



4th Annual Riley Hospital

SURGICAL RESEARCH DAY



INDIANA UNIVERSITY
SCHOOL OF MEDICINE

2020

Contents

WELCOME	1
KEYNOTE PERSPECTIVE	2
ABSTRACTS	10
Anesthesiology	10
Cardiothoracic Surgery	20
Neurosurgery.....	22
Orthopedic Surgery.....	26
Pediatric Critical Care.....	31
Plastic Surgery	40
Urology.....	40
AWARDS	45
PLANNING COMMITTEE	46
REVIEW COMMITTEE	46

WELCOME

Dear Colleagues,

On behalf of the surgeons, anesthesiologists, and perioperative nurses and advanced practice providers at Riley Hospital for Children, we are happy to present to you the abstract book for our 4th annual Surgical Research Day. It was disappointing but understandable why we needed to cancel our in-person conference for this year, in these unprecedented times. Surgical Research Day has become THE highlight of our academic year for perioperative services at Riley. Although an off-year, we still had over 40 abstracts submitted across surgery, anesthesiology, and nursing.

Dr. Nir Menachemi, from the Fairbanks School of Public Health, was to be our keynote speaker but instead he will provide our keynote manuscript, an opinion piece focusing on the positives that we can take away from this COVID pandemic. Dr. Menachemi’s services have been in demand, as he has provided data and recommendations to the Governor’s Office regarding the closing and re-opening of our state.

Best regards,



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Basic science and clinical surgical research are the pillars of our mission as academicians and surgeon-, anesthesiologist-, and nurse-scientists at Riley Hospital for Children, Indiana University School of Medicine, and Indiana University Health. Congratulations to our Top Abstracts winners!

We will come back from this stronger than ever and look forward to next year’s Surgical Research Day. I would like to thank the members of the planning committee and abstract review committee for their expertise and time in producing this event, and dedication to our Department of Surgery at Riley.

And our biggest gratitude goes to Ms. Kristin Zieles, who helped us organize and plan Surgical Research Day, and who put together this publication for us. We would not have been able to pivot to this format without her efforts.



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KEYNOTE PERSPECTIVE



Dr. Menachemi is the Fairbanks Endowed Chair and serves as the Chair of the Department of Health Policy and Management in the IU Fairbanks School of Public Health. He also holds an appointment as Research Scientist at Regenstrief Institute. Dr. Menachemi has published over 240 peer-reviewed studies, mainly on the topic of health services and outcomes research, and the impact of health information technologies on organizations. More recently, Dr. Menachemi has partnered with the State of Indiana as Principal Investigator on a COVID-19 study designed to determine the number of Hoosiers that have been infected. The results of this study has helped advise Governor Eric Holcomb and his team. This study, conducted in conjunction with the Indiana State Department of Health, is the first of its kind and provides vital baseline data to assist Indiana to respond on eventually recover from this crisis.

PERSPECTIVE: THE IMPACT OF COVID-19 PANDEMIC – AN OPTIMISTIC VIEW

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Abstract

The Department of Surgery at Riley Hospital for Children reacted in earnest to the COVID-19 pandemic on March 17, 2020, following Indiana Governor Eric Holcomb’s order to halt elective procedures in all hospitals around the state. This action was a few days after the American College of Surgeons (<https://www.facs.org/media/press-releases/2020/covid-031320>) and the Surgeon General [2] published recommendations to curtail elective surgical cases in an effort to “flatten the curve” and slow the spread of the virus.

SARS-CoV-2 is the virus that causes COVID-19 disease which could result in severe acute respiratory syndrome and/or a constellation of unusual symptoms including the loss of taste or smell. By virtue of the impact that has galvanized our attention, a large number of Americans have increased their understanding of virology and epidemiology—subjects which were previously mundane to most. As a nation, we follow the data, statistics, and trends broadcasted on network news, websites, social media, and elsewhere. We have been introduced to new “celebrity” experts, including Dr. Deborah Birx, Dr. Anthony Fauci, Dr. Jerome Adams, and Governor Andrew Cuomo, whose leadership and expertise helps comfort a wary public interested in more information. At the time of this writing, there were 4,243,626 cases of coronavirus infection, and 286,563 deaths

worldwide. The United States has surpassed every other country, with 1,381,665 cases of coronavirus infection, and 81,552 deaths. The epic scale of this pandemic has not been experienced in any current person's lifetime.

THE IRON TRIANGLE

For decades, the US has struggled to control rising health care costs which have outpaced the growth of the rest of the economy [9]. Health care spending is now 17.9% of the gross domestic product (GDP) [7]. The US ranks highest in healthcare spending and use of expensive technology among developed countries of the world [5]. However, there has not been a concurrent high ranking in health outcomes when considering our country's wealth and size. Given how much we spend on health care, we should expect to have proportionately better health outcomes. The US has the lowest life-expectancy, highest suicide rates, highest chronic disease burden including obesity, and highest rates of hospitalization and death from avoidable and preventable causes when compared to matched nations [8, 10]. Furthermore, the US has more socioeconomic and racial disparities that disproportionately limit access to care for the most vulnerable populations.

Researchers have described the "iron triangle" in health care which refers to the three major goals of any nation's health care delivery system – keep **costs** down, provide maximum possible **access**, and deliver the highest **quality** of care [11]. As described above, the US seems to perform poorly on all three components which are metaphorically depicted as a triangle. Historically, improvements on one aspect of the iron triangle were typically at the peril of one or more of the other sides. For example, increasing access to care might have either increased costs or have come at the expense of quality. Over the past decade, experts increasingly believed that significant disruption to our financing paradigm was necessary in order to experience improvement in all three components of the

triangle. As such, major reform was implemented in how we structure, finance, and provide health care services in the US. However, these reforms may not be enough.

COVID-19 AS A CATALYST FOR CHANGE

We believe the COVID-19 pandemic may serve as a catalyst for additional needed "disruption." Out of necessity, many have been forced to become more innovative and efficient. Notwithstanding the tremendous health and economic toll of the virus, the pandemic may have also ironically provided some indirect health "benefits." For some Americans, the pandemic was a temporary cure for the "workaholic" that defined many people's lives. More time away from work has allowed many individuals to slow down, spend more quality time at home, take peaceful walks with family. Many instances of strength, kindness, and humanity amongst strangers have been documented [16]. The virus may even help us realize greater inclusivity as we understand all communities are ultimately susceptible to this threat. For others though, life seems to have become even more complex and stressful as their jobs are ever so more important and they must risk to their own health to allow others to sustain their life. These heroes, from a wide array of industries (health care, government, journalism, food production, delivery, public safety, transportation, utility, etc.) are essential components of the machine that keeps the world in motion. But here, we focus on some optimistic interpretations of the situation.

A NEW DAWN IN HEALTH CARE

Below we describe a partial list of welcomed changes to the health care system the pandemic may have catalyzed. We take an optimistic view here too in that we believe these changes will help improve the health and lives of many.

- **The Coming of Age of Telemedicine.** Prior to the COVID-19 pandemic, as a nation, we were unable to overcome certain regulatory, political, financial, and sociological barriers

to the greater use of telemedicine. That may now change.

Very soon after the onset of the coronavirus crisis, the US enacted a series of stimulus packages which greatly favored expanded use of telemedicine. For example, \$185 million has been provided to support telehealth programs for rural critical access hospitals [17]. The Centers for Medicare and Medicaid Services (CMS) has also encouraged telemedicine use through the stimulus bill. There will likely be forthcoming guidelines for a direct payment mechanism for telemedicine. Many insurers are also waiving all co-payments and deductibles for non-COVID-19 illnesses. These types of forced disruptions may result in long-lasting acceptance of patient-to-provider telemedicine within US health care delivery. Once exposed to the 24/7 nature of telemedicine, consumers will probably demand it. It is our hope that the increased use of telemedicine can address at least some of the barriers to access to care experienced by many. It is also possible that expanded acceptance of telemedicine could reduce the costs of care if used sensibly.

