, 95%CI 1.4-3.0, p < 0.001).

Conclusion
Standardized postoperative discharge instructions after gastrostomy tube placement are associated with significantly reduced 30-day and 1-year postoperative hospital utilization.


Adjusted Survival Curve
Proportion of Children without Additional Utilization
1.0
0.8
0.6
0.4
0.2
0.0
0
100
200
300
400
Time Since Discharge (days)
Standardized Discharge Instructions
No
Yes

P24

POST-GASTROSTOMY COMPLICATIONS AND EMERGENCY DEPARTMENT UTILIZATION ARE TIED TO COMMUNITY LEVEL SOCIAL DETERMINANTS OF HEALTH

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Background

Gastrostomy tube (G-tube) placement is a common procedure in children, but often has high healthcare utilization and costs. Prior reports have described racial inequality in G-tube related healthcare utilization and complications. We hypothesized that beyond race, socio-economic risk factors predict adverse outcomes.

Methods

Following institutional review board approval, a retrospective review of children who underwent G-tube insertion between March 2011 and June 2018 at a single institution was performed. Children living at an address not coded in the 2015 American Community Survey were excluded. Patients' Social Deprivation Index (SDI) and Area Deprivation Index (ADI) were tabulated utilizing the patient's census tract or block group. Univariate statistics were compared with the student's T-test.

Results

166 patients were included in analyses. Emergency department (ED) utilization was higher in patients who identified as African American compared to Caucasion (2 vs. 0.89 visits per child, p=0.0015). African American children were more likely to live in communities with higher deprivation indices compared to Caucasian children (ADI mean 78 vs. 62, p=0.0001, SDI mean 74 vs. 47, $p < 0.0001$). Children living in areas of high deprivation had higher ED utilization (1.38 vs 0.53 visits per child, p=0.0003). Subset analyses by race showed both indices predicted G-tube related ED visits and early (within 90 days) G-tube dislodgement in African American children (Table 1). Furthermore, increased ED visits and need for G-tube related procedures were also associated with high SDI and ADI in Caucasian children (Table 1).

Conclusions

Community level deprivation indices, which transcend race, can predict a patient's individual risk of experiencing a complication requiring ED visitation after G-tube placement. These metrics may cue providers to families which may benefit from additional outreach, training, or other interventions to optimize care for children after G-tube placement.

P25

MINIMALLY-INVASIVE SUTURED OPEN REDUCTION INTERNAL FIXATION OF THE SLIPPED RIB: A NOVEL METHOD OF ALLEVIATING INTERCOSTAL NEURALGIA FROM SLIPPED RIB SYNDROME IN PEDIATRIC PATIENTS

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Purpose

Slipped rib syndrome (SRS) affects one or more of the 8-10th false ribs, triggering pain. In the pediatric population, SRS has been managed with analgesia, intercostal nerve blocks, and costal cartilage excision with mixed results. A novel technique of minimally-invasive sutured open reduction and internal fixation of the slipped rib without costal cartilage excision has alleviated intercostal neuralgia in adult patients. Here we report the first series of this procedure in pediatric SRS patients, hypothesizing improved pain and quality of life scores using validated standardized outcome measures.

Methods

After IRB approval, we performed a retrospective review of pediatric (< 21 years) cases of SRS treated at two institutions in 2020. Clinical details, including work up, medication needs, and results of the short form Orebro Musculoskeletal Pain Screening Questionnaire, were collected pre- and post-operatively. Questionnaire outcomes were compared using the Wilcoxon signed rank sum test.

Results

SRS was diagnosed clinically and nine patients (ages 12-21 years, mean 16) underwent suture fixation by two surgeons. Six were female, and three were male. Five were hypermobile, and two were trauma related. Suicidal ideation was present in two. Symptoms had been present for 18 months (mean, range 6-48). Four had bilateral repair, one in a staged fashion. At one month follow up, there were no surgical complications and narcotic medications used postoperatively were discontinued while ibuprofen was used in one patient. Patients reported significantly less pain ($p < .001$), and at six month follow up, had no pain and no medication needs (Table 1).

Conclusions

Pediatric patients with slipped rib syndrome demonstrate an excellent response to suture fixation without costal cartilage excision in this pilot. Long term data are needed to ensure longevity of response and durability of repair.

P26

HOSPITAL VOLUME-OUTCOME RELATIONSHIP FOR PECTUS EXCAVATUM REPAIR

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Purpose

The inverse relationship between higher surgical volume and improved patient outcomes has been established across multiple procedures. Pectus Excavatum repair (PER) is a complex, elective procedure in pediatric and young adolescent patients with a relatively high complication rate. Outcomes may improve with increased volume; however, this relationship has not been previously examined. We investigated the association between hospital and surgeon volume and complications after PER in a large national cohort.

Methods

Patients undergoing PER between 01/01/2013 and 12/31/2019 were identified from the Children's Hospital Association Pediatric Health Information System (PHIS) database using ICD-9-CM and ICD-10-CM diagnosis and procedure codes. Overall hospital and surgeon volumes were stratified into quartiles. The primary outcome was presence of complication (e.g., bar displacement, infection) based on ICD codes. Hierarchical logistic regression was performed to evaluate association of volume with complication risk, controlling for six patient co-variates and clustering within hospitals.

Results

We identified 7,817 PER patients (avg age 15.4 years; 17% female; 71% Non-Hispanic White, 67% with no reported comorbidities) treated by 408 surgeons at 47 hospitals. Patients undergoing PER at a hospital in the 2nd, 3rd and 4th lowest volume quartile had 63.2% (34.5-79.%), 55.5% (22.5-74.4%) and 66.3% (41.8-80.5%) lower odds of complication compared to the lowest volume quartile (Q1), respectively. Physician analysis showed 51.8% (12.3-72.8%) lower odds of complication in quartile 2 compared to Q1, controlled for hospital volume, but Q3 and Q4 did not have statistically significantly lower odds of complication compared to Q1.

Conclusions

We demonstrate an inverse relationship between PER hospital case volume and surgical complication risk for PER patients; but this relationship was not consistent for surgeon volume. These relationships emphasize the importance of hospital-based protocols and infrastructure in high volume hospitals over surgeon volume, provide strong rationale for both regionalization and within-hospital provider case-mix.

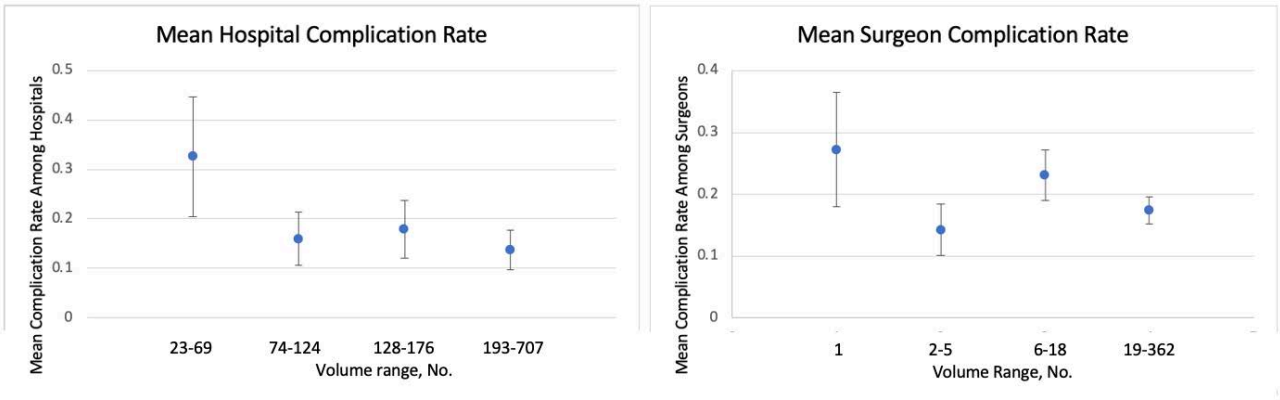

Fig. 1: Mean hospital and Physician complication rate per volume quartile with 95% confidence intervals

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OVARIAN PRESERVATION AND RECURRENT TORSION: BOTH LESS COMMON THAN WE THOUGHT

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Purpose
Surgical management of pediatric ovarian torsion includes total oophorectomy (TO) or ovarian preservation surgery (OPS). This study sought to identify factors contributing to surgical management, as well as readmission outcomes for ovarian torsion.

Methods
The Nationwide Readmission Database from 2010-2014 was used to identify patients < 18 years admitted with ovarian torsion. Patient factors, hospital characteristics, and readmission outcomes were compared by TO and OPS. Standard statistical analysis was performed and significance was set at $p < 0.05$. Results were weighted for national estimates.

Results
There were 6027 patients (age 13 ± 4 years) identified with the diagnosis of ovarian torsion who underwent either TO (65%) or OPS (35%). Patients carried secondary diagnoses of ovarian cyst (41%), benign mass (19%), and malignant mass (0.4%). Compared to OPS (Table 1), TO was more frequently performed for patients with a secondary ovarian mass, via laparoscopic approach, without incidental appendectomy, and was associated with higher hospital cost. OPS was more common in teaching hospitals (39% vs. 27%), patients less than 13 years of age (40% vs. 33%), and patients from high-income households (39% vs. 32%), all $p < 0.001$.

The readmission rates within 30 days and 1 year were 2% and 4%, respectively, with no difference between surgical management (Table 1). Of those readmitted (n=265), readmission diagnoses were cyst (10%), malignant mass (9%), benign mass (7%), and torsion (5%). Within 1 year following OPS, recurrent torsion and readmission for ovarian mass rates were 0.1% and 1.8%, respectively.

Conclusion
There are disparities in the utilization of OPS for ovarian torsion, with the majority of pediatric patients undergoing TO in the U.S. While risk of torsion in the contralateral ovary exists with either approach, the rate of recurrent torsion following OPS is lower than previously reported.

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PHELPS (PEDIATRIC HERNIA EXTRAPERITONEAL LIGATION AND PERCUTANEOUS SUTURING) - COMPARATIVE RESULTS OF USING OF NEW METHOD OF LAPAROSCOPIC TREATMENT OF INGUINAL HERNIA AT CHILDREN.

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Introduction

The aim of this study was to evaluate the effectiveness of a new technology for laparoscopic treatment of inguinal hernia in children (PHELPS) in comparison with another laparoscopic technique (SEAL).

Material and methods

We demonstrate the results of laparoscopic treatment of 705 patients with inguinal hernias. Of these, 260 patients were operated on using the new PHELPS technique. The remaining 445 children received the SEAL technique. The difference of the new technique of the treatment of inguinal hernia (PHELPS) consisted in the method of carrying out a hernial ligature around the neck of the hernial sac in such a way that the knot after using SEAL technique was located at the level of the peritoneum and did not include the tissue of the abdominal wall (aponeurosis and muscles) that causes them to erupt and leads to recurrence and hydrocele.

Results

Both groups of patients were comparable in terms of age, body weight at the time of surgery, gender composition. The average duration of operation confirmed comparable values of this indicator in the comparison groups (15.92 min versus 15.53 min; $p > 0.05$). The study demonstrated the equally enhanced recovery of patients after using both methods of laparoscopic treatment of inguinal hernias, which consists in a minimum number of doses of postoperative analgesia (1.2 versus 1.24; $p > 0.05$) and a shorter hospital stay (8.17 hours versus 8.31 h; $p > 0.05$). We found a statistically proven difference in the incidence of recurrence of the disease (0 versus 5; $p < 0.05$) and the hydrocele formation (0 versus 3; $p < 0.05$) as a result of the application of the innovative PHELPS technique.

Conclusion

Thus, the new method of laparoscopic treatment of inguinal hernias in children (PHELPS) improves the quality of other known methods of laparoscopic treatment of this disease thanks to the decrease in the frequency of recurrence and hydrocele formation.

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THE IMPACT OF ROUTINE POST-ANESTHESIA CARE UNIT EXTUBATION FOR PEDIATRIC SURGICAL PATIENTS ON SAFETY AND OPERATING ROOM EFFICIENCY

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Purpose

Maximizing operating room (OR) efficiency is essential for hospital cost containment and effective patient throughput. Little data is available regarding the safety and efficacy of extubation of children in the post-anesthesia care unit (PACU) by a nurse rather than in the OR. We sought to evaluate the impact of a long-standing practice of PACU extubation upon airway complications and OR efficiency.

Methods

The records of 1930 children who underwent inguinal hernia repair, laparoscopic appendectomy or pyloromyotomy at a children's hospital between July, 2018 and June, 2020 were reviewed. Extubations were performed in the OR only when the PACU was inadequately staffed or during the early months of the Covid-19 pandemic. Cases in which there was a deep extubation, a PACU hold was in effect or a patient went directly to an inpatient unit from the OR were excluded. Intra- and post-operative time metrics were recorded and emergency airway interventions were assessed.

Results

1747 operations were evaluated. Time from the end of the procedure to leaving the OR ranged from 4.1 to 4.8 minutes when extubation was done in the PACU and was 6-9 minutes less than with OR extubation. (see table). There were 23 airway events (1.5% of all cases) after PACU extubation that necessitated only brief bag-mask ventilation. There were no cases of re-intubation.

Conclusions

In a large population of children undergoing diverse surgical procedures, post-anesthesia care unit extubation was safe and resulted in rapid transfer of patients from the operating room after completion of their operation. Time saved due to shorter operating room times reduces hospital costs and can allow for increased throughput. Extubation in the post-anesthesia care unit may not only be as safe as operating room extubation, but may result in fewer serious airway events as patients may be less likely to have their endotracheal tube removed prematurely.

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FUNCTIONAL SIDE-TO-SIDE SPLENORENAL SHUNTS TO TREAT EXTRAHEPATIC PORTAL VEIN THROMBOSIS IN CHILDREN

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Introduction

Surgical shunts are commonly used to manage complications resulting from extrahepatic portal vein thrombosis (EHPVT) in children. Standard procedures including a meso-portal bypass (Rex shunt) or distal splenorenal (Warren) shunt require extensive dissection and exposure in a difficult operative field. We describe a single-center experience utilizing a functional Side-to-Side Splenorenal Shunt (fSRS), created using either an enlarged inferior mesenteric vein (IMV) or left adrenal vein (LAV), which provides a simple and technically less challenging alternative to existing shunt techniques.

Methods

Pediatric patients with isolated EHPVT who were not good candidates for a Rex shunt and underwent a fSRS procedure at our institution between 2014 and 2020 were reviewed. The shunts were created via anastomoses between the IMV and left renal vein, or between the LAV and splenic vein. Outcomes measured included the pre/post shunt portosystemic gradient change, early and late complications, postoperative shunt patency, and mortality.

Results

Twelve patients with EHPVT underwent a fSRS procedure. The mean age at time of operation was 6.3 years. The mean portosystemic gradient change for the cohort was -12.4mmHg (+/- 4.5). Only one patient required a revision – an IR venoplasty to dilate a narrowed shunt. No cases of recurrent variceal bleeding after the shunt procedure were reported. There were no episodes of shunt thrombosis that occurred after fSRS procedures. There was one sudden cardiac death in a patient with severe congenital cardiac anomalies five years after his fSRS that was unrelated to complications from portal hypertension or the procedure.

Conclusions

Surgical shunts continue to be an important adjunct in the treatment of complications related to EHPVT. The functional Side-to-Side Splenorenal Shunt is a safe and effective procedure that provides an alternative to more traditional shunts. Importantly, it is easy to perform, requiring minimal dissection and only one anastomosis.

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LASER HAIR REMOVAL AS PRIMARY TREATMENT OF PILONIDAL DISEASE

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Purpose

Colonic derotation is often necessary during a Hirschsprung disease pull-through in cases where the transition zone is proximal to the splenic flexure so that the pull-through comes down the right pelvis and its blood supply does not cross the duodenum. We present a minimally invasive approach which does not limit the ability to ensure colonic length, and protects the marginal artery blood supply while providing a tension-free anastomosis.

Methods

This technique is intended for patients with a transition zone proximal to the splenic flexure in which the middle colic artery must be divided to gain adequate length. The case presented here is an infant diverted with an ileostomy as a newborn after colonic mapping. Laparoscopic mobilization of the rectosigmoid and splenic flexure allowed the patient to avoid a laparotomy incision. The balance of the derotation is performed via the ileostomy closure site. Fluorescence imaging is employed to check the marginal artery vascular supply.