Health care organization, large and small, will now have to factor in how telemedicine is part of their future organizational strategies. We are optimistic, despite some challenges, that consumers will be better off.

- **Re-designing and Strengthening the Public Health Infrastructure.** The public health infrastructure provides communities, states, and the nation the capacity to prevent disease, promote health, and prepare for and respond to both emergency threats and ongoing challenges to health [19]. The COVID pandemic has highlighted the critical existing roles for public health agencies—and put on display how the ramifications of underfunding this

infrastructure can affect all citizens. The public health system and the private health care delivery system must be much more integrated. When either system does not perform well, unnecessary morbidity and mortality occurs. When one of the systems is overwhelmed, the other usually gets inefficiently strained. Countries that have mitigated the effects of COVID-19, like South Korea, had a strong public health response to containing the virus. Other countries, including the US, where the public health infrastructure was inadequately able, the health care delivery system was overwhelmed. We simply cannot afford to have disparate siloed systems not working together. The impact on health and the economy could not be more evident during the pandemic. Policymakers must develop new financing strategies so public health, medical services, and social services can be delivered in the most efficient, effective, and equitable manner that science has already demonstrated is possible.

Along the same lines, we need to assure public health data is accurate, relevant, and available to inform timely clinical and public health action. To do so, public health officials must rely on multiple data sources including those generated by the health care delivery system. Nowhere has that been more apparent than the reliance on public health data in creating local, state, and national strategies in mitigating spread of infection. National surveillance and reporting systems are vital [19]. To address the data-sharing gaps made evident with some delay in pandemic response, information exchange in support of care coordination and public health must receive more attention and more financial investment. Network

participants among the nation's 250,000 physician practices, 6,000 hospitals and laboratories, and 3,000 local health departments should be assembled into a more real-time, interoperable, system that can support the type decisions needed in a pandemic [20].

- **Population Health Management Here to Stay**. The COVID-19 pandemic has not affected every American the same way. Across the country in large urban centers, African Americans and other minorities have been affected out of proportion compared to Caucasian counterparts, in terms of mortality from the disease. COVID-19 has accentuated the socioeconomic and racial disparities that existed even before this crisis.

Social determinants of health such as safe and affordable housing, access to education, public safety, availability of healthy foods, local emergency/health services, and environments free of life-threatening toxins, play a role in a majority of health and disease outcomes, yet our society's investment in assuring healthy living is dwarfed by our spending on addressing the preventable consequences of failing to do so [13, 14, 15]. This makes little financial sense overall. Thus, changes in health care reimbursement have spurred an emerging interest in preventative care, cost control, accountability for health, and a slow transition from incentivizing providers to focus on volume of care to a new focus on value-based care. In response to these changes, many health care providers have adopted population health management techniques developed by public health experts [12].

However, significantly more reform is needed to address socioeconomic and racial disparities that are now fully exposed and on display for outraged observers. COVID-19 is the attention-grabbing event spotlighting existing inequities. It is our hope that health care providers and other stakeholders will more forcefully demand more action that will reduce disparities in access and quality and that will lead to the next generation of systems of care that are both cost-effective and more transparent in outcomes. There is a role for population health management even in the most highly specialized surgical subspecialties.

Optimal care of children with surgical disorders requires a coordinated effort between multiple disciplines but is commonly conducted in silos. Care is focused on particular time points (i.e., surgical interventions and in-hospital admissions) while largely ignoring the bulk of the life of the patient and family. Surgical diseases in children puts undue social and emotional stress on the patient and family, aspects that are neither sufficiently studied or addressed but have a significant impact on the ability of patients to live healthy and productive lives. Patient outcomes tend to be measured only in terms of survival while largely ignoring other important outcomes to patients and families. The "patient experience" has historically been an afterthought in the existing care paradigms. While some progress has been made in the context of primary and inpatient care, little emphasis has been placed on reducing the soaring costs associated with the management of pediatric patients with surgical disorders or to critically assess the relationship between cost and outcomes.

There are many opportunities to improve and innovate pediatric surgical care. Technology can be redesigned to enhance the inpatient and outpatient experience. Continuous physiological data may be recorded (e.g., the SickBay network) and predictive analytics performed, such as an arrest predictor algorithm in the ICUs. Telemedicine and wearable health devices may be utilized to improve patient follow-up, compliance, and adherence. Exploration of alternative payment models for pediatric patients, such as bundled payments and outcomes-based payment models, aligning the interests of patients, providers, and payors, could be pursued.

- **Together Against a Common Enemy.** Prior to the COVID pandemic, in many areas of the country, doctors, insurance companies, hospital administrators, politicians, and other stakeholders have been in political gridlock. Frequently, this gridlock resulted in lobbying legislatures in a ‘tit for tat’ approach designed to favor one stakeholder at the expense of another. These adversarial relationships seem insignificant in light of the common enemy known as SARS-CoV-2.

We hope in the aftermath of the pandemic, the American public will remember how frontline healthcare workers – physicians, advance practice providers, nurses, respiratory technicians, environmental services staff– risked their own safety and health to care for the sick. We hope hospital administrators will be remembered for assuring that their facilities were managed appropriately with the efficient use of staffing, equipment, supplies—all of which are in short supply and difficult to obtain. We hope

insurance companies will be remembered for helping to expand coverage, reducing barriers and administrative “red tape” and provided greater access to critical healthcare services. Several insurers have already waived patient cost-sharing and co-payments for COVID-related hospitalization and other treatment costs.

We hope policymakers are remembered for removing regulatory and other barriers that attenuate swift action and for supporting any and all action that increase COVID-19 testing, contact tracing, and other strategies to slow the spread of the virus [18]. Policymakers have already played a role in eliminating patient cost-sharing for COVID-19 testing; and in some states, have allowed individuals and businesses to defer the payment of insurance premiums for a set period of time.

Most importantly, we hope the above stakeholders could be remembered for working together against a common enemy. As previous adversaries when it came to debating the merits of each side of the iron triangle – patients, providers, payers, insurers, and policymakers – can come together and find common ground in this pandemic. It is with great hope this spirit of cooperation and goodwill continues in the new post-pandemic period. We are optimistic this newfound collaboration could lead to a much-needed overhaul of the US healthcare delivery system where each side of the iron triangle is enhanced simultaneously.

- **Breath of Fresh Air.** Widespread global shutdowns and lockdowns have brought about cleaner air, if only on a temporary basis. We are optimistic this could have some positive impact on the health of

individuals and the planet overall. Pollution levels in China and Italy have dramatically reduced. In India, people are reporting seeing the Himalayan mountains for the first time from their homes [21]. A record-breaking “hole” in the ozone layer over the Arctic has now healed and closed [23]. The reduced amount of traffic and the reduction in industrial activity should of undoubtedly improved the air quality in the US too.

Air pollution has been tied to chronic medical diseases, such as hypertension, heart disease, asthma, and diabetes. These chronic medical illnesses are responsible for the death of seven million people around the world each year, according to data from the World Health Organization [22]. It is possible that the pandemic offers lessons for the type of world that we want to have after the crisis. There may be calls to reduce burning fossil fuels, and to shift towards solar panels, renewable energy, clean energy, and sustainable transportation. Green businesses that replenish the planet’s resources and build sustainable infrastructures could benefit communities, the earth, and the economy—and thus should be incentivized and promoted [22].

- **The Rise of the Physician Leader.** All physicians are effectively the leaders of their clinical team. However, most physicians are not directly trained in the leadership skills of collaboration, communication, change management, and conflict resolution. We know of very few formal courses in medical school or residency training that explicitly focus on these skillsets. Physicians will continue to play a key role in all of the reforms and collaborations needed to continue the transformation of the US health care system. However, to do so

effectively more physicians will need leadership training—not only to improve their clinical team performance—but also to improve their interface with other stakeholder groups [24].

In order to be truly effective, physician leaders must understand more than just the practice of medicine. Physicians leaders must understand policy, business, public health and government. Society desperately needs leaders cross-trained in these domains—and it is unlikely that business or policy leaders will be trained in medicine. Thus, physicians are in an important position to assure that many among their ranks could acquire the training needed to work across the societal domains needed for progress. For anecdotes of what can be possible, we note several successful health care systems who exhibited early, robust, and definitive responses to the COVID-19 pandemic were led by physician executives (e.g., Tomislav Mihaljevic at The Cleveland Clinic, Gianrico Farrugio at Mayo Clinic, and others).

Lastly, physician leaders, cross-trained as described above, are in a unique position to help their organizations innovated in order to optimize on all three sides of the Iron Triangle – cost, access, and quality [6]. Programs, including the Physician MBA at the Indiana University Kelley School of Business and the MHA and MPH programs at the Indiana University Fairbanks School of Public Health, have tailored curriculums to prepare physicians to be cross-trained in areas that will create the agents of change and innovation needed in the US.

CONCLUSIONS

Although we outline an optimistic view of the future, we envision at least one pessimistic scenario. Specifically, perhaps worse than the pandemic itself would be if change does not occur as a result of it. The legendary Coach John Wooden once remarked to his team at halftime, as he was contemplating a modification of his team's defensive strategy, "Failure is not fatal, but failure to change might be." Coach Wooden's philosophy and teachings reach far beyond the basketball court and could be applied to many areas of life. It is essential that

we view the current coronavirus crisis as an opportunity to improve for ourselves, our society, and our health care system. Now is the time to put our differences aside, fight a common enemy, expand the use of cost-efficient technologies, strengthen the public health infrastructure, embrace population health management, and promote the development of additional physician leaders that can work with others to tackle our generation's greatest challenges.

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ABSTRACTS

Anesthesiology

1. PECS I and II Blocks as the Primary Anesthetic for Implantable Cardiac Device Generator Changes in Congenital Cardiac Patients: A Case Series

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As our congenital heart disease patients are aging, ICD generators are having to be replaced. General anesthesia poses increased risks to patients with congenital heart disease. Regional anesthesia decreases this risk and it also offers the advantage of multimodal pain therapy and potential for opioid sparing therapy. This is a retrospective cohort case series of 3 patients who received sedation in combination with PECS I and II block for an ICD generator change. The objective of this study is to assess efficacy of PEC Blocks I and II in combination with MAC sedation as an anesthetic for ICD generator change in congenital cardiac patients. Light sedation and ultrasound guidance were utilized for the blocks. PECS II block was performed first by introducing a 22g Simuplex needle under sterile conditions into the fascial plane between pec minor and serratus anterior with deposition of 20mL 0.5% ropivacaine

after negative aspiration. The needle was withdrawn to the fascial plane between pec minor and pec major and 10mL of the local anesthetic was deposited to perform a PECS I block. Sedation with propofol or precedex was utilized during the maintenance phase. PACU pain scores at highest reached 4, with 0 being most often reported. No opioids were used in PACU, rather either mild analgesics or no medications were given. Surgery incites complex stress response, which can lead to acute changes in physiology that can have a profound impact on patients with cardiac disease. Opioids have been the gold standard for treating pain in pediatric cardiac surgery; however, local anesthetics can achieve analgesia and blunting of surgical stress response in lower doses than opioids. Here we describe using PECS block as a surgical anesthetic in combination with MAC sedation for patients with complex cardiac disease undergoing ICD generator change. The PECS I and II blocks are an effective regional anesthetic for use in patients undergoing ICD generator change.

2. Spinal Anesthesia Reduces Opioid Use, Improves Hemodynamics and Improves Operating Room Efficiency for Infants Undergoing Percutaneous Achilles Tendon Lengthening (OATL)

Michael Acquaviva, MD; Christine Calton, MD; Tyler Christman, MD; Robert Bielski, MD; Tanna Boyer, DO; Anne Elisa Cossu, MD

TOP ABSTRACT

Objective: Concerns about the effects of general anesthesia on both the developing brain and postoperative respiratory control have led to renewed interest in regional anesthesia for infants. Percutaneous OATL

and casting for the treatment of clubfoot is a short procedure and is ideally suited for spinal anesthesia. This study was approved as an exempt study by the IRB and parental consent was not required.

Methods: 30 consecutive patients received spinal anesthesia (SP) by one anesthesiologist (MAA). All patients had EMLA cream applied to the skin over the lumbar area in Day Surgery >30 min prior to procedure. In the operating room, the infants were positioned and spinal anesthesia performed with 0.5% bupivacaine with a 1 inch 25 gauge spinal needle. No intravenous catheters were inserted. Heart rate (HR), blood pressure (BP), and arterial oxygen saturation were measured every 5 minutes. The 30 spinal patients were compared to 15 patients that received general anesthesia (GA)

Results: Mean age: GA: 2 months; SP: 2.25 months. Mean weight: GA: 5.9 kg; SP: 5.3 kg.

HRs and BPs were normalized and reported as percent change from baseline.

1. SP patients had less change in their BP compared to GA patients.
2. During the perioperative period 10 of 15 GA patients received opioids and 1 of 30 SP patients received opioids.
3. Time from the start of anesthesia to the end of anesthesia: GA: 39.5 min; SP:20.4 minutes
4. Time from the end of surgery to time the patient left the OR: GA: 9.1 min; SP: 4.1 min
5. Time from the end of anesthesia to first oral intake: GA: 33 min; SP:16.3 min
6. First phase recovery room time: GA:36.9 min; SP:20.4 min

	5 min	10 min	15 min	20 min	25 min	30 min
Heart rate:						
SP	+6.6%	+3.2%	+0.4%	-5.0%	-4.1%	-7.2%
GA	-2.8%	-0.2%	+2.6%	+4.3%	-1.6%	-2.6%
Systolic BP:						
SP	-11.0%	-9.5%	-7.7%	-8.8%	-7.7%	-5.1%
GA	-20.8%	-25.2%	-24.0%	-23.7%	-28.8%	-25.6%
Diastolic BP:						
SP	-8.5%	-12.8%	-16.9%	-17.2%	-8.5%	-11.6%
GA	-34.1%	-36.2%	-39.7%	-38.1%	-40.2%	-40.9%

Conclusion: Spinal anesthesia eliminates the need for exposure to potentially toxic general anesthetics, provides better hemodynamic stability and reduces opioid exposure when compared to general anesthesia for infants undergoing OATL. Spinal anesthesia also improved efficiency for use of operating room and recovery room resources.

3. Use of High-fidelity Lung Simulators to Test a Ventilator Splitter Device

Tanna J. Boyer, DO, MS, Sally Ann Mitchell, EdD, MMSc, Johnny Cartwright, BBA, CHSOS Rami A. Ahmed, DO, MHPE

Abstract: The coronavirus disease 2019 (COVID-19) pandemic has rapidly exposed healthcare system inadequacies. Hospital ventilator shortages in Italy compelled US physicians to consider creative solutions, such as using Y-pieces or T-pieces, to preclude the need to make decisions of life or death based on medical equipment availability. We add to current knowledge and testing capacity for ventilator splitters by reporting the ability to examine the functionality of ventilator splitters by using two high-fidelity lung simulators. Data obtained by the high-fidelity lung simulators included: tidal volume, respiratory rate, minute ventilation, peak inspiratory pressure, peak plateau pressure, and positive end-expiratory pressure.

Introduction: The COVID-19 pandemic has rapidly exposed healthcare system inadequacies. Hospital ventilator shortages in Italy compelled US physicians to consider creative solutions to preclude the need to make decisions of life or death based on medical equipment availability.¹ One common remedy utilizes Y or T-pieces to

split ventilator tubing in order to provide simultaneous ventilation for two patients with one ventilator. However, this is fraught with possible problems as cited in the Joint Statement on Multiple Patients Per Ventilator² including:

- volume delivery to the most compliant lung segments;
- inability to control positive end-expiratory pressure;
- inaccurate pulmonary mechanic measurements;
- alarm malfunction and alarm fatigue;
- complex data interpretation and clinical reasoning required for medical decision-making; and
- additional monitoring necessary for patient safety and management.²

Innovations and freeware using three-dimensional (3D) printed ventilator parts allows for an optional inspiratory limb flow limiter to account for differential lung compliance.³ Clarke⁴ published a similar 3D printed design, and tested the system using two, simple reservoir bags as simulated lungs. The idea of splitting one ventilator with 22mm connectors originated in the Emergency Medicine literature by Neyman and Irvin.⁵ One of their trainees then went on to test this application in real-life when he ran out of ventilators during the 2017 Las Vegas mass shooting.⁶ We add to current knowledge and testing capacity for ventilator splitters by reporting the ability to examine the functionality of ventilator splitters by using two high-fidelity lung simulators (Figure 1).