Results

The approach described obviates the need for a large laparotomy incision. In the last 3 years, we have performed a laparoscopic-assisted colonic derotation in seven patients \with transition zone proximal to the splenic flexure. The transition zone was in the transverse colon in 2 patients and in the right colon in 5 patients. There were no leaks, and two patients developed post-operative strictures that were amenable to dilations only.

Conclusion

Minimally invasive colonic derotation ensures enough colonic length and protects the marginal artery blood supply to provide a tension free anastomosis with minimal complications.

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LAPAROSCOPIC-ASSISTED COLONIC DEROTATION UTILIZING FLUORESCENCE IMAGING IN A PATIENT WITH HIRSCHSPRUNG DISEASE PROXIMAL TO THE SPLENIC FLEXURE

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Introduction

Pilonidal disease is a chronic inflammatory skin disorder involving hair follicles in the gluteal cleft. Treatment varies widely, from antibiotic therapy to wide excision and reconstruction. Surgical wounds can be prone to infections, dehiscence, and recurrence. Post-operative laser hair removal (LHR) has demonstrated promise to reduce recurrence, but has yet to be investigated as a primary treatment strategy.

Methods

A single center prospective pilot study was performed to investigate laser hair removal as primary treatment for pilonidal disease. Patients with moderate to severe disease were recruited. Participants underwent 4-8 treatment sessions of Nd:YAG or LP-Alexandrite laser by a pediatric dermatologist until hair removal endpoints. Patients with persistent symptoms underwent excision. Primary outcomes were rate of resolution without surgical intervention and rate of recurrence after surgical resection, if performed. Secondary outcomes were episodes of infection, quality of life assessed by standardized surveys, and cost comparison using age, sex, and severity-matched historical controls.

Results

Twenty-one patients were enrolled, 18 started laser treatments, and 1 withdrew prior to completion of LHR. All patients demonstrated significant improvement in hair follicle density in the treatment area with no adverse events. Six of 13 (46%) who completed laser treatments had resolution without surgical intervention, and 5/7 (71%) who underwent excision resolved after one surgery. QOL scores improved after laser treatments ($p=0.0156$). To date, estimated cost of LHR group is significantly lower than historical controls ($3075±2044 vs $6959±2307, $p < 0.0001$).

Conclusion

Moderate to severe pilonidal disease can be difficult to manage, especially for chronic or recurrent symptoms. Laser hair removal is evolving as an effective post-operative adjunct to standard surgical excision to reduce recurrence rate, but may also provide an effective primary treatment strategy and improve disease both with and without surgical intervention. Further research is needed to determine which patients would be most likely to benefit from this treatment strategy.

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TRENDS, OUTCOMES, AND EFFICACY OF THYMECTOMY FOR PEDIATRIC MYASTHENIA GRAVIS IN THE UNITED STATES, 2004-2020

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Purpose

Thymectomy is an accepted therapy for pediatric myasthenia gravis (MG), but uncertainties remain regarding surgical approach and outcomes. Prior literature is based on small, single-institution series. We utilized national data to examine trends over time and to test the hypothesis that adoption of thoracoscopy would lead to equal surgical outcomes and burden of postoperative medical therapy compared to the open approach.

Methods

A retrospective, cross-sectional analysis of patients 0-19 years old who underwent thymectomy for MG from 2004-2019 was conducted. Data were obtained from the Children's Hospital Association Pediatric Health Information System. Annual rates of thymectomy for MG, patient demographics, surgical approach, and outcomes were assessed. MG-related admissions and doses of MG-related medical therapy were examined before and after surgery.

Results

Overall, 510 patients underwent thymectomy for MG at 48 children's hospitals from 2004-2019. Patients were 70.0% female and mean age was 12.1 years (SD:5.8). With regards to surgical approach, 51.7% (n=264) were performed via an open approach compared to 48.2% (n=246) thoracoscopically. Utilization of thoracoscopy increased over time, although isolated institutions have continued to utilize the open approach (Figure). Open surgery was associated with longer length-of-stay (LOS) (6.1 versus 3.7 days, p= < .001) and intensive care (ICU) admission (66.0% versus 40.1%, p= < .001). There were no significant differences in mortality, complications, age, race, or sex between approaches. Among patients with data before and after surgery (n=236), decreases in mean number of MG-related admissions (2.8 versus 1.6), doses of intravenous immunoglobulin (4.7 versus 1.1), steroids (8.5 versus 6.7), and acetylcholinesterase inhibitors (9.1 versus 7.4) were observed.

Conclusion

Thymectomy for pediatric MG is a widely utilized treatment with efficacy in decreasing disease severity, though institutional variation exists in surgical approach. Open thymectomy was found to be associated with longer LOS and ICU admission, but there were no differences in mortality, complications, demographics, or postoperative severity of MG.

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MULTICENTER ASSESSMENT OF CRYOANALGESIA USE IN MINIMALLY INVASIVE REPAIR OF PECTUS EXCAVATUM

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Purpose
Minimally invasive repair of pectus excavatum (MIRPE) entails significant pain management challenges, often requiring high postoperative opioid use. Cryoanalgesia, which blocks pain signals by temporarily ablating intercostal nerves, has been recently utilized as an analgesic adjunct. We hypothesized that the use of cryoanalgesia during MIRPE would decrease postoperative opioid use and length of stay (LOS).

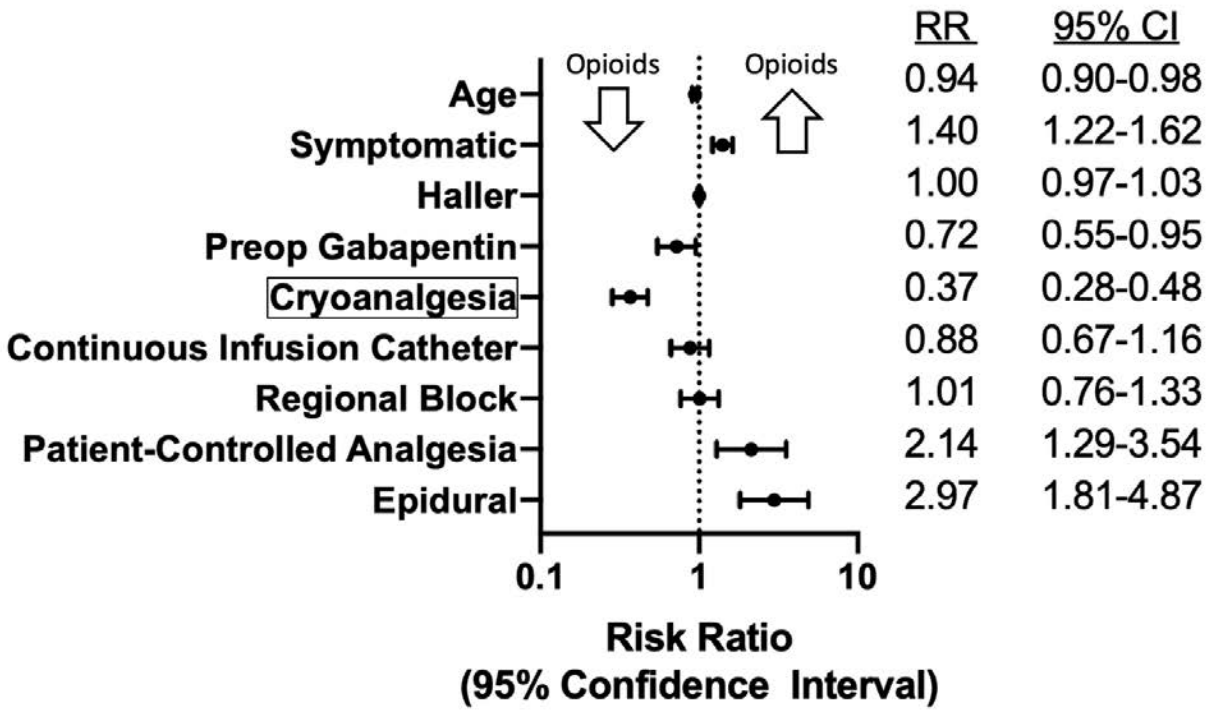
Methods
A multicenter retrospective cohort study of 19 children's hospitals was conducted of children (age < 18) undergoing MIRPE from 1/1/2014 to 8/1/2019. Demographics, surgical details, analgesic medication utilization, and 30-day postoperative outcomes were collected. Differences in total postoperative oral morphine equivalents per kilogram (OME/kg) and 30-day LOS between patients who received cryoanalgesia vs. those who did not (usual care) were assessed using univariate and multivariable generalized linear models with gamma distribution and log link, adjusting for confounders and within-center clustering. $P < 0.05$ considered significant.

Results
Of 887 patients, 135 (15%) received cryoanalgesia. Groups were similar by age, sex, body mass index, comorbidities, and Haller index. On univariate analysis, preoperative gabapentin, cryoanalgesia, continuous infusion catheters, and regional blocks were associated with lower opioid use ($P < 0.05$). However, on adjusted analysis certain adjuncts were ineffective or associated with higher opioid use; cryoanalgesia was associated with lower OME/kg vs. usual care (2.5 vs. 6.8, risk ratio [RR] 0.37 [95%CI, 0.28-0.48]) (Figure). Cryoanalgesia was also associated with a shorter mean LOS than usual care (2.6 days vs. 4.0 days, RR 0.65 [0.50-0.85]). Complications were similar between groups (29.5% vs. 21.5%, p=0.06), including a similar rate of emergency department visit, readmission, and/or reoperation.

Conclusions

Use of cryoanalgesia during minimally invasive repair of pectus excavatum appears to be effective in lowering postoperative opioid requirements and length of stay without increasing complication rates. Other adjuncts appear to increase and/or be ineffective at reducing opioid utilization. Cryoanalgesia should be considered for patients undergoing this surgery.

Figure: Predictors of opioid use in multivariable regression model adjusting for center allocation



APSAsode - Diversity, Equity and Inclusion: Operationalizing DEI in Pediatric Surgical Care

7:00 PM – 8:30 PM

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CONTRIBUTION OF DIFFERENTIAL REFERRALS TO FEMALE SURGEON UNDER-EMPLOYMENT

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Purpose

Recent publications show that female surgeons have lower operative volumes than equivalently educated male surgeons with similar seniority. Since operative volume for most surgeons is dependent on new patient referrals, inequities in new patient referrals may contribute to this employment disparity. We examined if there are inequities in new patient referrals to female versus male surgeons.

Methods

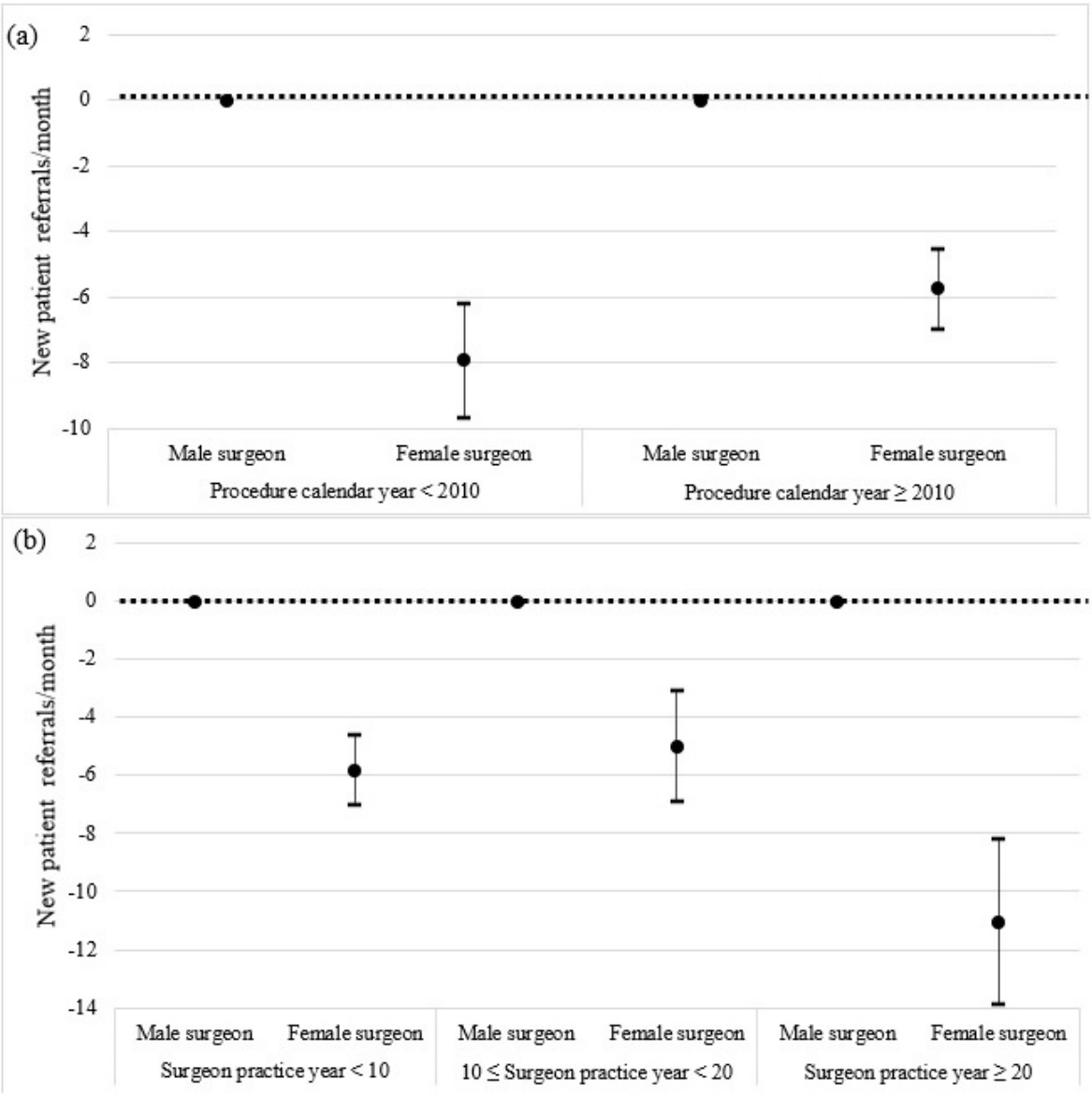
Case records from a large academic medical center from 1997 to 2018 were evaluated. The primary end point was total new patient referrals per month with a secondary end point of operative rate for each surgeon-month. Multivariate linear analysis was performed, adjusting for surgeon race, calendar year, seniority, and clinical subspecialty.

Results

A total of 121 surgeons across 12,410 surgeon-months were included. Overall, surgeons had a median of 14 new patient referrals per month (interquartile range (IQR)=7, 27) with an operative rate of 51.5% (IQR= 28.6%, 71.4%). On adjusted analysis, female surgeons saw 5.4 fewer new patient referrals per month than male surgeons (95% CI -6.4 to -4.5). Subset analyses found that gender disparity increased with surgeon seniority, but there was a non-significant trend towards improvement over the two decades study period (Figure).

Conclusion

In conclusion, female surgeons, with comparable ability, received fewer new patient referrals than their male peers. This contributes to female surgeon under-employment and requires a systemic intervention to ensure equal opportunity for surgeon employment.


(a)
2
0
-2
-4
-6
-8
-10
New patient referrals/month
Male surgeon
Female surgeon
Male surgeon
Female surgeon
Procedure calendar year < 2010
Procedure calendar year ≥ 2010
(b)
2
0
-2
-4
-6
-8
-10
-12
-14
New patient referrals/month
Male surgeon
Female surgeon
Male surgeon
Female surgeon
Male surgeon
Female surgeon
Surgeon practice year < 10
10 ≤ Surgeon practice year < 20
Surgeon practice year ≥ 20

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ARE PEDIATRIC SURGERY CLINICS LGBTQ+ INCLUSIVE?

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Purpose

Despite reaching milestones in Lesbian-Gay-Bisexual-Transgender-Queer (LGBTQ) rights during recent years, LGBTQ communities continue to experience health inequities. Data on these disparities among pediatric patients and their families are minimal. Our main objectives were to assess whether LGBTQ-inclusive (L-I) questions were being asked across pediatric surgery health centers in North America and provide a framework for initiating diversity studies that promote LGBTQ inclusivity in the pediatric population.

Methods

United States and Canadian pediatric surgery departments affiliated with a pediatric surgery fellowship or general surgery residency program were contacted to obtain health intake forms. The forms were assessed for LGBTQ-inclusivity using a novel L-I scoring system consisting of 6 criteria: preferred name, preferred pronoun, preferred language, gender identity, sex assigned at birth, and L-I guardianship data. Institutions without forms were invited to comment on the use of L-I intake questions.

Results

58 out of 125 programs (46.4%) responded to our query. 10 of 58 participating institutions (17.2%) provided intake forms. The median L-I score for the intake forms was 2/6 points. The most common L-I question asked was L-I guardianship data. No intake form asked about preferred pronouns. Of the 48 institutions without forms, 17 (35.4%) reported asking questions during initial visits. Narratives from these 48 institutions varied widely. Some institutions supported routine L-I questions while others stated L-I questions are unnecessary, irrelevant, and/or offensive.

Conclusion

Very few pediatric surgery departments consistently ask L-I questions during the intake process. Comments questioning the appropriateness and necessity of L-I questions highlight the need for education regarding the importance of L-I in all clinical settings. We propose a standardized L-I patient registration form to be completed during initial pediatric surgery visits. These L-I questions will provide sociodemographic information essential for providing culturally competent care of LGBTQ patients and families."

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IMPACT OF RACE ON LETTERS OF RECOMMENDATION FOR THE PEDIATRIC SURGERY MATCH

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Introduction

The process of obtaining a pediatric surgery fellowship position remains highly competitive. Strong letters of recommendation (LOR) are essential components of a successful application. Recent studies have reported gender bias in LOR to postgraduate programs in other specialties. The potential for this, and other biases, merits continued investigation. The purpose of this study was to determine whether there are significant linguistic differences in LOR for pediatric surgery based on race/ethnicity.

Methods

A retrospective review of applications to pediatric surgery fellowship at a single institution (2016-2020) was performed. Race was self-reported by applicants. LOR were analyzed via a Linguistic Inquiry and Word Count (LIWC) software program. Match status was recorded. Descriptive statistics and bivariate analysis were utilized. Significance was determined at $p < 0.05$.

Results

1263 LOR were analyzed from 325 applicants (51% female). Caucasians accounted for 65% of the applicants, followed by Asian Americans (12%), Hispanics/Latinx (10%), African Americans (4%), and Other (9%). Letter writers were largely male (83%), and Professors (57%) while 65% were Pediatric Surgeons and 7.8% were Pediatric Surgery Fellowship Directors. Non-Caucasian applicants were predominantly female (55%; p=0.016). Match rates were highest for Asian Americans (57%), African Americans (45%), Caucasians (43%), and lowest for Hispanics/Latinx (30%; p=0.0002). Non-Caucasian LOR were more likely to include analytical (p=0.02), religion (p=0.0006), and social (p=0.01) terms; whereas anger (p=0.04), and negative emotion (p=0.024), appeared more frequently in Caucasian LOR.

Conclusion

Current national events have refocused emphasis on the importance of diversity and inclusion. This study demonstrates linguistic differences in LOR for pediatric surgery training programs based on applicant race. These findings also suggest certain linguistic differences in LOR may impact match results. Ongoing research into the impact of this on the differential matching rates for minority groups is warranted.

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DIVERSITY AND REPRESENTATION AMONGST ACADEMIC PEDIATRIC SURGEONS

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Purpose

Efforts have been made to increase diversity and equity in academic medicine. Our purpose in this study was to examine representation of gender and race amongst academic pediatric surgeons.

Methods

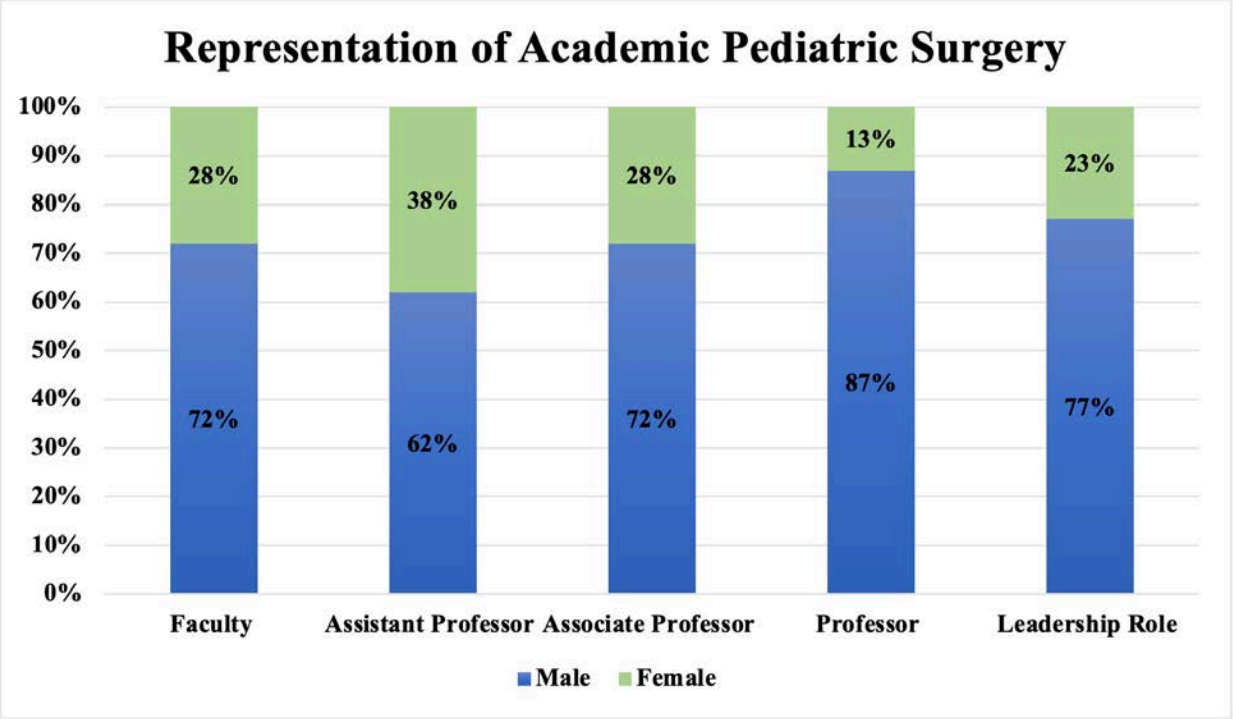
A review of current publicly available faculty rosters of pediatric surgical divisions affiliated with medical schools in the United States was completed evaluating academic rank, racial group, gender, and leadership positions (medical directors and program/associate program directors). Descriptive statistics were performed.

Results

Of 674 faculty in 108 programs, the majority are Non-Hispanic White (75%) and male (72%). Additional race groups are Asian (16%), Hispanic (5%), and Black (3%). For academic faculty positions, women are most commonly assistant professors (38%) and as rank increases, their representation decreases. Conversely, as academic rank increases for men their representation in these positions increases (Figure). The majority of full professor appointments (82%) and leadership positions (77%) are held by men. Of all leadership positions, Non-Hispanic Whites represent 77%, Hispanic 3%, Asian 16%, and Black 3% of faculty. Only 14% of Division Chief and 0.1% of Surgeon-in-Chief appointments are held by women, whereas 27% of other leadership positions are held by women.

Conclusion

Significant disparities exist in representation of women and minorities in academic pediatric surgery, as well as in academic rank and leadership. As diversity in medicine continues to evolve, efforts to increase representation and inclusion in pediatric surgery should be undertaken. An evaluation of barriers may be needed to ensure continued diversity in pediatric surgery reflective of the patients we care for and continuing to improve the advancement of the field collectively.


Representation of Academic Pediatric Surgery
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
28%
72%
38%
62%
28%
72%
13%
87%
23%
77%
Faculty
Assistant Professor
Associate Professor
Professor
Leadership Role
Male
Female

APSAsode - Informatics: Developing Best Practices in Telemedicine for the Pediatric Surgeon

7:00 PM – 8:30 PM

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LEVERAGING COLLABORATION IN PEDIATRIC MULTIDISCIPLINARY COLORECTAL CARE USING A TELEHEALTH PLATFORM

Joseph J. Lopez, MD, Mary Langston, Maddie Jermain, Deanna Smith, Margaret Martin-McLain, Rebecca M. Rentea, MD, John Rosen, Christina Low Kapalu, Julie Strickland, Anne-Marie Priebe, John Gatti, Alonso Carrasco, Christine Warner, Wendy Lewis

Children's Mercy Kansas City, Kansas City, MO

Purpose

Pediatric colorectal issues require complex multi-disciplinary care. The present Covid-19 health crisis has substantially shifted how this healthcare delivery can safely take place. We sought to track in-person (IP) and telehealth (TH) visits and subsequent satisfaction in this quality improvement project.

Method

We present the interdisciplinary clinic experience from October 1, 2019 to August 30, 2020 in which patient volume, visit time length, patient satisfaction survey results, and frequencies of colorectal diagnoses seen before (October 1, 2019 through January 31, 2020) and during the present pandemic (February 1, 2020 through August 31, 2020). Microsoft Teams virtual meeting software was used for TH visits. The multidisciplinary clinic included colorectal surgery, urology, gynecology, gastroenterology, psychology, nutrition, and social work. Time between visits were spaced to avoid crowded waiting rooms and TH visits booked in-between IP visits. To facilitate communication between different providers and families, a unique Microsoft Teams link was created.

Results

A total of 383 patient visits were performed in the time-frame. The median patient age was 7.3 years (IQR 4-13). Before the pandemic, 152 (100%) in-person visits were performed. During the pandemic, 87 (37.7%) TH visits and 144 (62.3%) in-person visits were performed (Table 1). Seventy-four visits were interdisciplinary clinic visits, 17 of these using the TH platform. The median length of each TH visit was 25 minutes (IQR 15.5-30) while the median length of IP visits was 45 minutes (IQR 30-45). Prior to the pandemic, the baseline median length of an IP visit was 45 minutes (IQR 40-50).

Conclusion

Our experience shows interdisciplinary follow-up visits on a TH platform can be performed with efficiency and similar patient satisfaction as IP visits. As the pandemic evolves and the TH platform becomes more accessible for patients and their families, a prospect for convenient, efficient, and safe healthcare delivery for this complex patient population exists.

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UTILIZATION OF TELEMEDICINE AND ERAS IN ADOLESCENT METABOLIC AND BARIATRIC SURGERY

Hae-Sung Kang, MD[1], Cody McHargue, MD[2], Samuel Kraus[3], Joshua Kang[3], Dima Malkawi[3], Jonathan DeAntonio, MD[1], David A. Lanning, MD, PhD[4]

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Purpose

Principles of Enhanced Recovery after Surgery (ERAS) have been applied successfully to adult surgery but data supporting its application in pediatric surgery is lacking. We have previously shown the feasibility of telemedicine in pediatric postoperative care. We hypothesized that the utilization of telemedicine as part of ERAS protocol (TERAS) could facilitate early discharge and improve care of adolescent bariatric surgical patients.

Method

ERAS principles included: patient education, preoperative carbohydrate loading and minimization of fasting, emphasis on non-narcotic analgesia, minimization of indwelling catheters, and early postoperative mobilization. Additionally, a telemedicine encounter between the surgeon and the patient was done within 7 days of discharge. Compliance with TERAS principles, length of stay (LOS), narcotic use, perioperative complications, ED visits and readmission rates were compared between enrolled patients and historic controls matched by age, BMI and obesity-related comorbidities (n=10 each). Patient satisfaction with telemedicine follow up was surveyed.

Results

Compliance rate to the protocol was higher and LOS was shorter in the study group than the controls (Table). During the first postoperative day, narcotic use was lower in the study group with a comparable average pain rating (Table). There was no difference in ED visit, readmission or complication rates (Table). All of the patient families reported preference of using telemedicine for postoperative follow up to avoid traveling, given they lived 86±57 miles away from the hospital. Lastly, the average caregiver satisfaction was 5 (“very satisfied”) using a 5-point scale scoring system.

Conclusion

Utilization of TERAS protocol in adolescent bariatric surgery improved postoperative care as shown by shorter LOS and decreased narcotic use without affecting pain control or the rate of ED visits and readmission. In the context of the recent challenges of COVID-19 pandemic, TERAS protocol has proven to be valuable in providing safe postoperative follow up while limiting inpatient time and in-person visits.

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OUTCOMES OF A TELEMEDICINE BOWEL MANAGEMENT PROGRAM DURING COVID-19

Maria E. Knaus, MD[1], Hira Ahmad, MD[2], Gregory Metzger, MD[3], Tariku Beyene, PhD[3], Jessica Thomas[4], Laura Weaver[5], Alessandra Gasior, DO[2], Richard J. Wood, MD[6], Ihab Halaweish, MD[4]

[1]Center for Colorectal and Pelvic Reconstruction, Center for Surgical Outcomes, Nationwide Children's Hospital, OH, USA, [2]Center for Colorectal and Pelvic Reconstruction, Nationwide Children's Hospital, Columbus, OH, USA, [3]Center for Surgical Outcomes, Nationwide Children's Hospital, [4]Center for Colorectal and Pelvic Reconstruction, Nationwide Children's Hospital, [5]Center for Colorectal and Pelvic Reconstruction, Nationwide Children's Hospital, Columbus, OH, USA, [6]Center for Colorectal and Pelvic Reconstruction, Columbus, OH, USA

Purpose

Due to the COVID-19 pandemic, we transitioned from an in-person bowel management program (BMP) to a telemedicine BMP. The telemedicine BMP consists of either remote (video and/or phone calls) visits or a single initial in-person visit followed by remote visits (hybrid). We hypothesize that families will be satisfied with a telemedicine BMP and that there will be improvement in quality of life and functional outcomes after the telemedicine BMP.

Methods

After IRB approval, demographic and outcomes data were obtained for patients who underwent the telemedicine BMP from May-October 2020. Outcomes included a parent/patient satisfaction survey, Pediatric Quality of Life Index (PedsQL), and parent/patient reported outcome measures (PROMS) (Vancouver, Baylor, and Cleveland scores) at baseline, 1-, and 3-month follow-up. Variables were compared using Mann-Whitney U tests, Fisher exact tests, or chi-square test. A linear mixed model was used to evaluate outcome scores across time.

Results

Sixty-two patients were included in our analysis with an average age of 8 (range 3-18 years). Patients had a diagnosis of the following: anorectal malformation (33), Hirschsprung's disease (13), functional constipation (12), myelomeningocele (3), and spinal injury (1). Forty-five patients underwent the remote BMP and 17 underwent the hybrid BMP. Sixty-two percent of patients completed the satisfaction survey, with a median score of 5 for all questions (1=very dissatisfied, 5=very satisfied). Over 75% of parents said they would prefer a telemedicine program over an in-person program. There was significant improvement in the majority of the PROMs after the BMP ($p < 0.01$), but no difference in the PedsQL score ($p>0.05$) (Table 1).

Conclusion

A telemedicine bowel management program can be an acceptable alternative to a traditional in-person program. There was high parent/patient satisfaction and significant improvement in outcomes. Further research is needed to assess long-term outcomes.

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PEDIATRIC SURGEON PERCEPTIONS OF SURGICAL TELEMEDICINE IN THE COVID-19 PANDEMIC ERA

Sarah Ogle, DO MS[1], Shannon Acker, MD[2], Kyle Rove[3], Alexander Kaizer, PhD[4], Thomas Inge, MD, PhD[5], Jose Diaz-Miron[3]

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Purpose

The use of telemedicine encounters (TMEs) in surgical specialties had been limited prior to the COVID-19 pandemic, but the number of of TME dramatically increased during the pandemic to allow timely patient care and minimize viral exposure. Our aim was to evaluate surgeon satisfaction and perspectives with TMEs throughout the pandemic.

Methods

After institutional review board approval was obtained, anonymous surveys were distributed to surgical faculty at one freestanding pediatric medical center to assess satisfaction and barriers to TMEs early during the pandemic and again 3 months later. Responses were summarized, with p-values for group comparisons from Fisher's exact test. A logistic regression analysis was performed to evaluate the effect of surgeon age on satisfaction at the follow-up survey.