This study was exempt from the Indiana University IRB, exemption # 1801644617. HIPAA privacy regulations are not relevant as this article does not contain patient information. This manuscript adheres to the applicable EQUATOR guidelines.

Innovation Report: To address more than just the issue of differences in compliance between patients associated with the ventilation of multiple patients using one ventilator, a team at Eli Lilly (Eli Lilly & Company, Indianapolis, Indiana, USA) developed a ventilator splitter device (patent, Food and Drug Administration [FDA] approval, and publication pending), and partnered with our academic healthcare team to substantiate proof of concept, inform iterative design, conduct feasibility studies, and perform pilot testing. Using two high-fidelity lung simulators (IngMar ASL 5000 Lung Solution™ with Breathing Simulator and Lung Adaptor, IngMar Medical, Pittsburgh, Pennsylvania, USA)⁷ with two manifold-driven, high-fidelity, adult manikins (Laerdal SimMan© 3G advanced patient simulator, Laerdal Medical, Stavanger, Norway) ventilated by one ventilator (General Electric [GE] Datex Ohmeda Aestiva 3000 Anesthesia Machine with 7900 SmartVent™, GE Healthcare, Chicago, Illinois, USA ; Servo-i Ventilator, Getinge, Göteborg, Västra Götaland County, Sweden), we were able to provide crucial testing with a high level of accuracy and robust data analysis (Figures 2 & 3).

All machines performed with only a few crashes (likely from overuse as no causes were identified after searching software logs) over 12 days, running an average of 7.91 hours per day. To our knowledge, neither the IngMar ASL 5000™ nor the Laerdal SimMan© 3G manikin have been run for this length of time outside of manufacturer testing. This extensive duration of testing was vital to ascertain the ventilator splitter durability, which would be required for long-term ventilation of COVID-19 patients.

Data obtained by the high-fidelity lung simulators included: tidal volume, respiratory rate, minute ventilation, peak inspiratory pressure, peak plateau pressure, and positive end-expiratory pressure (Figure

4). We also provided feedback through our lens of expertise in patient care, ventilation management, and clinical applications of the ventilator splitter with a team of anesthesiologists and intensivists. The testing guided iterative improvements in the ventilator splitter and confirmed the absence of any performance issues. Thus, the high-fidelity lung simulators facilitated demonstration of the durability, efficacy, and safety of the ventilator splitter device.

Discussion: We report the first use of two high-fidelity lung simulators with two high-fidelity manikins and a ventilator to perform testing of a ventilator splitter device. This project was made possible, in part, by high-fidelity lung simulators with National Institute of Standards and Technology (NIST) calibrated measurements. The high-fidelity lung simulators and high-fidelity manikins have clearly demonstrated value to our institution, community, and the patients for which we care in preparing for this pandemic. We share this experience with the medical community so that this technology can be used across professions to rapidly facilitate translational testing of medical ventilator solutions. This project substantiates the capacity of industry-academic-healthcare partnerships to investigate innovative solutions through rapid-cycle product development and testing and holds promise for future interdisciplinary and interprofessional collaborations.

4. Rapid prototype feasibility testing with simulation: improvements and updates to the Taiwanese “aerosol box”

Johnny Cartwright, BBA, CHSOS, Tanna J. Boyer, DO, MS, Matthew C. Hamilton, DO, Rami A. Ahmed, DO, MHPE, Sally Ann Mitchell, EdD, MMSc

Abstract: Taiwanese anesthesiologist Dr. Hsien Yung Lai published his design for an

aerosol box on 3/21/20. It was designed to keep physicians working in clinical environments safe during intubation, a known aerosol generating procedure, despite limited personal protective equipment (PPE).^{1,3} Dr. Lai’s design was rapidly shared via social media and gained notoriety among US anesthesiologists. We made modifications to his design and tested our prototype “aerosol boxes” via simulation to make iterative improvements. Our modifications addressed these design issues: (a) limited access for intubation assistance; (b) lack of negative pressure evacuation from the box; (c) lack of arm/sleeve protection; (d) instability on the OR table; and (e) the possibility that aerosolized virus particles could escape the box on the open/caudal end. Our simulations revealed increased user satisfaction and safety by providing stability, negative pressure suction, intubation assistance port, and optional arm protection with OR gown sleeves. We offer our modifications to assist colleagues manufacturing these boxes and to facilitate iterative design improvements for intubation and airway management.

Introduction: Taiwanese anesthesiologist Dr. Hsien Yung Lai published his design for an *aerosol box* on 3/21/20. It was designed to keep physicians working in clinical environments safe during intubation, a known aerosol generating procedure, despite limited personal protective equipment (PPE).^{1,3} Dr. Lai shared worldwide via a Creative Commons License,¹ which is free-ware if attributed and used non-commercially. He designed the box two months earlier, during the COVID-19 outbreak in Wuhan, China, and is quoted as being pleasantly surprised at renewed interest from US physicians as surges of COVID-19 patients presented and PPE was scarce.²

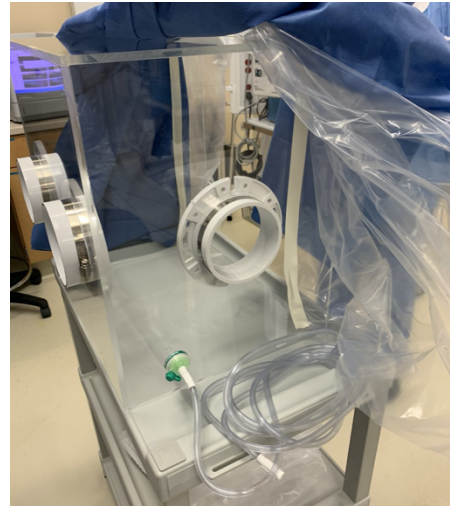
What problem was addressed: Dr. Lai’s design was rapidly shared via social media and gained notoriety among US

anesthesiologists. Canelli et al demonstrated with fluorescent dye that the box was effective at trapping cough droplets, and theorized it would also protect against aerosols.⁴ We discussed building aerosol boxes for our anesthesia team members on 3/23/20, built our first prototype 3/25/20, and conducted simulation testing 3/26/20. Our modifications addressed these design issues: (a) limited access for intubation assistance; (b) lack of negative pressure evacuation from the box; (c) lack of arm/sleeve protection; (d) instability on the OR table; and (e) the possibility that aerosolized virus particles could escape the box on the open/caudal end.

What was tried: We modified the Taiwanese aerosol box (see Fig 1). Access for another healthcare provider to manually assist during intubation was created by adding a side access port. We drilled a hole to fit a 6.5 mm endotracheal tube connector to permit suction from inside the box to the waste gas scavenger system via standard suction tubing, which can be used with/without a viricidal/bactericidal filter. Toilet flanges were added to all three arm ports so sterile OR gown sleeves could be added as an extra layer of protection. Additionally, a plastic sheet, clear trash bag, cut C-arm drape, Jackson table hip shield, etc. can be secured with adhesive tape to the open end of the box.