Results

The response rate was 71% initially (52/73) and 63% at follow-up (46/73). Sixty-eight percent (n=36) reported no prior use of telemedicine, with inability to perform a PE (n=19) and limited awareness of TME technology (n=13) cited as the most common barriers. Collectively, there were no significant differences in the overall satisfaction of TMEs (p=0.35) or surgeon age (p=0.32) between the initial and follow-up surveys with >70% (initial n=39; follow-up n=33) of surgeons being satisfied or very satisfied; however an inverse relationship between surgeon age and satisfaction at the follow-up survey was identified (95% CI: 0.62, 0.90, p=0.007). Most common future concerns related to continuing TMEs after the pandemic were inability to perform a physical exam (65%), reimbursement (44%), and limitations due to multi-state licensing requirements (44%).

Conclusions

Most surgeons had no prior experience with TMEs, but adoption of TMEs with the COVID19 pandemic resulted in satisfaction with this digital platform. Inability to perform a physical exam remained a concern throughout the pandemic. Further longitudinal studies are needed to assess stability of adoption and satisfaction with TMEs by surgeons.

Medical Student Posters

7:00 PM – 9:00 PM

MP1

CORE NEEDLE BIOPSY IS SAFE, EFFECTIVE, YET UNDERUTILIZED IN DIAGNOSIS OF PEDIATRIC SOLID TUMORS

Banan Otaibi[1], Charles Lee[2], Brianna Spencer[1], Christa N. Grant, MD[3]

[1]Penn State Hershey Medical Center, [2]Penn State Herhsy Medical Center, [3]Penn State Children's Hospital, PA, USA

Purpose

Approach to biopsy of pediatric solid tumors varies widely by tumor type, institution, and provider. Percutaneous core needle biopsy (CNB) is increasingly recognized as a safer, less invasive alternative to open surgical biopsy (OSB), but is not widely adopted. We hypothesized that CNB is as safe as OSB.

Methods

Single center retrospective analysis of the last 48 consecutive tumors biopsied by CNB and OSB at our institution from 09/2014 to 01/2020. The dataset was then narrowed to abdominal and retroperitoneal tumors to decrease heterogeneity. Data collected included number of core biopsies collected, tissue utilization, patient weight, and tumor volume. The primary outcome was whether tissue yield was adequate for diagnosis and ancillary testing. Secondary outcomes included complications, need for additional procedures, enrollment in open clinical trials, and institutional tissue banking of surplus tissue.

Results

Patient weight and tumor volume were comparable. When only abdominal and retroperitoneal tumors were included, there were 29 CNB and 16 OSB. Ability to yield the diagnosis was excellent in both cohorts, with only 1 child in the CNB group requiring a repeat procedure (2nd CNB) for diagnosis. There was significant heterogeneity in the number and gauge of CNB between providers, and gross under-utilization of surplus tissue samples. Only 2/8 children who consented for tissue banking in the OSB cohort had tissue banked, and 1/9 in the CNB cohort. OSB was associated with higher complication rates (4/16) which required transfusion or had active bleeding requiring surgical intervention than CNB (1/29) ($p < 0.05$).

Conclusion

Lack of a standardized protocol for CNB of pediatric solid tumors results in sample heterogeneity and may limit ancillary testing and enrollment in clinical trials. Poor follow through with tissue banking protocols limited institution-level future research. Ongoing efforts at our institution aim to standardize this process. Large scale prospective trials are needed.

MP2

WHY DO PORTS GET STUCK? A CASE-CONTROL STUDY

Jennifer Crook[1], Lindsay J. Talbot, MD[2], Andrew M. Davidoff, MD[2], James Hoffman[3], Andrew J. Murphy[2], Zhaohua Lu[2], Xiaoqing Wang, PhD[2], Nan Henderson[3], Kimberly Proctor[3], Vinod Maller[1], Hasmukh Prajapati[1], Robert Gold[1], Abdelhafeez Abdelhafeez[3]

[1]University of Tennessee Health Science Center, [2]St. Jude Children's Research Hospital, Memphis, TN, USA, [3]St. Jude Children's Research Hospital

Purpose

We sought to identify clinical features associated with difficult subcutaneous port removals in children.

Methods

Ports placed between April 2014-September 2017 at our institution were prospectively tracked for difficult removals. Ports with extreme (guidewire to facilitate removal, catheter breakage, near-catheter breakage, endovascular intervention) or moderate (dissection to the vessel wall, counter incision, or abnormally strong traction) resistance during removal were identified. A case-control analysis was performed. Patients with stuck ports (cases) were compared to gender and age-matched controls in a ratio of 1:3. Logistic regression determined the association between case/control status and clinical features adjusting for biological sex and age as covariates. Multiple testing correction was performed by determining the false discovery rate. A two-sided significance level of adjusted $p < 0.05$ was used.

Results

57 stuck ports (28 extreme and 29 moderate; 10 endovascular intervention) and 171 controls were analyzed. Stuck ports were associated with a diagnosis of acute lymphoblastic leukemia (86% cases versus 22.2% controls; $p < 0.001$) and a longer placement duration (median 2.6 years [interquartile range (IQR) 2.5-2.6] versus 0.8 years [IQR 0.5-1.4]; $p < 0.001$). Procedural and device features associated with stuck ports included subclavian access (71.9% cases versus 48.5% controls; p=0.0126), placement by a surgeon versus an interventional radiologist (80.7% cases versus 58.5% controls; p=0.0162), a polyurethane versus silicone catheter (96.5% cases versus 79.9% controls; p=0.001), and a rough catheter appearance at removal (92.6% cases versus 9.4% controls; $p < 0.0001$). Prior lines, TPN, catheter-associated DVT, and bacteremia episodes were not associated with stuck ports.

Conclusion

Polyurethane central venous catheters placed for the two-year treatment of acute lymphoblastic leukemia may become difficult to remove. This constellation of factors warrants more extensive preoperative discussion of risk, endovascular backup availability, and scheduling for longer operating room time. Internal jugular placement of a silicone central venous catheter may be preferential in this patient population.

MP3

INJURY PATTERN AND OUTCOMES FOLLOWING ALL-TERRAIN VEHICLE ACCIDENTS IN CHILDREN

McKell Quattrone[1], Brittany Levy[1], Andrea Doud[2], John Draus[2], David Worhunsky[2]

[1]University of Kentucky, [2]University of Kentucky, Kentucky Children's Hospital

Purpose

All-terrain vehicles (ATVs) pose a significant risk for morbidity and mortality among children. Kentucky currently ranks fifth, nationally, in ATV-related fatalities, and current state law limits engine size for children less than 16 years but mandates helmet use on public land only. The goal of this study was to examine the epidemiology of ATV accidents among children who presented to our pediatric trauma center to determine the impact of current legislation on injury patterns and outcomes.

Methods

A retrospective review was performed on pediatric patients (age □ 18) who presented to our level I pediatric trauma center between 2006 and 2019. Patient demographics, injury pattern, and outcomes were analyzed based on helmet use as well as age.

Results

A total of 720 patients presented during the study period. Most were male (71%) and not wearing a helmet (82%). The most common injuries included extremity fractures (48%) and head injuries (39%), and there were 7 fatalities. The lack of helmet use was associated with head injury (42% versus 23%, $P < 0.01$), intracranial hemorrhage (15% versus 7%, $P=0.03$), and a lower mean GCS (13.9 vs. 14.4, $P < 0.01$). Children 16 years and older were least likely to wear a helmet and most likely to suffer head injury, intracranial hemorrhage, severe TBI, serious or severe injury based on ISS, intrathoracic injury, and vertebral fractures (Table 1).

Conclusion

Despite current state law, the vast majority of injured children were not wearing a helmet, and these children were more likely to suffer head injuries. Our data also suggests that children 16 years and older are at greatest risk for injury. Given the significant variability in state laws regulating ATV use among children, our data suggest that stricter laws regarding helmet use and age-based standards may be necessary to lessen the burden of ATV-related injuries.

MP4

VOMITING BABIES AND GASTRIC ANTRAL WEB- A MISSED OPPORTUNITY FOR SURGICAL INTERVENTION?

Aushja Syed[1], Kimberly Somers[2], Sabina M. Siddiqui, MD[3]

[1]MCW, [2]Children's Wisconsin, [3]Medical College of Wisconsin, WI, USA

Introduction

The diagnosis of a gastric antral web (GAW) requires a high index of suspicion. We aim to 1) create and use a classification system for post-operative AWRP patients, 2) assess early follow-up outcomes, and 3) identify clinical features predictive of successful surgical intervention.

Methods

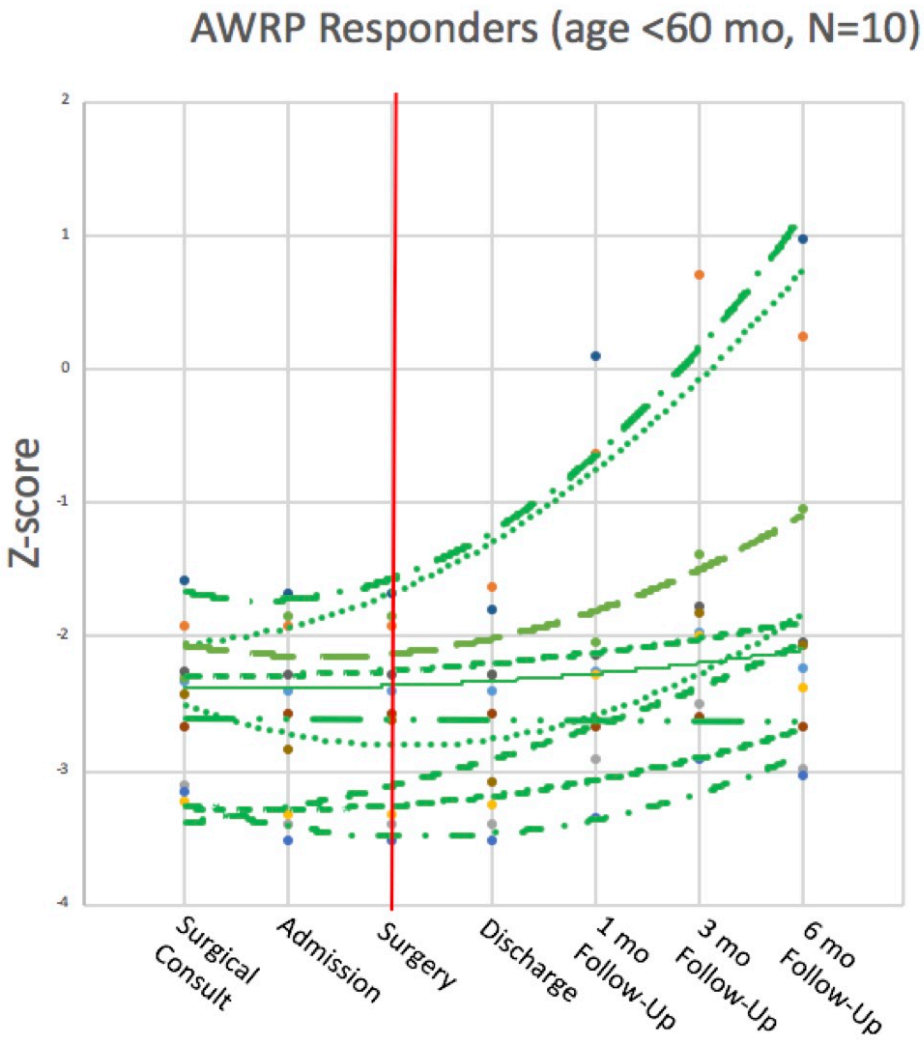
An IRB-approved single-institution retrospective review of patients with endoscopic diagnosis of GAW and clinical signs consistent with partial gastric outlet obstruction, including inability to tolerate gastric feeds, failure to thrive, and discomfort with feeding. Charts were reviewed for patients undergoing AWRP from January 2013 – December 2019. Primary outcomes extracted were Z-scores and vomiting frequency. Follow-up was conducted at 3 months for all patients. Patients were classified as Responders (R- gained weight, vomiting resolved), Partial Responders (PR- gained weight, occasional spit ups) and Non-Responders (NR- no weight gain, continued vomiting).

Results

44 patients (24 male, median age 100.4 months) were identified as having undergone antral web resection and pyloroplasty (AWRP) during the study period. Four patients were excluded from our analysis as retrospective chart review yielded incomplete data.
More than two-thirds of patients gained weight 3 months after surgical intervention (67.5%, n=27).
Complete symptom resolution occurred in 42.5% of patients (n=17, R); 25.0% (n=10, PR) showed weight gain with only occasional vomiting reported; 32.5% (n=13, NR) did not gain any significant weight and continued to exhibit emesis postoperatively.
On subjective report from primary caregivers, quality of life at the time of surgical follow-up improved in 34 patients' families (85.0%).

Conclusion

GAW presents an important surgically reversible cause of vomiting and FTT in children. It is a diagnosis to consider in a vomiting child with failure to thrive. Outcomes appear dependent on patient selection. More data is needed to understand which clinical and anatomic features of the disease are amenable to surgical treatment.



Five patients >60 months of age are excluded from failure to thrive (FTT) data analysis due to short follow-up period in which we did not expect to see significant growth trend changes.
Twenty-two patients presented with FTT, with an average presenting Z-score for cohort of -1.75 (range -5.55 to 1.41). More than two-thirds of patients gained weight 3 months after surgical intervention (67.5%, n=27).

MP5

BARRIERS TO SAME-DAY DISCHARGE AFTER APPENDECTOMY FOR UNCOMPLICATED APPENDICITIS

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Purpose
Same-day discharge (SDD) after appendectomy for uncomplicated appendicitis (UA) can decrease length of stay and costs without increasing complications or readmissions, yet its use in children is inconsistent. The purpose of this study was to quantify barriers to implementation of SDD after appendectomy for UA in children.

Methods
An IRB-approved review of children (age ≤18 years) undergoing appendectomy for UA between 2015-2019 at a tertiary care children's hospital was performed. Travel time to the children's hospital and neighborhood-level socioeconomic disadvantage as marked by Area Deprivation Index (ADI) were determined from patient home addresses. Associations with SDD were evaluated using multivariable logistic regression models.

Results
Among 1025 children undergoing appendectomy for UA, 41% underwent appendectomy before 12PM, 20% between 12PM–3PM, and 39% after 3PM. 42% were admitted between 6PM-6AM with surgery the following day. 20% were SDD. Total hospital charges were significantly less for SDD patients, while readmissions, emergency visits, and unscheduled clinic visits were similar. SDD increased significantly over time, from 6% in 2015 to 38% in 2019. SDD was less common among children from more disadvantaged neighborhoods ($p=0.04$) and children undergoing surgery after 12PM ($p < 0.001$). Timing of surgery and socioeconomic disadvantage remained closely associated with SDD when adjusting for other variables (Table 1). Compared to surgery before 12PM, those with surgery between 12PM-3PM and after 3PM were 76% and 97% less likely to be SDD, respectively. Likelihood of SDD decreased by 9% per decile increase in neighborhood-level socioeconomic disadvantage. Age, race, insurance status, and travel time were not significantly associated with SDD.

Conclusion
To increase SDD and maximize value of surgical care for children with UA, systems should address socioeconomic impediments to timely discharge, prioritize early appendectomy after overnight admissions, and facilitate SDD even when appendectomy is performed later in the day.

MP6

ANALYSIS OF COST AND OUTCOMES OF INTERCOSTAL NERVE CRYOABLATION VERSUS THORACIC EPIDURAL FOR POSTOPERATIVE ANALGESIA FOLLOWING THE NUSS PROCEDURE FOR PECTUS EXCAVATUM

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Purpose

Pain control is the predominant factor in the post-operative management of pectus bar placement patients. Cryoablation of intercostal nerves has been suggested to significantly decrease length of stay. We examined the outcome and total cost of our pectus excavatum repair patients under the cryoablation protocol compared to a historical cohort of those who received epidural anesthesia.