During the rapid improvement cycle, we switched from retail ¼" acrylic to ⅜" thick industrial grade. Gorilla Glue plastic epoxy was used, and it only created a mechanical bond. It was not strong enough to allow the box to be moved around for placing over the patient, removed for cleaning, etc. especially after repeated use. To increase durability, we applied an adhesive, SCIGRIP Weld-on 3, that chemically bonded the acrylic pieces.⁵ It is a high-strength, clear, water-thin, acrylic plastic cement. The product is labeled as intended for industrial use only, not household. Thus, we utilized industrial

strength filtration systems and proper PPE during assembly. The thicker acrylic also provided more stability, and the boxes fit snugly to the OR table foam mattress headpiece and metal bars rails.



What lessons were learned: Intubations with an airway task trainer demonstrated our modifications enhanced the user experience to meet the needs of the anesthesia team, and aligned with everyday practice of anesthesiology in the US. Thus, the aerosol box did not inhibit routine airway management. It is common in our academic anesthesiology practice for someone to hand the endotracheal tube to the laryngoscopist - an anesthesiologist assisting a resident/fellow, anesthesiologist assistant, certified registered nurse anesthetist, student, or nurse/technician assisting one of the above.

Adding a suction port and plastic sheet to the open-end reduced the anxiety of anesthesiologists concerned with spreading aerosolized virus throughout positive pressure airflow ORs. Many anesthesiologists did not anticipate the need to wear OR gown sleeves, although they did agree it may offer an extra layer of protection. Everyone deemed the box stable on the OR table.

Prototype boxes deteriorated after 3-5 uses. Thicker acrylic boxes with industrial adhesive have endured three weeks of clinical use. Modified boxes have been deployed to several hospitals, used successfully, and received positive feedback from end-users.

Conclusion: Dr. Lai created a novel aerosol box for intubation that has been used to protect physicians around the world. Our modifications increased user satisfaction and safety by providing stability, negative pressure suction, intubation assistance port, and optional arm protection with OR gown sleeves. We offer our modifications to assist colleagues manufacturing these boxes and to facilitate iterative design improvements for intubation and airway management.

5. Serratus Anterior Plane Block for Management of Post Thoracotomy Pain and Facilitation of Early Recovery After Pediatric Cardiac Surgery

Daniel Germeroth DO, Anne E Cossu MD

Introduction: Muscle splitting, rib retraction and chest tube insertion during thoracotomy causes severe pain that is difficult to control with opioids alone leading to poor respiratory mechanics and increasing postoperative complications. This case report compares outcomes in two age and procedure-matched patients who had aortic coarctation repair through a thoracotomy.

One patient received a serratus anterior plane block (SAPB) while the other did not.

Methods: SAPB was performed after induction of general anesthesia in the lateral decubitus position. The serratus anterior muscle was identified at the level of the 5th rib in the midaxillary line. Local anesthetic was injected into the fascial plane deep to the muscle. After surgery, patients were brought to the cardiac ICU intubated and sedated. Time to extubation, time to ICU discharge, use of supplemental oxygen, total morphine dose per kg and average pain scores were recorded.

Discussion: Post-thoracotomy pain is a significant contributor to morbidity following cardiac surgery. While regional and neuraxial anesthetics provide analgesia and improve respiratory mechanics, they are rarely used in pediatric cardiac surgery. Thoracic epidural catheters or paravertebral blocks are challenging in neonates or may be contraindicated in surgical procedures requiring heparinization. The patient who received SAPB had decreased total morphine dose over the first 24 hours postoperatively but longer time to extubation, ICU discharge and time of supplemental oxygen. This is likely related to underlying congenital heart disease.

Conclusion: We are currently enrolling infants under 1 year old undergoing cardiac surgery through a thoracotomy into a prospective, randomized, single-blinded trial. We hypothesize that SAPB will enhance early recovery by reducing opioid requirements, time to ICU discharge, time to extubation, and need for supplemental oxygen.

6. Perioperative Methadone Improves Clinical Outcomes in Children: Role of methadone Pharmacokinetics

Senthil Packiasabapathy, Blessed W. Aruldas, Min Yue, Brian Overholser, Nicole Horn, Jian Ye, Senthilkumar Sadhasivam

Introduction: Despite the proven clinical efficacy of methadone in children, there is a paucity of clinical data on its pharmacokinetics (PK) and pharmacodynamics (PD) in children. We aim to determine the pharmacokinetics, clinical analgesia and adverse effect profiles of intravenous methadone in children.

Methods: This is an IRB approved, prospective, observational study of PK and PD of methadone in children 8-17.9 years of age, of ASA status 1-3, undergoing Nuss bar procedure for pectus excavatum. Participants receive 3 doses of intravenous methadone at 0.1 mg/kg up to a maximum of 5 mg. First dose is given intraoperatively, subsequent doses are given in 12-hour intervals. Serum concentration of methadone and its primary inactive metabolite, 2-ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine (EDDP), are measured at 10-30 minutes, 2 hours and 10-12 hours after each dose, using liquid chromatography- mass spectrometry (LC-MS/MS) assay. concentrations are normalized to dose and the metabolic ratio (MR) of methadone to EDDP were estimated. QT interval on ECG was recorded as a metric for PD, once at preoperatively and once on postoperative day 1.

Results: Methadone PK analyses have been completed in 25 children so far. The mean methadone concentrations were 38.4 ± 12.6 ng/mL between 10 to 30 minutes following the initial dose. The methadone concentrations 10 to 12 hours following

each of the 3 doses was 10.4 ± 5.3 ng/mL, 10.3 ± 6.4 ng/mL, and 21.4 ± 10.3 ng/mL, respectively. The corresponding MR at 10-12 hours following each of the three doses were 5.6 ± 5.0 , 4.3 ± 2.6 , and 8.7 ± 3.8 , respectively.

Discussion: Despite the significant improvement of clinical outcomes with the use of perioperative methadone as demonstrated by our previous study on spine patients, the inter-individual variability in response is significant. As noted from the results, the methadone concentration and the MR rise sharply after the third dose of methadone in children, signifying cumulative effect of repeat doses.

Conclusion: Recruitment is ongoing, with a greater sample size, non-linear modelling for methadone PK in children and correlating with genetic profile and clinical outcomes including QTc to create a PK-PD model for methadone in children.

7. Implementation of a Wellness Program for Anesthesia Providers and Early Success on Improving Physical Wellbeing

Senthil Packiasabapathy, Dhanashri Pawale, Alex Serafin, Elizabeth Block, Lorrie Ortiz, Senthilkumar Sadhasivam

Introduction: According to an ASA newsletter, over >50% of the anesthesiologists report at least one symptom of burnout. This can have consequences both in personal and professional lives. We aimed to established anesthesia staff specific wellness program to reverse burnout, anxiety, and depression, and improve physical, emotional and spiritual wellbeing of anesthesia providers.

Methods: The IU department of Anesthesia implemented a 2-part wellness program aiming to improve provider wellness. The first part: the physical well-being was rolled out in July 2019. As part of this, an on-site anesthesia specific, physical wellness center with treadmill, rowing machine, elliptical, interactive bike, free weights and showers was established in the anesthesia office at the Riley Hospital for Children. Many anesthesia providers utilize the free fitness center before or after work, or during breaks. Users have 'fitness buddies' to help keep up motivation and challenge each other. Some anesthesia providers participated in the "Finish 2019 Healthier Fitness Challenge" with the goals of 10-pound weight loss, 2% body fat loss, and improved endurance performance with 1 mile run and 1000-meter row between July 1, 2019 and December 31, 2019. The second part, focuses on improving emotional and spiritual wellbeing with "Inner Engineering" program (\$250 worth and 10.5 hours AMA Category 1 CME online course and daily practices – free for IU anesthesia team, supported by a grant) and use of validated psychological tools and biomarkers including cortisol, C-reactive protein levels, lipid profile and HbA1c levels over 3 time points over a year.

Results: We report early success (first 3 months: July 1 – September 30) of 16 anesthesia providers who took up the "Finish 2019 Healthier Fitness Challenge". Within 3 months after beginning the challenge, there was a significant reduction in body weight (mean weight loss 4.7 lbs.), body fat percentage (mean fat loss 1.2%), decrease in the 1 mile run time (mean decrease of 1 minute) and decrease in 1000

meter row time (mean decrease of 2.25 minutes).