Methods

Retrospective chart review for patients who underwent the Nuss procedure from 06/2002-01/2020. Patients were identified by ICD-9 and ICD-10 codes. Demographic data, type and duration of patient analgesia, length of surgery, postoperative length of stay, and post-operative complications were collected. Cost was adjusted for inflation using the Consumer Price Index (CPI) for Medical Care Specific Inflation (January 2020). Descriptive statistics were performed and comparisons were analyzed using T-tests (P value < .05 determined as significant).

Results

A total of 158 patients met inclusion criteria. Thoracic epidural catheters were inserted in 127 patients. Intercostal nerve cryoablation was performed in 31 patients. The average total charge to patients for hospitalization was greater for patients who had cryoablation ($84,527.63) versus epidural catheters ($48,675.74) ($p < .001$). The cost of hospitalization to the institution following Nuss procedure was greater for patients with cryoablation ($28,621.72 versus $21,807.33, $p < .001$). Patients with cryoablation had a greater duration of surgery (158 ± 44.6 mins versus 95 ± 31.4 mins, $p < .001$) and a shorter length of hospitalization (3.4 ± 1.5 days versus 5.8 ± 1.5 days, $p < .001$). Patients with epidural catheters had a higher rate of in-hospital complications (51.2% versus 12.9%, $p < .001$).

Conclusion

Intercostal nerve cryoablation for the management of postoperative pain following Nuss procedure results in a greater total cost of hospitalization to the institution and patient. The additional cost associated with cryoablation and increased operating room time was not offset by the reduction in the length of hospital stay or in-hospital complication rate.

MP7

LAPAROSCOPIC INGUINAL HERNIA REPAIR– FEASIBLE AND SAFE IN VERY LOW BIRTH WEIGHT BABIES

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Purpose

The purpose of this study is to evaluate if laparoscopic inguinal hernia repair (IHR) in very low birth weight (VLBW) babies during the neonatal period, without using a specific weight threshold, is safe and efficacious.

Methods

After obtaining IRB approval, a retrospective cohort study of forty-six neonates undergoing IHR during their Neonatal Intensive Care Unit (NICU) admission at a single institution Level 3 NICU between January 1st, 2018 and December 31st, 2019 was performed. Exclusion criteria included patients undergoing concurrent operations other than circumcisions and babies weighing more than 1500g at birth. Unpaired t-test and Fischer's exact test was used for quantitative and qualitative analyses, respectively. A p-value of < 0.02 was used to determine the significance of laparoscopic (n=17) versus open (n=29) IHR in terms of demographics, outcomes, and outcomes when separated by weight at operation (greater than or less than 2000 grams). All means reported ± standard deviation (SD) and medians are reported ± interquartile range (IQR).

Results

The characteristics of the open IHR compared to the laparoscopic IHR is outlined in the Table; including, the significant finding of smaller babies in the laparoscopic group (p=0.002). There was no difference in operative time (p=0.86), duration of post-operative respiratory-support (p=0.55), postoperative length of hospitalization (p=0.16), long-term complications (p=0.73), or complications requiring re-operation (p=1) between the two groups. Additionally, there was no difference in outcomes when comparing babies who were less than 2000g at the time of operation.

Conclusions

Laparoscopic inguinal hernia repair is safe, feasible, and effective for very low birth weight babies, without previous abdominal surgery, during their initial neonatal intensive care unit admission and have comparative outcomes to open, even in smaller neonates.

MP8

A DECADE OF FIREARM INJURIES: CHILDREN CAUGHT IN THE CROSSFIRE

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Purpose

Firearm injuries (FI) remain a significant cause of preventable morbidity and mortality in pediatric patients. To better define evolving trends and avenues for prevention, we examined 10-years of firearm injuries managed at our Level 1 Trauma Center.

Methods

Following IRB-approval, the medical records of all patients presenting to our ACS verified, Level 1 Pediatric Trauma Center for treatment of FIs from 2010-2019 were retrospectively reviewed. Data was analyzed using Student's T-test, and p-value < 0.05 was considered significant.

Results

645 patients were included in this study. Overall mortality was 4% (n=26). FI victims were most commonly African American (n=512, 79%), male (n=554, 86%), aged 14-17 (n=431, 67%), and from single-parent families (n=314, 56%). The incidence of FIs increased significantly over the last 5 years of the study (2010-2014, 50.8 FIs/year), compared to 2015-2019 (averaging 80.4 FIs/year, p=0.0017). Concurrently, FI related fatality increased from an average of 1.6 deaths/year (2010-2014) to 3.6 deaths/year (2015-2019, p=0.0347). For the entire cohort, 69 (11%) patients were identified as recidivists with documented prior or subsequent FI. Five zip-codes accounted for 231 (38%) of FIs, with twenty-eight (41%) of recidivist FIs presenting from these same regions. Although accidental FI rates remained stable (p=0.79), accounting for 14% of the total injured, self-inflicted FIs increased significantly from average 6.8/year to 12.0/year, p=0.0355, and assaults increased from an average of 34/year to 55.4/year, p < 0.0001. Within assaults (n=447), drive-by and random shootings increased from 9.4 to 19.8 per year (p=0.0071), patients shot as unintended victims of an intentional shooting increased from 4.2 to 7.6 per year (p=0.0429), and targeted violence uptrended from 14.8 to 20.4 per year (p=0.2657).

Conclusion

FIs remain a significant concern for pediatric patients, with higher mortality rates and increasing evidence of random assaults. Furthermore, violence and recidivism are concentrated in specific geographic regions, presenting an opportunity for targeted interventions.

MP9

MAINTAINING OUTCOMES IN CONGENITAL DIAPHRAGMATIC HERNIA USING PROTOCOLIZED CARE

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Background

Congenital diaphragmatic hernia (CDH) requires aggressive multidisciplinary care and expertise, particularly for severe cases. Overall survival is an important measure of outcome in comparing management strategies and quality of care. Our previously published data noted increasing survival over past decades. Given changes in team dynamics since 2015 (changing from single surgeon to team management), we evaluated whether continuing the established management principles would result in preservation of the published high survival outcomes.

Methods

All cases of CDH from 2015-19 were analyzed. A limited cohort (1/1-10/31/2015) comprised the pre- group as prior outcomes have been reported. The post- group included patients presenting between 11/1/2015-12/31/2019. Both in-born and out-born cases were included. Data pertinent to hospital course, operative care, and outcomes were collected and analyzed. The protocol included initial ventilator settings, liberal and prolonged use of ECLS when needed, and early operative intervention. Survival probability was calculated using the CDH Study Group (CDHSG) formula. Data was analyzed using univariate analysis.

Results

Thirty seven cases met inclusion criteria (15 and 22 in the "pre-"and "post-" groups, respectively). No difference in proportions of left sided defects, gender, gestational age, birthweight, APGAR at 5 minutes, ECLS use, or hospital length of stay were observed. In addition, there was also similarity noted for stomach position, ventilation duration, and prenatal diagnosis (Table). We noted the severity of the CDH was not different (CDHSG score 0.61 vs. 0.67, p=0.36), and the survival to discharge remained high (82.4% vs. 90.9%, p=0.64). Previous historical cohorts published from our institution indicate improving survival from 1992 through 2014 (rising from 78% overall to 88% overall).

Conclusions

These data demonstrate that high survival outcomes for CDH can be maintained by following protocolized management algorithms. This is particularly important with multidisciplinary teams and suggests that similar results can be achieved at other centers.

MP10
A MULTIDISCIPLINARY APPROACH TO ALCOHOL AND DRUG USE SCREENING & PREVENTION FOR ADOLESCENT INPATIENTS

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Background

Pediatric trauma centers are required to screen patients for alcohol or other drug use (AOD), Briefly Intervene, and Refer these patients to Treatment (SBIRT) to meet Level 1 and 2 trauma center requirements set by the *American College of Surgeons*. We evaluated if a mandatory electronic medical record (EMR) tool increased SBIRT screening compliance for adolescent inpatients.

Methods

A SBIRT EMR tool was implemented for pediatric inpatient AOD screening. A positive screen prompted brief intervention and referral for treatment in coordination with social work and psychiatric consultants. We compared pre and post implementation screening rates among inpatients age 12-18 with no primary admitting psychiatric diagnosis and performed sub-group analyses.

Results

There were 873 patients before and 1,091 after implementation. Questionnaire screening increased from 0% to 34.4% ($p<0.001$), without an increase in positivity rate, and lab screening decreased by 4.2% ($p=0.003$). Recent quarters showed nearly 80% compliance among all inpatients. Females were more likely to receive a social work consultation than males (14.5% vs 7.5%, $p<0.001$), despite a greater number of positive questionnaires among males (9.5% vs 17.9%, $p=0.013$). White patients were more likely to receive a social work consultation (12.9%) compared to Asian (2%), Black (6.3%), and Other (6.9%) ($p=0.007$), despite comparable rates of positive screenings. When comparing English to non-English speakers, English speakers were more likely to have a social work consult (12.0% vs 2.4%, $p<0.001$) and psychiatry/psychology consult (13.6% vs 5.6%, $p=0.011$).

Conclusion

Multidisciplinary training along with an EMR tool increased SBIRT protocol compliance. Demographic disparities in intervention rates may exist.

Tables & Figures

Table 1. Screening, intervention, and disparities after SBIRT implementation

	Pre-implementation n = 873		**Post-implementation n = 1,091**		**p-value**
	n	%	n	%	
Screening					
Laboratory	116	13.3	99	9.1	0.003
Questionnaire	0	0.0	375	34.4	<0.001
Social work consult	128	14.7	119	10.9	0.013
Psychiatry or Psychology consult	166	19.0	138	12.7	<0.001
	Female n = 532		**Male n = 559**		**p-value**
	n	%	n	%	
Social work consult	77	14.5	42	7.5	<0.001
	Asian n = 49	**Black n = 111**	**White n = 728**	**Other n = 144**	**p-value**
Social work consult	1 (2.0)	7 (6.3)	94 (12.9)	10 (6.9)	0.007
	English n = 965		**Non-English n = 126**		**p-value**
Social work consult	116 (12.0)		2 (2.4)		<0.001
Psychiatry or Psychology consult	131 (13.6)		7 (5.6)		0.011

Values listed are n (%)

APSAsode - Critical Care - Sharpening your Critical Care Skills: Updates in Ventilator Strategies, Pulmonary Hypertension, and ECMO Management

7:00 PM – 8:30 PM

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EARLY PROSTACYCLIN USE FOR CDH-ASSOCIATED PULMONARY HYPERTENSION IS ASSOCIATED WITH IMPROVED SURVIVAL TO DISCHARGE

Akila B. Ramaraj, MD[1], Samuel E. Rice-Townsend, MD[2], Carrie Foster[3], Emma Jackson[3], Delphine Yung[3], Ashley Ebanks[4], Rebecca Stark[3]

[1]Seattle Children's Hospital, WA, USA, [2]Seattle Children's Hospital, Seattle, WA, USA, [3]Seattle Children's Hospital, [4]University of Texas Health Sciences Center at Houston

Purpose

Off-label use of prostacyclins has emerged as a therapeutic option for managing congenital diaphragmatic hernia-associated pulmonary hypertension (CDH-PHTN). The optimal time to start this medication remains unclear. This study evaluates the relationship between early initiation of prostacyclin analogs and clinical outcomes in CDH patients.

Methods

The CDH Study Group Registry was queried for all patients born from 2007-2019 who were admitted within the first week of life and received a prostacyclin during the course of their care. Patients who received the first dose of prostacyclin within the first 7 days of life were considered “early initiators”. Log-odds testing was used to evaluate the odds ratio of survival to discharge (SD) and need for ECMO between the Early and Late groups. Student’s t-tests were used to compare ventilator days and length of stay (LOS) between the two groups. Multivariate logistic regression was used to compare the odds of survival to discharge after adjusting for ventilator days, LOS, need for ECMO, when the prostacyclin was started relative to the ECMO run, and the number of medications required to manage the patient’s PHTN .

Results

579 patients were identified after applying restriction criteria, 289 and 290 in the early and late groups respectively. Early prostacyclin initiation was associated with increased odds of SD (OR:1.8, 95%CI:1.3-2.5, $p < 0.001$), decreased odds of needing ECMO (OR:0.30, 95%CI:0.21-0.43, $p < 0.001$), fewer ventilator days (31 vs. 47 days, $p < 0.001$), and shorter LOS (68 vs. 86 days, p=0.0091). After adjusting for covariates, early prostacyclin initiation was independently associated with increased odds of SD (OR: 20.14, 95%CI:1.62-251, p=0.02)

Conclusions

Early prostacyclin initiation to manage CDH-associated PHTN is independently associated with improved SD, as well as decrease in ECMO use, days on ventilator and LOS. These results suggest that early prostacyclin therapy in babies with CDH with PHTN may improve outcomes.

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TRENDS IN USE OF PROSTACYCLIN ANALOGS FOR MANAGEMENT OF CDH-ASSOCIATED PULMONARY HYPERTENSION

Akila B. Ramaraj, MD[1], Samuel E. Rice-Townsend, MD[2], Carrie Foster[3], Emma Jackson[3], Delphine Yung[3], Ashley Ebanks[4], Rebecca Stark[3]

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Purpose

Off-label use of prostacyclins to manage congenital diaphragmatic hernia-associated pulmonary hypertension (CDH-PHTN) has been described over recent years, but use is not standardized across institutions. This study aims to describe trends in use of these medications in the CDH Study Group (CDHSG) patients.

Methods

The CDHSG was queried for all patients born from 2007-2019. Records were reviewed to describe the number of patients receiving prostacyclins, the day of life on which the agent was started, start time relative to extracorporeal membrane oxygenation (ECMO), the duration of medication use, and continuation of the medication at the time of discharge. Finally, trends in use by year of birth were evaluated to assess for changes in use over time.

Results

There were 6439 patients identified from the registry who were born during the study period. 4372 (68%) patient required medications to manage their pulmonary hypertension. Of these, 604 (14%) received a prostacyclin at some point during their care. The median start time for these medications was 7.5 days of life (mean 16.9 days, SD 32.5 days), and the median duration was 12.5 days (mean 25.1 days, SD 49.1 days). 340 of patients required ECMO during care, 53 (15.5%) of whom started the prostacyclin prior to ECMO, and 159 (46.8%) of whom started prostacyclin therapy during their ECMO run . Only a small cohort (26/604, 4.3%) required continuation of the prostacyclin at the time of discharge. The proportion of patients receiving a prostacyclin remained relatively stable over the study period

Conclusions

While the proportion of patients receiving a prostacyclin for management of CDH-PHTN has remained relatively stable over the last 13 years, there is significant variation in timing of initiation and duration of use especially in the pre-ECMO period that warrants further investigation to describe optimal use in these patients.

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THE EFFECT OF VOLUME STATUS AND EARLY RENAL REPLACEMENT AS A PREDICTOR OF OUTCOME ON PEDIATRIC ECMO

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Purpose

Acute kidney injury (AKI) commonly occurs during ECMO therapy with a 4-fold increase in mortality. Studies have suggested that cumulative fluid overload (FO) in critically ill patients is an independent factor associated with mortality. We hypothesized that the early use of renal replacement therapy (RRT) in patients with FO, ECMO is associated with improved survival.