Conclusion: Early success with improved physical wellbeing in terms of mid-point 2019 fitness challenge goals is encouraging. The IRB approved emotional and spiritual well-being part of the initiative is underway, with enthusiastic participation.

8. Isha Yoga Practices and Participation in Samyama Retreat Are Associated with Reduced HbA1C and Systemic Inflammation, Improved Lipid Profile, and Short-term and Sustained Improvement in Mental Health: A Prospective Observational Study of Meditators

Senthilkumar Sadhasivam, Suresh Alankar, Raj Maturi, Amy Williams, Ramana Vishnubhotla, Sepideh Hariri, Mayur Mudigonda, Dhanashri Pawale, Sangeeth Dubbireddi,⁸ Senthil Packiasabapathy, Peter Castelluccio, Chithra Ram, Janelle Renschler, Tracy Chang, Balachundhar Subramaniam

Background: Meditation is gaining recognition as a tool to impact health and well-being. Samyama is an 8-day Isha Yoga intensive residential meditation experience requiring several months of extensive preparation and vegan diet. The health effects of Samyama have not been previously studied. The objective was to assess physical and emotional well-being before and after Samyama participation by evaluating psychological surveys and objective health biomarkers.

Methods: This was an observational study of adults before and after the Isha Samyama retreat. All participants were invited to complete surveys. Controls included household significant others. Surveys were completed at baseline (T1), just before Samyama (T2), immediately after Samyama

(T3), and 1 month later (T4) to assess anxiety, depression, mindfulness, joy, vitality, and resilience through validated psychometric scales. Voluntary blood sampling for biomarker analysis was done to assess hemoglobin (Hb), HbA1c, lipid profile, and C-reactive protein (CRP). Primary outcomes were changes in psychometric scores, body weight, and blood biomarkers.

Results: Depression and anxiety scores decreased from T1 to T3, with the effect most pronounced in participants with baseline depression or anxiety. Scores at T4 remained below baseline for those with pre-existing depression or anxiety. Vitality, resilience, joy, and mindfulness increased from T1 to T3 (sustained at T4). Body weight decreased by 3% from T1 to T3. Triglycerides (TG) were lower from T2 to T3. Participants had lower HbA1c and HDL at T2, and lower CRP at all timepoints compared with controls.

Conclusions: Isha Samyama participants had reduced depression and anxiety, and improved well-being for at least 3 months after the retreat. Physical health improved as evidenced by weight loss, improved HbA1C and lipid profile. Samyama may serve as an effective way to improve physical and mental health, and future studies may examine its use as an alternative therapy in patients with clinical depression and/or anxiety.

9. Use of EXPAREL versus Bupivacaine for Local Wound Infiltration after Ravitch Procedure

Brandon Tanner MD, Anne E. Cossu MD, Rania K. Abbasi MD, Matthew Hamilton DO, Jeremy Herrmann MD

Introduction: The management of postoperative pain after surgical repair of pectus excavatum/carinatum with the Ravitch procedure is challenging. Our objective was therefore to compare the use of bupivacaine to its longer-acting form, EXPAREL, in patients who had undergone pectus excavatum repair with the Ravitch procedure.

Methods: Four patients received local wound infiltration with EXPAREL in 2019. These patients were matched by age to 4 patients in 2018 who received local wound infiltration utilizing 0.25% bupivacaine with epinephrine.

Results: There was a decrease in opiate use of 1.42MME/kg compared to 2.2, a decrease in diazepam use of 0.14mg/kg compared to 0.50, a decrease in ondansetron use of 25% of patients compared to 75%, a decrease in chest tube drainage of 9.7mL/kg compared to 12.5, and increase in the time to first recorded stool output of 49.9 hours post-op compared to 47.5 in the EXPAREL group as compared to the bupivacaine group.

Post-Operative Outcome	EXPAREL	Bupivacaine
Opiate Use (MME/kg)	1.42	2.2
Diazepam Use (mg/kg)	0.14	0.5
% Pts Received Ondansetron	25	75
Chest Tube Drainage (mL/kg)	9.7	12.5
First Bowel Movement (Number of Hours Post-Op)	49.9	47.5

Discussion: The decreased use of opiates and benzodiazepines suggests that better pain control may have been achieved with the use of EXPAREL. Decreased chest tube drainage in the EXPAREL group could provide an additional benefit of earlier chest tube removal and discharge from the hospital. Although the EXPAREL group had an increased time to first bowel movement, the

difference was only a matter of hours. To reach statistical significance, our goal is to prospectively collect data from additional patients in 2020 who will receive EXPAREL and age-match these to retrospective patients who received 0.25% bupivacaine. These data may serve to better delineate the potential advantage of EXPAREL.

Conclusions: There may be potential advantages to the use of EXPAREL over bupivacaine for local wound infiltration in patients who undergo the Ravitch procedure for pectus repair, however, more data is needed to understand the significance of our findings.

10. Standardized Multimodal Analgesia Protocol Including Suprazygomatic Maxillary Nerve Blocks Enhances Post-Operative Recovery and Opioid Sparing After Cleft Palate Repair

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Objective: Congenital cleft palate repair is a painful procedure with risk of postoperative airway obstruction and poor diet tolerance resulting in prolonged hospital stay. Recently, suprazygomatic maxillary block (V2 block) has been recognized as an effective regional anesthetic technique to enhance perioperative analgesia. This study aims to compare the efficacy of a multi-modal, perioperative analgesic regimen including bilateral suprazygomatic V2 blocks with conventional opioid-based analgesia.

Methods: A multi-modal, perioperative analgesic regimen including bilateral suprazygomatic V2 blocks in combination with dexamethasone, acetaminophen,

dexmedetomidine, morphine, and ketorolac was implemented as a standard protocol for infants undergoing cleft palate repair. Outcomes including total dose of opioid administered in the 24hrs postoperatively, time to first feed, duration of hospitalization, and incidence of postop complications including airway compromise and diet intolerance. These outcomes were compared to historical data from patients receiving conventional opioid-based analgesia

Results: Compared to non-standardized, conventional perioperative analgesia, a standardized multi-modal analgesic protocol with suprazygomatic maxillary regional nerve blocks significantly reduced 24-hour postoperative morphine consumption (0.15 ± 0.02 vs. 0.02 ± 0.01 mg/kg, $N=20/\text{group}$, $p < 0.0001$), shortened time to first feed 6.9 ± 1.1 vs. 3.4 ± 0.5 hrs., $N=20$, $p=0.008$), and reduced hospital length of stay (40.5 ± 5.5 vs. 24.4 ± 2.8 hrs., $N=20$, $p=0.013$). In conventional pain management group, three of twenty patients (incidence of 15%) experienced acute hypoxic events and seven patients (35%) developed diet intolerance on postoperative day 1 and 2 which was resolved spontaneously later. Interestingly, none of the twenty patients in the multi-modal analgesic regimen group experienced either of these complications.

Conclusions: Effective perioperative analgesia is pivotal in enhancing recovery after surgery and return to normal patient function. Here we describe a standardized, multimodal approach to perioperative analgesia that both enhances recovery and reduces post-operative opioid consumption in pediatric patients undergoing cleft-palate repair. Additionally, our patients did not incur any adverse events in the perioperative period.

Cardiothoracic Surgery

11. Impact of Gastrostomy Tube and Nutritional Monitoring on Interstage Outcomes following Stage 1 Norwood Palliation

Caleb Matthews MD, Dana Hartman, PNP-PC, Anne Farrell, MD, Cameron Colgate MS, Brian Gray MD, Jeremy Herrmann MD

Objective: Patients with functional single ventricle physiology undergo a series of staged operations beginning the stage I Norwood procedure (S1P), which carries a mortality risk of 15%. Patients remain at risk for complications during the interstage period prior to second stage palliation (S2P). Feeding dysfunction (FD) is common in this population and may be associated with the poorer outcomes. In 2013, we implemented a comprehensive nutritional support program including earlier consideration of gastrostomy tube (GT) placement for infants with identified FD. We aimed to characterize the impact of this strategy on interstage mortality and growth.

Methods: Patients who underwent S1P between 2008 and 2018 were retrospectively reviewed. Baseline demographics, operative characteristics, and outcomes during the interstage period were analyzed for the entire cohort; for patients with (GT) or without GT (nGT); and across three eras: I; 2008-2012; II, 2013-2016; III: 2017-2018.

Results: 79 patients met inclusion criteria (50 GT, 29 nGT). Birth, S1P and S2P weight-for-age z-scores (WAZ) were similar across eras and between GT and nGT. Overall interstage mortality was 3.8% (3/79) and did not vary by era or presence of GT. GT placement following S1P occurred at a

median of 97.59 ± 53.46 days in Era I vs. 33.75 ± 17.12 days in era III ($p < 0.001$). Weight gain was greater after GT placement than before (0.020 vs. 0.011 kg/d, $p < 0.05$). The GT group was associated with more feeding dysfunction, postoperative complications, and longer length of hospital stay after S1P. However, the GT group achieved a similar WAZ as the nGT group even though the interstage interval was shorter for the GT group in Era III (176.70 ± 46.39 vs 202.93 ± 53.75 , $p = 0.019$). There was only 1 GT-related readmission.

Conclusion: Aggressive GT consideration for patients with FD following high risk S1P is associated with improved interstage growth and similar overall survival as patients without FD.

12. 20 Years Using Stentless Porcine Aortic Root in Adult Right Ventricular Outflow Tract Reconstruction

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Background: Right ventricular outflow tract reconstruction (RVOTR) is one of the most common procedures performed alone or in combination with other procedures for pediatric and adult patients with congenital heart disease. The stentless porcine aortic root prosthesis (SPAR) has been described as a suitable valve for, and we report our medium to late term outcomes of the valve in the pulmonary position.

Methods: A retrospective chart review was conducted of patients over 18 who underwent RVOTR with the SPAR between January 1998 and October 2019. Primary outcomes included survival and freedom from any valvular re-intervention. Secondary

outcomes included endocarditis and conduit dysfunction obtained from echocardiography and/or cardiac MRI.

Results: A total of 135 patients underwent RVOTR with a SPAR at a median age of 32.4 (range 18-71). 129 had previous surgery, with 127 having undergone prior RVOTR for a variety of pathologies. Indications included pulmonary insufficiency (90.4%), stenosis (34.8%), endocarditis (7.4%) and carcinoid syndrome (4.4%). Median follow-up was 2.97 years (IQR 0.6-8.0). Overall survival was 93.3%, with 6 early and 3 late deaths. Survival at 1, 5, 10 and 14.5 years was 94.5%, 93.2%, 90.8% and 79.5%, respectively. Eight (5.9%) valvular re-interventions included 2 surgical replacements for endocarditis, 3 percutaneous replacements for stenosis and 3 balloon valvuloplasty's for stenosis at medians of 8.5, 6.4 and 1.9 years, respectively. Freedom from re-intervention at 1, 5, 10 years was 99.1%, 94.7% and 90.7%, respectively. Endocarditis occurred in 4 patients (2.9%), with 2 requiring surgical valve replacement. Progressive conduit degradation was evident at 10 years with 22.2% and 7.7% \geq moderate stenosis and insufficiency, respectively.

Conclusions: In one of the largest single institution experiences with adults, and now with the longest follow-up period, this usage of the SPAR demonstrates excellent mid-to-long term durability, low rates of endocarditis, and high freedom from re-intervention.

13. Surgical Mitral Valve Replacement using the Sapien-3 pericardial valve: A report of three cases performed in 2018

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Objective: Mitral valve replacement (MVR) in children is a complex procedure that continues to have poor outcomes, secondary to the prostheses (P) small orifice area, extension of (P) into the left ventricular outflow tract (LVOT), lack for growth and/or expandability and need for Coumadin with mechanical MVR's. Here we highlight the novel use of the Sapien-3 percutaneous valve surgically placed in the mitral position of 3 children. We selected the Sapien-3 because of its larger orifice area and shorter profile as compared to the more commonly used Melody.

Methods: Three patients underwent MVR with the Sapien-3 PV were retrospectively reviewed for complications and outcomes.

Results: Average age 10years (range 3-16years), average MVR size was 23mm (range 20-26mm), average length of stay was 8 days (range 6-12days). Average length of follow 11 months (range 8-15 months). The average decrease in mean gradient from preop was 8mmHg (4-14 mmHg). One patient had transient heart block that resolved. Two patients are back to normal activities and one patient has some activity intolerance. One patient has mild asymptomatic LVOT obstruction but is clinically well. No patient has required balloon expansion of the Sapien-3 and no patient is anticoagulated with anything other than aspirin.

Conclusions: The Sapien-3 valve can successfully be placed in the mitral position in children. Our short-term follow up has been satisfactory and is the longest reported follow up that we know of. Continued monitoring will be needed to compare hemodynamics and durability to those of the Melody valve in the mitral position of children.

Neurosurgery

14. Use of Tranexamic Acid with Subcutaneous Injection of Epinephrine and Triamcinolone Reduces Blood Loss, Transfusion Rates and Length of Stay in Open Sagittal Craniosynostosis Repair

Laurie L Ackerman, MD; Anna Ackerman Snider; Jian Ye, MD

TOP ABSTRACT

Introduction: In 2017 we adopted tranexamic acid (TXA) infusion and Epinephrine/Triamcinolone scalp injection in open sagittal synostosis surgery. We believe this reduced blood loss and transfusion rates in this population.

Methods: Retrospective review of 102 consecutive patients operated for sagittal synostosis aged <4 months at surgery from 2007 to 2019 was conducted. We collected demographics (age, sex, weight at surgery, and length of stay (LOS)) ; intraoperative information (estimated blood loss (EBL), administration of packed red blood cell (PRBC) transfusion or plasmalyte/albumen in mls, operating time, baseline hemoglobin (Hb) & hematocrit (Hct), type of local anesthetic (1/4% bupivacaine vs Ephinephrine/Triamcinolone)) and use and volume of TXA). Postoperative Hb, Hct, coagulation studies, & platelets at 2 hours

postoperatively and postoperative day (POD) 1 were also recorded.

Results: There were 3 groups: ¼% Bupivacaine/Epinephrine (N=61), Epinephrine/Triamcinolone (N=11) and Epinephrine/Triamcinolone with TXA bolus/infusion intraoperatively (N=30). Sixty-eight were male, and 34 were female. No differences existed between groups for age (\bar{x} 3.3 mos), weight (\bar{x} 6.1Kg) or ICU LOS (1 day). Groups receiving Ephinephrine/Triamcinolone or Ephinephrine/Triamcinolone/TXA had lower mean EBL (30 & 25 vs 40 mls $p<0.0001$), lower rate/amount of PRBC transfusion (127.7 & 83.7 vs 154 mls $p<0.0001$), and shorter operative time (76.5 & 66.1 versus 91.7 minutes $p<0.0001$). Eight Ephinephrine/Triamcinolone/TXA patients did not require transfusion. LOS was shortest for Ephinephrine/Triamcinolone /TXA vs the Ephinephrine/Triamcinolone or bupivacaine groups (2 vs 3,3 days, $p<0.0001$). No significant differences between groups were noted on POD 1 Hb, Hct, PT, PTT, or INR (\bar{x} Hct 25).

Conclusion: Use of Ephinephrine/Triamcinolone/TXA significantly reduced EBL, PRBC transfusion, OR Time and LOS in open sagittal synostosis surgery. Given a mean postoperative Hct of 25, it could be argued that even lower rates of transfusion could be tolerated. Use of Ephinephrine/Triamcinolone/TXA may be a useful adjunct for other surgical cases.