Methods

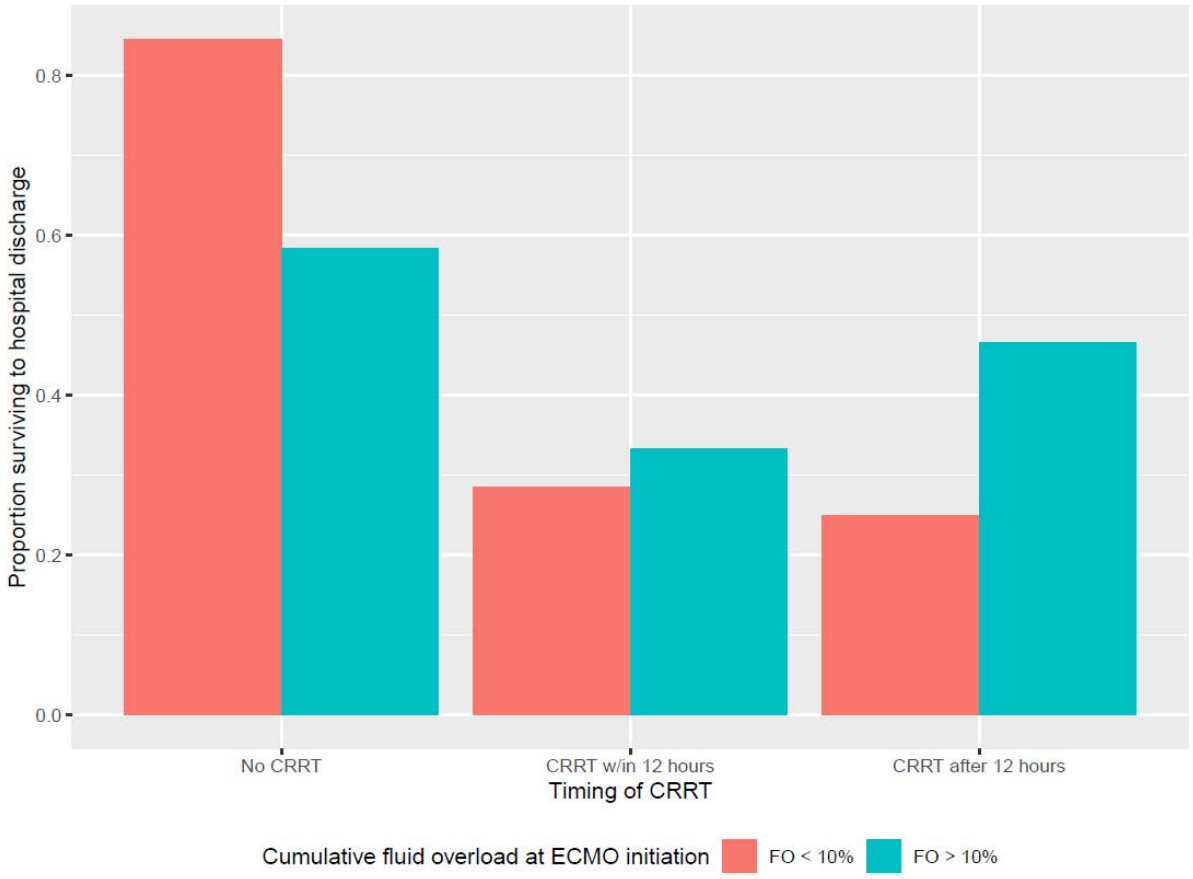
We retrospectively reviewed the records of all pediatric patients supported on ECMO for ≥48 hours at our institution from 2011-2018. Data was collected on early (12 hours) use of RRT, lactate, diuretic use, and incidence of AKI. FO was calculated as the percentage of weight greater than 10% above admission weight. Patients were divided into groups based on admission diagnosis.

Results

136 patients met inclusion criteria. Overall survival to hospital discharge was 44%. The incidence of FO greater than 10% on initiation of ECMO was 57%. In univariate analysis, higher lactate at ECMO initiation was associated with increased odds of mortality (p=0.021). There was evidence of an interaction between FO at ECMO initiation and timing of RRT initiation: Patients without FO at ECMO initiation, RRT use at 12 hours from ECMO initiation was associated with increased odds of mortality compared to those patients without RRT (p=0.021, p=0.004, respectively OR13.75 CI 1.48-127.47). In patients with FO, RRT was not associated with mortality, regardless of timing of RRT initiation (p=0.199, p=0.496, respectively OR 1.6 CI 0.41-6.19) Figure 1. This interaction effect remained significant after adjustment for lactate level at ECMO initiation ($p < 0.001$ for both RRT groups in patients without FO and p=0.73, p=0.42 for patients with FO.)

Conclusion

Fluid overload is common in pediatric patients who require ECMO support. In patients with no fluid overload at the time of ECMO initiation empiric use of renal replacement therapy may be associated with poor outcomes.


Proportion surviving to hospital discharge
0.8
0.6
0.4
0.2
0.0
No CRRT
CRRT w/in 12 hours
CRRT after 12 hours
Timing of CRRT
Cumulative fluid overload at ECMO initiation
FO < 10%
FO > 10%

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CEREBRAL OXYGENATION IS IMPROVED IN CHILDREN RECEIVING BLOOD DURING ECMO SUPPORT

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Purpose

Transfusion of red blood cells is associated with increased risk of adverse outcomes in critically ill children, including children who require ECMO support. Cerebral oximetry has been extensively studied as a surrogate for adequate brain perfusion and oxygen delivery in the intensive care unit and during ECMO. We sought to determine if cerebral regional tissue oxygenation (CrSO2) could be used to help guide blood transfusion transfusions on ECMO.

Methods

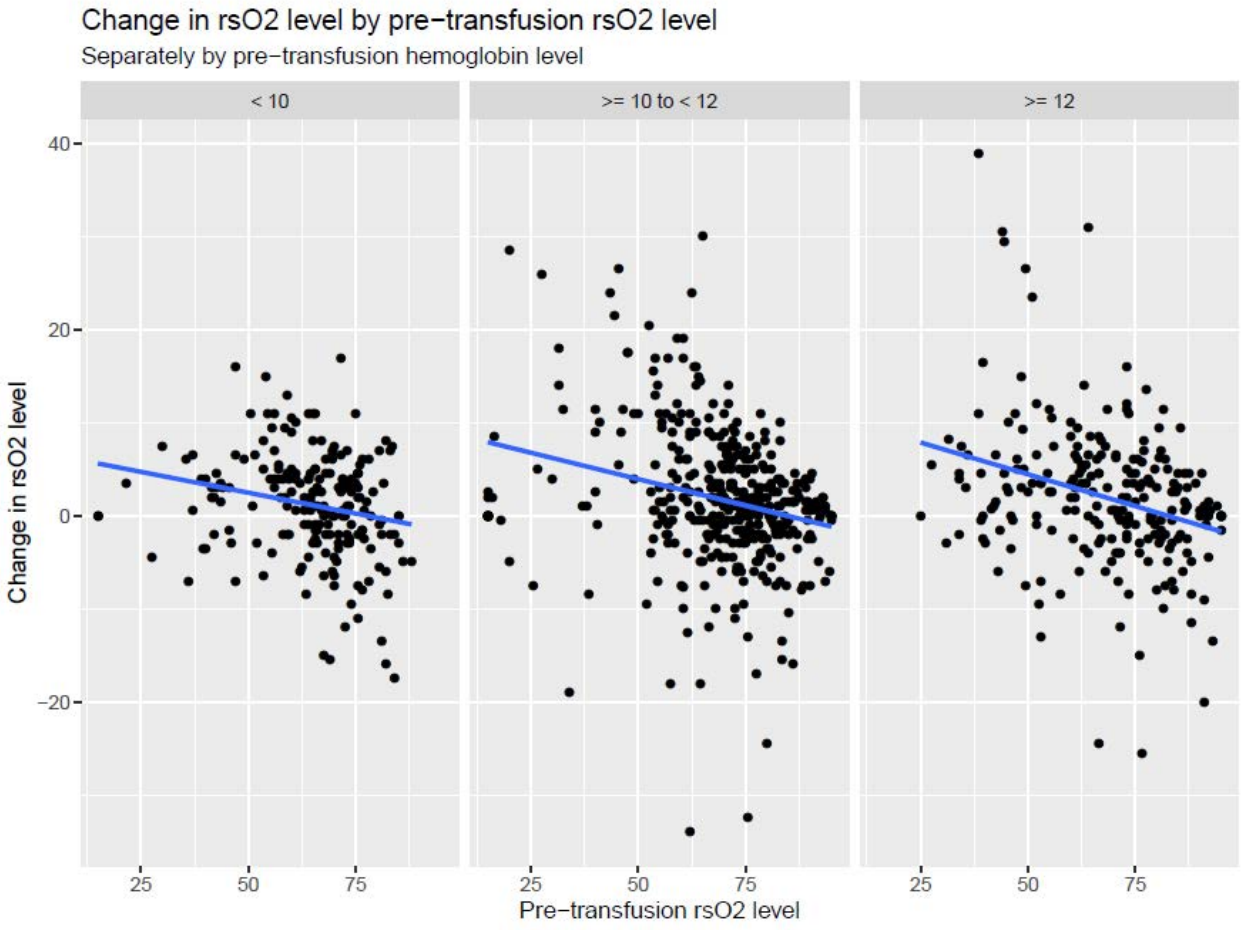
Institutional IRB was obtained. We retrospectively reviewed the medical records of all pediatric patients supported on ECMO at our institution from 2011-2018. We obtained data on all transfusion events that occurred at least four hours apart. We grouped transfusion events by pre-transfusion hemoglobin concentration (12 g/dL). Cerebral rSO2 values were collected within 4 hours and no later than 2 hours after a transfusion. Changes in cerebral rSO2 values were analyzed using linear mixed-effects models to account for repeated transfusion events within patients.

Results

We identified a total of 847 transfusion events in 111 patients during the study period (Table 1). Cerebral rSO2 increased post- vs pre-transfusion across all hemoglobin groups ($p < 0.001$). Pre-transfusion rSO2 was lowest in lowest hemoglobin group ($p < 0.003$) and proportion of transfusion events following cardiac surgery was highest in the highest hemoglobin group ($p < 0.001$). There was no difference in mean change in rSO2 levels between hemoglobin groups both unadjusted ($p= 0.64$) and adjusted for age, pre-transfusion rSO2 value, and diagnosis category ($p=0.32$). A greater change in rSO2 was associated with a lower pre-transfusion rSO2 (Figure 1).

Conclusion

Among neonatal and pediatric extracorporeal membrane oxygenation patients, there was a statistically significant increase in regional tissue oxygenation following blood transfusion, although clinical significance needs to be investigated further. The effect was strongest amongst patients with lower cerebral oxygenation pre-transfusion.


Change in rsO2 level by pre−transfusion rsO2 level
Separately by pre−transfusion hemoglobin level
< 10
>= 10 to < 12
>= 12
Change in rsO2 level
40
20
0
−20
25
50
75
Pre−transfusion rsO2 level

APSAsode - Cancer: Deep Dives into Pediatric Cancer - Thyroid, Anaplastic Wilms Tumor and Biology of Neuroblastoma

7:00 PM – 8:30 PM

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MOLECULAR GENETICS AUGMENT CYTOPATHOLOGICAL CHARACTERIZATION OF PEDIATRIC THYROID NODULES

Emily R. Christison-Lagay, MD[1], Manju Prasad[2], Armine Darbinyan[2], Raffaella Morotti[2], Catherine Dinauer, MD[3], Emily R. Christison-Lagay, MD[1], Maayah Marah

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Purpose

Molecular genetic testing supplements cytological characterization of thyroid nodules by fine needle aspiration (FNA) and may be particularly useful for indeterminate nodules falling into Bethesda classes III and IV. While incorporation of genetic profiling is now commonplace in adult patients, data in children are limited. We sought to investigate the molecular genetics of pediatric nodules with correlation to cytologic and histologic classification at time of definitive treatment.

Methods

Retrospective chart review of 164 patients < 21 years who underwent surgical resection of a thyroid nodule between February, 2002-July, 2020. Individuals who had available molecular testing on either FNA or final histopathology were included. Molecular data was compared to reported cytology as well as final histopathology.

Results

85(52%) patients with a mean age of 16.7 years had molecular genetic testing performed either at time of FNA(70), post-operatively on surgical pathology specimens(12), or both(3). BRAF V600E testing was performed on 84 patients, 31 (37%) of these were positive. Of the remaining 54, 21 had testing for additional mutations and fusions. In 12 (57%) of these, an alternate mutation/fusion was identified. The presence of BRAF or DICER1 mutations or RET-PTC, NTRK-TPR, PAX8-PPARG, ETV6-NTRK3, or STRN-ALK gene fusions predicted malignancy in 100% of cases and were associated with Bethesda IV nodules. NRAS mutations were identified in 3/20 patients (2 Bethesda III and 1 Bethesda IV nodule) with benign adenomas. Nine of 19 Bethesda IV nodules underwent genetic analysis. In addition to NRAS, 7 other fusions were detected, all associated with differentiated thyroid carcinoma. Knowledge of the precise molecular genetic abnormality changed or would have changed the recommended operative procedure in 67% of patients.

Conclusion

Expanded molecular genetic testing on FNA specimens of pediatric patients with thyroid nodules, particularly those with indeterminate cytology, can improve prediction of malignancy and augment surgical decision making.

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LONG TERM OUTCOMES FOR PATIENTS WITH ANAPLASTIC BILATERAL WILMS TUMORS ON AREN0534

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Purpose

Anaplastic histology in the setting of BWT is associated with poor prognosis NWTS- 5 4-year EFS and OS were 43.8% and 55.2% . AREN0534 sought to improve outcomes for BWT. To inform treatment guidelines and future research directions for patients with BWT and anaplastic histology, we analyzed the events and long-term outcomes for this rare subgroup.

Method

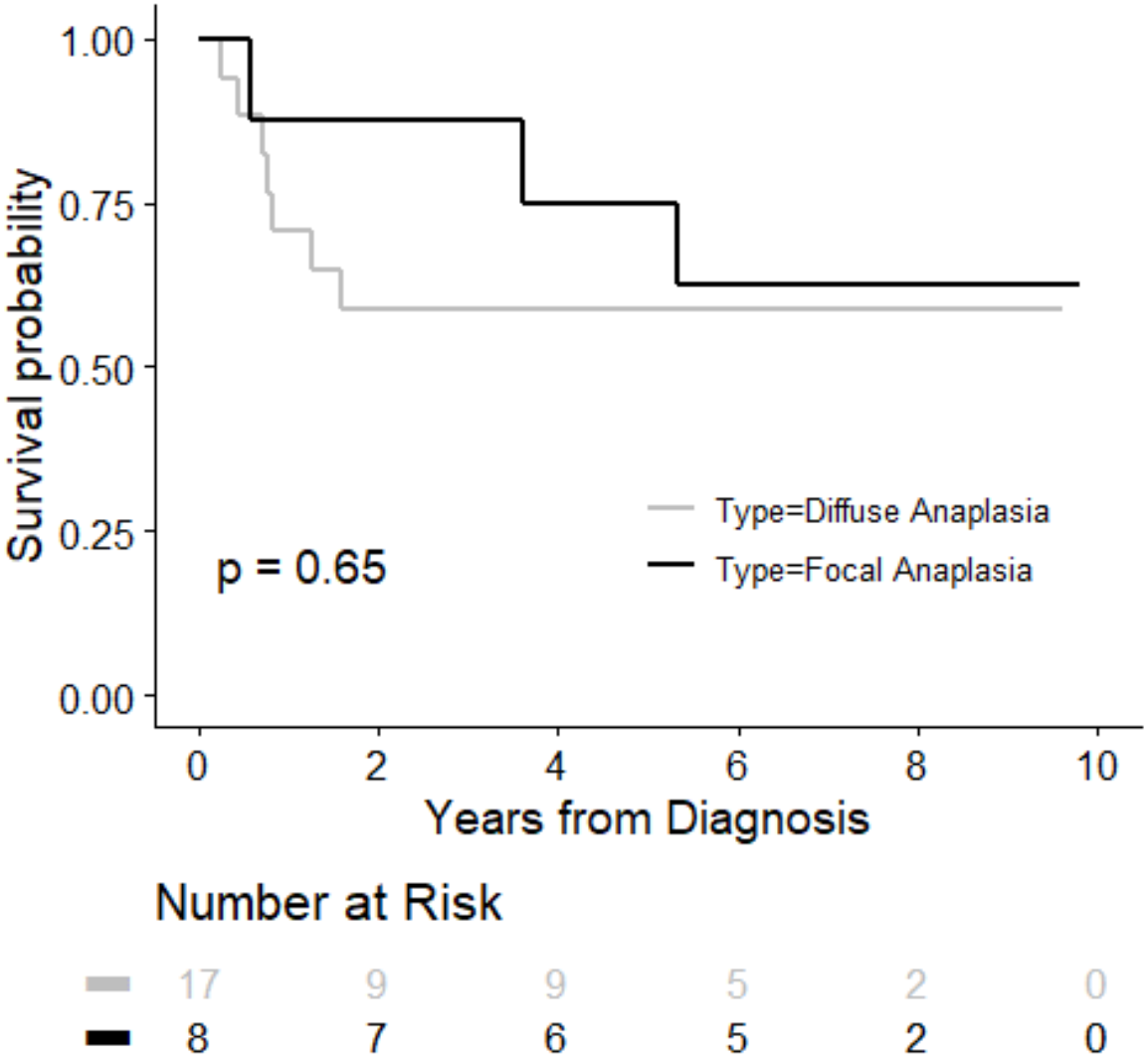
AREN0534 was open to enrollment from 2009 to 2015. Patients with focal(FA) or diffuse(DA) anaplasia were included in this sub-analysis. Location of relapse, progression and 7-year EFS and OS with 95% CI are reported.

Results

There were 25 patients with anaplastic BWT (17 DA and 8 with FA). 1/8 patients with FA had bilateral FA and 4/17 patients with DA had bilateral DA. There were 18 females and 7 males; median age of enrollment was 43.1 months (24.1- 113.7). For FA, 7-year EFS was 62.5%(95% CI, 24.99-100) and OS was 87.5%(95% CI, 62.8-100). One patient with FA died from local relapse due to FHWT in the contralateral kidney at 5 years off therapy. A second patient with stage II FA had progressive disease while on therapy. This patient did not have nodes sampled. Pathology at progression was DA. For DA, 7-year EFS was 58.8% (95% CI, 25.7-91.9) and OS was 70.1% (95% CI, 36.5-100). 7 patients had events, 3 with local tumor progression (all died) and 4 with relapse (2 died). All 4 relapses had initial positive surgical margins and occurred within a year of ending therapy. The sites of relapse were local (2), and lung only (2). Of the 10 patients who were without an event, 5 had positive margins.

Conclusion

Patient with BWT and anaplasia often have discordant pathology. Late events are rare. Margin status at the time of definitive surgery does not seem to impact outcomes in the context of contemporary multimodality therapy including radiation to positive margins.


1.00
0.75
0.50
0.25
0.00
Survival probability
p = 0.65
Type=Diffuse Anaplasia
Type=Focal Anaplasia
0
2
4
6
8
10
Years from Diagnosis
Number at Risk
17
9
9
5
2
0
8
7
6
5
2
0

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EXPRESSION OF PROGRAMMED DEATH LIGAND 1 IN DRUG RESISTANT NEUROBLASTOMA

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Purpose

Neuroblastoma (NB) is the most common extracranial solid malignancy in childhood, accounting for nearly 10% of childhood cancers and 15% of cancer deaths in children. Prior studies suggest that inhibition of the interaction between programmed death ligand 1 (PD-L1) and programmed cell death protein 1 (PD-1), a tyrosine kinase receptor, has been successfully used for treatment of multiple advanced adult cancers but has yet to be explored in pediatric solid tumors. In this study, we investigated the expression of PD-L1 in neuroblastoma to determine the potential usefulness as a target for drug therapy in both wildtype and drug-resistant cell lines.

Methods

We used Human WT neuroblastoma cell lines (SKN-SH, SKN-AS, SKN-DZ) and created doxorubicin resistant (DoxR) cell lines by incubating WT cells with incremental concentrations of doxorubicin. Resistance was determined by a 100-fold difference in half maximal inhibitory concentration (IC-50) on 3-(4,5-dimethyl-2-thiazolyl)-2,5-diphenyltetrazolium bromide (MTT) calorimetric assay. Matrigel in vitro invasion assays were used to compare invasiveness of WT to DoxR cells. Western blot assays were used to compare PD-L1 expression in WT and DoxR cells. Chi-square tests were used to determine significant difference in percent invasion.

Results

DoxR cell lines were successfully created. DoxR cells were significantly more invasive than WT cells across each cell line, (SKN-SH 8.8% vs. 31.8%, p=0.026, SKN-AS, 12.7% vs 35.8%, p=0.008, SKN-DZ, 16.8% vs. 33.0%, p=0.134). Expression of PD-L1 was present in all DoxR cell lines as well as SKN-SH and SKN-DZ but not SKN-AS cell lines on Western blot assays.

Conclusion

PD-L1 is expressed in all DoxR and some WT neuroblastoma cells and may be a potential target for drug therapy, particularly for drug resistant neuroblastoma. Further studies exploring the invasiveness and expression of PD-L1 with inhibition of the PD-1, PD-L1 interaction as well as expansion into an animal model are needed."

APSAsode - Education: Addressing Today's Educational Challenges Using Technology

7:00 PM – 8:15 PM

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PERCUTANEOUS PERITONEAL DRAIN PLACEMENT: A PILOT STUDY OF PEDIATRIC SURGERY SIMULATION-BASED TRAINING FOR GENERAL SURGERY RESIDENTS

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Purpose
General surgery residents often feel unprepared performing pediatric surgery procedures while on rotation or in clinical practice. Case volume and experience performing pediatric procedures may be inadequate for high acuity, low volume procedures. Surgical simulation-based training (SBT) has been shown to improve resident confidence and performance. We designed a single institution pilot study to assess whether SBT for placement of a percutaneous peritoneal drain for perforated necrotizing enterocolitis (NEC) was feasible and lead to skill acquisition, retention and increased resident confidence.

Methods
We performed a needs assessment of pediatric surgeons' and residents' confidence in resident ability to independently place a percutaneous peritoneal drain for perforated NEC. We then created a low cost, inanimate model of NEC. Residents completed two simulation sessions three months apart, completed confidence testing before and after each session, and were assessed using a standardized case scenario and procedure checklist. Wilcoxon Signed-Rank Tests evaluated changes in residents' confidence and performance. An exact McNemar test determined changes in proficiency. Significance was defined as $p < 0.05$.

Results
A need for pediatric SBT, specifically for percutaneous peritoneal drain placement for perforated NEC was established. Nine post-graduate-year three general surgery residents completed this curriculum. Residents reported improved confidence completing each step of the procedure initially ($p=0.005$) and at 3 months ($p=0.008$). They had improved technical scores across all steps of the procedure ($p=0.011$). The number of residents deemed proficient significantly improved ($p=0.031$).

Conclusion We demonstrated the feasibility of assessing the confidence and technical skills of general surgery residents performing a simulated placement of a percutaneous peritoneal drain for patients with perforated NEC. Residents' confidence and proficiency improved after completing this curriculum.

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WHO MANAGES BURN INJURIES IN CHILDREN? A PROGRAM DIRECTOR SURVEY EVALUATING BURN TRAINING DURING PEDIATRIC SURGERY FELLOWSHIP

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Purpose
Burn is one of the leading causes of injury and death in children. Each year nearly 250,000 children require medical attention for burn injury, ranging from simple outpatient treatment to multi-system involvement with extensive debridement and skin grafting. Currently, the Residency Review Committee does not require general surgery residents to rotate on a burn service. As burn injury is common in children and many trainees no longer receive burn training in their residencies, we sought to evaluate the exposure to burn management in pediatric surgery training programs.

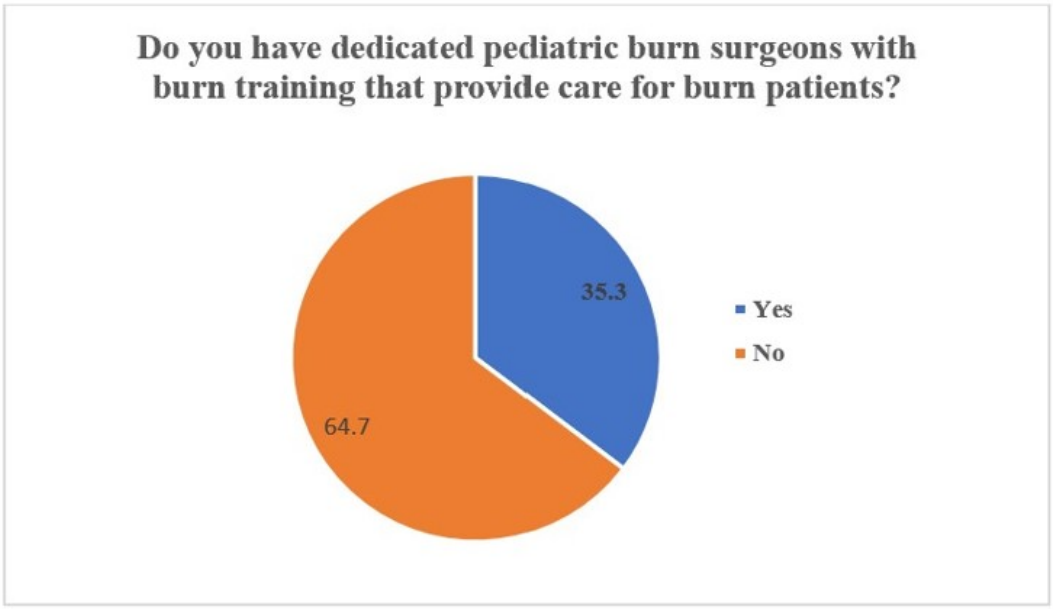
Methods
An electronic survey was sent to all program directors at accredited pediatric surgery training programs (58) during the 2020 academic year. In addition, a case log review was performed for academic years 2015-2019. Descriptive statistical analysis was performed.

Results
Thirty-six program directors participated in the survey (response, 62%). Just over half (56%) of the respondents reported having both an inpatient and outpatient component for burn management. In contrast, nearly 20% reported having no burn management at their institution. Fifty-four percent of the responding programs had fellow participation in burn management. Over a five-year period, a case log review identified a median of 0 or 1 case logged each year for graduating pediatric surgery trainees. From a logistics standpoint, the majority of centers did not have dedicated pediatric burn surgeons with burn injuries primarily managed by general pediatric surgeons (Figure 1). Over one-third (36%) of the institutions relied on plastic or adult surgeons to care for pediatric burn victims. Lastly, 72% of respondents reported transferring larger burns (>30%TBSA) to other institutions.

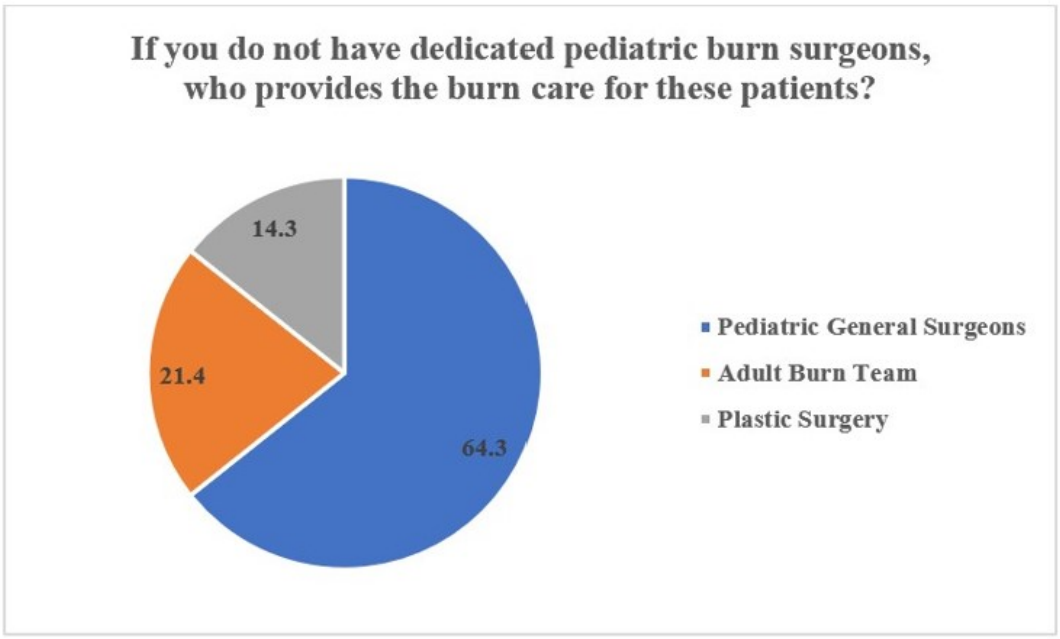
Conclusion
Pediatric surgery trainee involvement in burn management varies throughout the country with many programs offering no designated burn training. Increasing exposure to pediatric burn management during pediatric surgery training is needed to provide improved care for this patient population.

Figure 1: Survey results—Who provides burn cares?

A.



B.



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VIRTUAL CURRICULUM DELIVERY IN THE COVID-19 ERA - THE PEDIATRIC SURGERY BOOT CAMP V2.0

Robert Baird, MSc, MDCM[1], Owais Ghani[2], Harold N. Lovvorn, MD[3], Pramod S. Puligandla, MD, MSc[4], Steven Lopushinsky[5], Rodrigo LP Romao, MD MSc[6], Christopher Blackmore[7], Sanjay Krishnaswami, MD[8], Benedict C. Nwomeh, MD, MPH[9], Cynthia D. Downard, MD, MMSc[10], Todd A. Ponsky, MD[11]

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Purpose

The APSTPD Transition to Fellowship Course (Boot Camp; BC) was launched in 2017 to facilitate first-year Pediatric Surgery (PS) resident transition to pediatric hospital environments. Initially created as a 2-day, in-person learning event hosted at two sites, including didactic lectures, simulation/animal labs, and social networking opportunities, COVID-19 necessitated conversion to a virtual platform. We evaluated the impact of a virtual curriculum on BC resource utilization, learner engagement, knowledge retention, and stakeholder satisfaction.

Methods

A virtual curriculum based on ACGME/ABS Pediatric Surgery Milestones delivered pre-recorded and live content over a single 10-hour day with a concluding social hour. All PS residents and subspecialty fellows were invited to participate. Metrics of learner engagement, faculty interaction, knowledge retention, and satisfaction were analyzed during and after the course.

Results

Forty-two learners (33 first-year) representing 31/56 PS residencies (55.4%; 8/8 Canadian v. 23/48 US; p=0.006) registered. The virtual BC budget was $15,500 (USD), 54% of the anticipated in-person course. Live engagement data showed 109/308 chat board entries were faculty teaching points and/or learner questions; 7 others cited learning material. Fifty-four topic-specific polling/survey questions were delivered live. Pre- and post-tests identical to prior BCs were administered the week of and 8 weeks after, revealing significant knowledge improvement (pre-test 48.6% [286/589] vs post-test 66.9% [89/133]; $p < 0.0002$). Learner surveys (n=13) suggested the virtual BC facilitated fellowship transition (85%) and strengthened peer-group camaraderie (69%), but in-person events were still favored (77%). Program Director (PD) surveys (n=18) included 7 programs that did not participate. PDs also favored in-person events (61%). Non-participating programs cited perceived insufficient value-added and excessive participants as concerns.

Conclusions

The virtual PS BC format reduced overall expenses, improved knowledge, interfered less with schedules, achieved more inclusive trainee reach, and facilitated content archiving. Learners and PDs still favored an in-person model. These data will inform future curricular development for the PS BC.

APSAsode - Fetal Diagnosis and Treatment - FETO in the Management of CDH: Is it the Future?

7:00 PM – 8:30 PM

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LONG-TERM SAFETY OF PLACENTAL MESENCHYMAL STROMAL CELLS FOR IN UTERO REPAIR OF MYELOMENINGOCELE IN AN OVINE MODEL

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Purpose

Surgical repair of myelomeningocele (MMC) in utero has been established as the current standard of care. We have previously demonstrated that augmentation of in utero MMC repair with early gestation human placental mesenchymal stromal cells seeded onto an extracellular matrix (PMSC-ECM) improves motor outcomes in a fetal ovine MMC model, but long-term safety has not been evaluated. This study aimed to establish the long-term safety of PMSC-ECM application directly onto the fetal spinal cord in preparation for first-in-human clinical trials.

Methods

At 100-106 days gestation, five fetal lambs underwent laminectomy of L5-L6 with placement of human PMSC-ECM directly onto the exposed spinal cord. Six normal lambs that did not undergo any surgical intervention served as controls. All lambs were delivered via Cesarean section between 140-142 days gestation and monitored for 3 months. Magnetic resonance imaging (MRI) of the brain and spine was performed at birth and at 3 months. Histology of all organs was performed to evaluate for tumor formation. Spinal cord and brain tissues were evaluated by polymerase chain reaction for the presence of human DNA, which would indicate the persistence of PMSCs.

Results

Throughout the 3-month study period, there was no gross visual evidence of tumor formation or other adverse effects with regards to wound healing. MRIs demonstrated no evidence of tumor formation, hindbrain herniation or spinal cord tethering. Histological analysis demonstrated no evidence of tumor development or any treatment related adverse effects. No lambs had detectable human DNA in the spinal cord or brain tissues at 3-months.

Conclusion

There was no evidence of tumor formation or adverse effects in lambs treated with direct topical application of PMSC-ECM in utero and no persistence of human PMSCs at 3 months. This supports the long-term safety of the PMSC-ECM product for in utero repair of MMC.

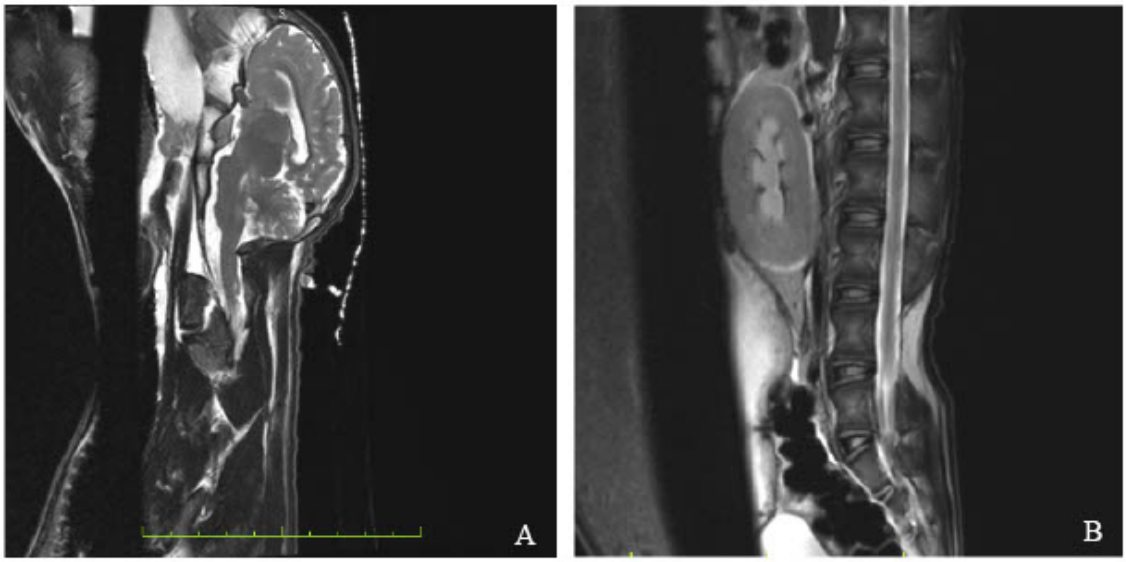

Figure 1: 3-month MRI of brain (A) and lumbar spine (B) of a lamb that underwent surgical intervention with application of the PMSC-ECM product.

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INTRAOPERATIVE USE OF PATCH FOR MYELOMENINGOCELE CLOSURE AND ITS EFFECT ON POSTNATAL VP SHUNT PLACEMENT

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Introduction
Fetal repair of Myelomenigoceles (MMCs) and Myeloschisis has shown improved neurologic outcomes, compared to postnatal repair. Patches can assist with closure of large spinal defects when primary repair is not feasible. However, it has been hypothesized that patches may not provide a watertight closure and have ongoing leakage of cerebrospinal fluid that can affect the degree of hindbrain herniation (HBH) and the need for postnatal ventriculoperitoneal (VP) shunting.

Methods
A retrospective review of patients who underwent fetal MMC/Myeloschisis repair was performed. Multivariate analyses were performed for (1) MRI measurement variables, gestational age, and prenatal diagnosis to identify which variables predicted the need for a patch, for (2) post-operative MRI degree of HBH, both absolute and relative to pre-operative imaging for patch versus primary repair and (3) post-operative MRI findings and VP shunt placement.

Results
82 patients underwent fetal repair of MMC or myeloschisis. Patients that required patches were significantly more likely to be younger (p=0.003), be diagnosed with Myeloschisis (p=0.027), have a longer defect length (p=0.031) and larger defect surface area (p=0.029). 66 of these patients were at least six months of age and were included in our shunt analysis. Fetuses with less pre-operative HBH and primary closures were significantly more likely to have increased improvement in their relative HBH (9.7 mm for no patch and 4.1 mm for patch placement) (p=0.037 and p=0.001). Newborns were significantly less likely to have shunt placement if they had less HBH on their post-surgical MRI and increased improvement in their relative HBH (p=0.02).

Conclusion
We have shown that patches are associated with less post-operative HBH reversal which leads to increased postnatal VP shunt placement. This could be related to patch leaking/dehiscence. We should consider alternative closures for large defects such as myofascial flaps or improved patch biomaterials.

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LONG-TERM NEURODEVELOPMENTAL OUTCOMES AFTER FETAL TRANSFUSIONS FOR HYDROPS FETALIS

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Purpose

Hydrops fetalis arises from multiple etiologies, involves tissue hypoxia, and can often be treated with fetal therapy. We sought to evaluate the long-term neurodevelopmental outcomes of fetuses with hydrops and Alpha thalassemia major (ATM) who survived after in utero transfusions (IUTs).

Methods

We invited parents of our international registry of ATM patients to participate. A single provider virtually administered the Vineland Adaptive Behavior Scales, Third Edition (Vineland-3). The Vineland-3 yielded standard scores in three domains (Communication, Daily Living, Socialization) and an overall percentile compared to age-matched children. Statistical significance was set at < 0.05 and 95% confidence intervals were calculated. Schooling information was obtained as appropriate.

Results

Ten patients presented with hydrops which resolved after IUTs. Patients received a median 5 IUTs (IQR 3.3-5), beginning at a median 24 weeks (IQR 22.6-25.5) gestation. Two patients also received in utero hematopoietic stem cell transplantation. They were born at a median 37 weeks (IQR 36.5-37.2) and are now 1 month to 11 years old. Nine patients underwent Vineland testing. All domains were at or above the population average: communication median 50 (IQR 18-70), daily living median 66 (IQR 55-68), socialization median 70 (IQR 55-81), and overall median 53 (IQR 37-73). Patients transfused at an earlier gestational age had a higher overall score (r= -0.76; p = 0.01), Figure 1. All (3) school-aged patients attended regular schooling; one was in the appropriate grade-per-age (Vineland-3, 66th percentile), two patients were one year behind due to being held back by a parent prior to school starting (37th, 53rd percentile).

Conclusion

Fetal transfusions in Alpha thalassemia major can reverse hydrops fetalis and result in near term birth and normal long-term neurodevelopmental outcomes. Initiation of fetal therapy as early as possible may optimize outcomes. The Vineland scale is a useful tool to evaluate neurologic outcomes in survivors of hydrops.

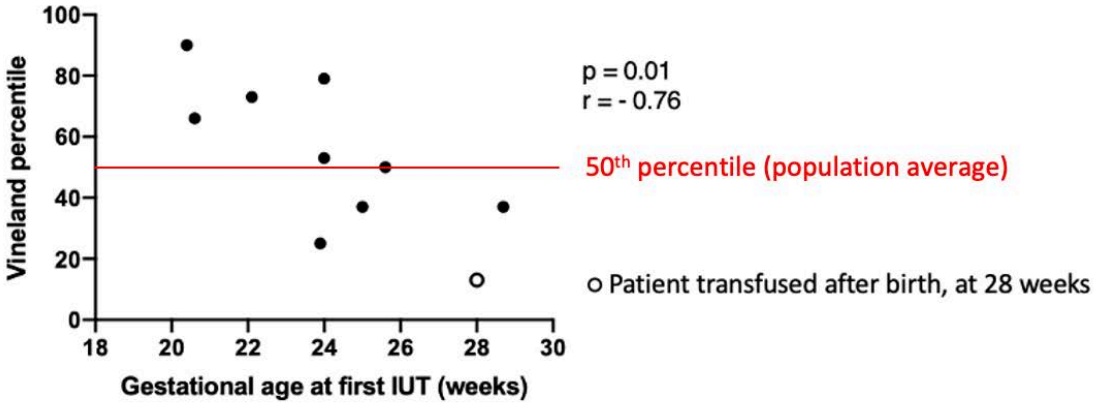

Figure 1. Gestational age at first in utero transfusion (IUT) versus Vineland overall percentile. Each dot represents one patient. The open circle represents a patient transfused shortly after birth, at 28 weeks gestation.

APSAsode - Practice: Strategies to Optimize the Successful Submission and Reimbursement of Unlisted CPT Codes

7:00 PM – 8:00 PM

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EMPLOYMENT SEARCH EXPERIENCE OF RECENT PEDIATRIC SURGICAL FELLOWSHIP GRADUATES: AN APSA SURVEY, PART OF THE RIGHT CHILD/RIGHT SURGEON INITIATIVE

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Background

APSA's Right Child/Right Surgeon Initiative addresses issues concerning patient access to appropriate pediatric surgical care and workforce distribution. The APSA Workforce Committee sought to understand the experiences and motivations of recent graduates of Pediatric Surgery Training Programs entering the workforce.

Methods

Using APSA membership databases, we identified members who completed fellowship training from 2009-2019. An online survey was created using Survey Monkey, and invitations to participate were sent via email.

Results

144 of 447 invited participants responded (32% response rate). 91% of respondents participated in dedicated research prior to fellowship, but only 64% perform research during their employment. 23% completed an additional clinical fellowship, but only 54% currently practice within the second field. When asked to identify the top three factors used to choose a position, the most common responses were "location or geography" (71%), "available mentorship" (53%), and "compensation and benefits" (37%). Describing their first position, 77% reported working in an academic institution, 78% reported working in a metropolitan/urban area, and 55% reported working in a free-standing children's hospital. 94% participate in General Surgery resident education, and 49% are faculty within a Pediatric Surgery fellowship. Overall, 92% of respondents were able to find the type of employment position that they had wanted.

Conclusion

In our survey the overwhelming majority of young pediatric surgeons found the type of job they desired. Most report beginning their practice in more populated, urban areas within academic institutions. Geographic location and work environment played heavily into their employment decisions. These preferences could contribute to continued disparity in access to pediatric surgeons between urban and rural America and to dilution of experience for urban surgeons. Possible solutions include alternative incentive programs for employment in less populated areas or new training models for general surgeons in rural areas to train in fundamentals of Pediatric Surgery.

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CHARACTERISTICS OF PEDIATRIC SURGICAL PRACTICE IN 2019: SURVEY OF THE AMERICAN PEDIATRIC SURGICAL ASSOCIATION (APSA) MEMBERSHIP FOR THE PRACTICE COMMITTEE

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Introduction

This survey was done to better understand the situations and issues that affect the members in their practice of pediatric surgery in North America today. To that end, the Practice Committee of APSA undertook a survey of its membership in 2019.

Methods

An internet-based survey of the membership was sent to 1,117 members of APSA in the United States and Canada with 277 responses (response rate of 25%). A total of 39 questions sought information regarding demographic criteria, practice characteristics, compensation methodology, workforce issues, and concerns for the future of pediatric surgery.

Results

Demographic and preliminary practice data are noted in Table 1. When asked if there were enough pediatric surgeons in the practice, 75% responded yes, however, 69% foresaw the need to recruit within the next 2 years. 51% believed that their index cases remained stable over time; 33% felt they had decreased. 77% of the respondents had hired a recent graduate from a pediatric surgery training program; 29% felt the new graduate lacked competence for complex cases; 10% felt they lacked competence even for uncomplicated cases. Conversely, of the 25% of respondents finishing training within the past 5 years, only 80% of them felt they were competent to start practice without additional mentoring. Sub-specialization within practices: 56% of respondents had none. 40% had some form of sub-specialization, usually for specific disease entities. Future concerns (2 most common responses of 15): promoting the quality of care for their patients, workforce issues and maintaining competence.

Discussion

This survey provides a broad-based snap shot of current pediatric surgery practice characteristics. Surgeon demographics, employment models, competency and workforce issues are just a few of the items that appear to be changing. Monitoring these changes will be vital to identify areas where pediatric surgery practices and pediatric surgeons may be better supported.

APSAsode - New Technology
7:00 PM – 8:00 PM

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AN EXPERIMENTAL STUDY ON LONG-TERM OUTCOMES AFTER MAGNETIC ESOPHAGEAL COMPRESSION ANASTOMOSIS IN PIGLETS

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[1]Department of Pediatric Surgery, Dr. von Hauner Children's Hospital, Ludwig-Maximilians-University Munich, Munich, Bayern, Germany, [2]UCSF, [3]Johannes Gutenberg University Mainz, [4]Ludwig-Maximilians-University

Purpose

Creating a longterm patent anastomosis during thoracoscopic esophageal atresia repair is challenging. We have previously shown that this can be accomplished using specially-shaped magnets. However, long-term patency has so far not been demonstrated. This study evaluates the longterm outcome of the magnetic compression anastomosis in an experimental pig model over 2 months.

Methods

Ten 8-week-old piglets underwent creation of an esophageal compression anastomosis with custom-made 8mm magnets and a U-shaped esophageal bypass loop to allow peroral nutrition. Two weeks later, the bypass loop was closed surgically, requiring the pigs to swallow via the newly-created magnetic compression anastomosis. The pigs were fed soft chow for 2 months, and monitored for weight gain and signs of dysphagia. At two months, esophagoscopy and contrast esophagography was performed. The esophagus was removed and histologically evaluated.

Results

Six piglets survived until the endpoint. In two pigs, closure of the bypass loop failed, these demonstrated mean weight gain of 770+/-70 grams/day. Weight gain in four pigs that exclusively fed via the magnetic anastomosis averaged 565+/-74 grams/day (p=0.18), and there were no signs of dysphagia. All magnets passed with the stool within 16 days. After 2 months, the magnetic compression anastomosis was visible and easily negotiated with a 6.5mm endoscope (figure a.), corresponding to esophogram findings (figure b.). The macroscopic specimen demonstrated an intact, patent esophagus (figure c.). Histopathology showed a circular anastomosis lined with epithelium (figure d.).

Conclusion

Magnetic esophageal compression anastomosis provides a longterm functional and patent anastomosis in pigs. Therefore, this concept may simplify minimal-invasive esophageal atresia repair by obviating a technically challenging and time-consuming handsewn anastomosis.

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THE A, B, CS OF MAGNETIC ESOPHAGEAL COMPRESSION ANASTOMOSIS USING SPECIALLY DESIGNED, CURVED MAGNETS FOR MINIMAL INVASIVE REPAIR OF ESOPHAGEAL ATRESIA

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Purpose

Thoracoscopic esophageal atresia affords many benefits to the patient, but intracorporeally suturing the anastomosis is technically challenging. We designed specially curved magnets that can be deployed endoscopically to create an esophageal anastomosis in children born with esophageal atresia. The bi-radial shape produces a zone of maximal compression centrally and thereby allows the peripheral tissue to heal. This report describes our experience in 3 patients with Gross Types A, B, and C EA and reports the outcome at least 1 year thereafter.

Methods

Compassionate care ethics approval was obtained. Stable neonates with esophageal atresia and a previous gastrostomy were offered the technique using the new magnets. In a first operation, the pouches were thoracoscopically approximated (figure a.). After tension subsided several weeks later, the novel 8mm diameter magnets were placed and mated endoscopically from above and below (figure b.). Postoperative outcomes are reported.

Results

Magnet placement was accomplished without problems in type A and B cases (figure c.). In the last case, the magnets separated and required endoscopic repositioning. All procedures were carried out endoscopically, patients were extubated in the operating room. The magnets passed distally and were eliminated in the stool between 7 and 10 days postoperatively. Patients were followed-up for 18, 14, and 9 months, respectively. They required 4, 4, and 5 dilatations. Gastrostomies were closed after 6, 11, and 9 months. All are on full oral feeds.

Conclusion

Magnetic esophageal compression anastomoses using our specially curved magnets produces a secure, functional anastomosis with no morbidity. Some hurdles remain, particularly with caliber differences between the magnets and the esophagus, and when there a tissue gap between the lumen.

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Figure

Thoracoscopic approximation of the esophageal ends (a.), endoscopic deployment of the magnet in the lower esophageal pouch (b.), and postoperative chest radiograph with the magnets (arrows) in place (c.).