15. Racial and Socioeconomic Disparities in Access to Surgical Care for Spasticity in Children

Eric Metzman, BS, Blake Priddy, MD, Andrew Jea, MD, MHA, and Kristin N. Zieles, BS

Objective: Racial and socioeconomic disparities within the US healthcare system lead to inequality in accessibility of needed health services, may affect outcomes, and are a growing concern. The effect of disparities has only been sparsely studied for accessibility to pediatric neurosurgery care. We analyze the impact of race and socioeconomic status on accessibility to neurosurgical care for spasticity in the pediatric age group.

Methods: Demographic information, household income, payer status, type of referring physician, age at first encounter, time to surgery from first encounter, and distance traveled for tertiary care were abstracted from the EHR at Riley Hospital for Children from January 1, 2007 to December 31, 2019. Student's t-test and chi-squared test were utilized to determine statistical significance for continuous and categorical variables, respectively.

Results: We analyzed 151 unique patients, but excluded 69 patients; therefore, our study population constituted 82 patients. Given our small sample size, we set statistical significance at a p-value of 0.20. We found that race was not associated with primary care physician (PCP) versus specialist referral ($p = 0.82$), age at first encounter ($p=0.37$), distance travelled ($p = 0.69$), unplanned readmission rate after surgery ($p = 0.95$), baclofen pump infection ($p = 0.95$), and baclofen pump malfunction ($p = 0.94$). However, race was significantly associated with surgery type ($p = 0.18$), time from presentation to intervention ($p = 0.12$), and Ashworth scale outcomes ($p = 0.007$). Insurance type was not significantly associated with age at first encounter ($p = 0.22$), distance travelled ($p = 0.94$), time from presentation to intervention ($p = 0.52$), unplanned readmission rate ($p = 0.47$), baclofen pump infection ($p = 0.47$), and baclofen pump malfunction ($p = 0.91$). Insurance type was significantly associated with surgical procedure ($p = 0.06$), Ashworth

scale outcomes ($p = 0.03$), and PCP versus specialist referral ($p = 0.20$).

Conclusions: Given the paucity of socioeconomic data in the literature, our findings are novel in that this study showed race and insurance types to be significantly associated with delay in care, choice of surgical procedure, surgical outcomes, and referral patterns. The findings suggest the presence of racial and/or socioeconomic status disparities in access to pediatric neurosurgical care for spasticity. Further studies on health disparities in the pediatric neurosurgical patient population are necessary.

16. Building a Minimally Invasive Laser Ablation Program in Children Targeting NeuroOncology and Epilepsy Foci

Natasha Raman, Diane Siebold, Lynn Netter, Andrew Jea, Jeffrey S. Raskin

Multidisciplinary, patient-centric programs are improving value in healthcare nationwide. Programmatic development requires collaboration, resources, and opportunity. A program director should marshal the necessary resources, invigorate the stakeholders, and guide implementation within a complex system. The goal is to establish standardized protocols which formalize an innovative advance in healthcare.

Laser Interstitial Thermal Therapy (LITT) is a minimally invasive neurosurgical application that is rapidly changing the treatment of children with a wide variety of neurosurgical pathology. Briefly, saline cooled lasers are stereotactically placed in deep or periventricular lesions and treated by thermal injury with real-time magnetic resonance monitoring.

At Riley Hospital for Children, a coordinated team of neurosurgeons, anesthesiologists, neurologists and neuro-oncologists, neuroradiologists, imaging technologists, medical company representatives, and subspecialty nurses developed the first-in-Indiana standard workflow for LITT in children. From August to September 2017, the LITT team communicated, planned, and rehearsed each part of the complex protocol including induction, operative placement on a demonstration head, transport to the MRI suite, and laser ablation of a surrogate lesion. October 2017 marked the first stereotactic laser ablation performed on a child in Indiana; the program has performed 19 cases over 16 months. Three patients had antecedent biopsies and no patient experienced hemorrhagic complications; one patient had a transient neurological deficit. Median discharge was postoperative day one.

LITT is known to improve outcomes and enhance value. Standardized protocols, collaboratively developed by a multidisciplinary team, were rehearsed and then applied clinically. Quality and safety were paramount. The Visualase Program at Riley is a successful example of programmatic development.

17. A Standardized Protocol to Reduce Perioperative Hypothermia in Pediatric Spinal Deformity Surgery: A Quality Improvement Initiative

R. Diane Seibold, RN, BSN, CNOR, Tylyn Bremer, RN, BSN, Katrina Ducis, MD, Andrew Jea, MD, MHA, FACS, FAAP

Background: Hypothermia in adult surgical patients has been correlated with an increase in the occurrence of surgical site wound infections, increased bleeding, slower recovery from anesthetics, prolonged

hospitalization, and increased healthcare costs. Pediatric surgical patients are at potentially increased risk for hypothermia because of their smaller body size, limited stores of subcutaneous fat, and less effective regulatory capacity. This risk is exacerbated during pediatric spinal surgery by lower preoperative temperature, increased surface exposure to cold during induction and positioning, and prolonged surgical procedure times. The purpose of this quality improvement initiative was to reduce the duration of hypothermia for pediatric patients undergoing spine surgery.

Methods: Demographic and clinical data was collected on 162 patients who underwent spinal deformity surgery between October 1, 2017 and July 31, 2019. Data points included patient age, gender, diagnosis, surgical procedure, and temperature readings throughout different phases of perioperative care. Temperatures were obtained upon arrival to day surgery, upon presentation to OR, during prone positioning, at incision and at procedure end. Twelve patients were analyzed prior to implementation of a protocol, while 119 patients composed the post-protocol group.

Results: Using descriptive statistics, the average body temperature at the time of incision was 34.0 degrees Celsius prior to adoption of a preoperative warming protocol, and 35.3 degree Celsius after following a preoperative warming protocol ($p < .0001$). There were no complications, such as burns, hyperthermia, or arrhythmias, related to preoperative warming of patients.

Conclusion: The placement of a warming blanket on the bed prior to patient arrival and actively targeting normothermia reduced the incidence and duration of hypothermia in pediatric patients undergoing spine surgery with no adverse events.

18. PedsQL for Prediction of Postoperative Patient-Reported Outcomes following Chiari Decompression Surgery

Kristin Zieles, BS, Shawyon Baygani, BS, and Andrew Jea, MD, MHA

Objective: The purpose of this study is to determine if the preoperative Pediatric Quality of Life Inventory (PedsQL) score is predictive of intermediate-term PedsQL outcomes following Chiari decompression surgery. The utility of preoperative patient-reported outcomes (PROs) to predict pain, opioid consumption, and long-term PROs has been previously demonstrated in adult spine surgery. However, to our knowledge, there is currently no widely accepted tool to predict short-, intermediate-, or long-term outcomes after pediatric Chiari decompression surgery.

Methods: A prospectively maintained database was retrospectively reviewed. Patients who underwent first-time decompression for symptomatic Chiari malformation were identified and grouped by their preoperative PedsQL scores: mild disability (score 80–100), moderate disability (score 60–80); and severe disability (score < 60). PedsQL outcomes were collected at 6-week, 3-month, and 6-month follow-up. Preoperative PedsQL subgroups were tested for an association with demographic and perioperative characteristics using one-way ANOVA or chi-square analysis. Preoperative PedsQL subgroups were tested for an association with improvements in short- and intermediate-term PedsQL by using one-way ANOVA and paired Wilcoxon signed rank test controlling for statistically different demographic characteristics, when appropriate.

Results: A total of 87 patients were included in this analysis. Patients were grouped by their preoperative PedsQL scores: 28% had mild disability, 40% had moderate disability, and 32% had severe disability. There was a

significant difference in the prevalence of comorbidities ($p=0.009$) among the subgroups; however, in terms of other demographic or operative factors, there was no significant differences. The postoperative patient- and parent-reported PedsQL values were significantly different between all three groups at 6-weeks, 3-months, and 6-months after surgery ($p < 0.05$), except at the 6-month timepoint for parent-reported outcomes ($p = 0.111$). Patients with severe disability demonstrated statistically significant greater improvements (compared to preoperative score) in patient- and parent-reported PedsQL at all timepoints after surgery, except at the 6-week patient-reported outcomes, 6-month patient-reported outcomes and 6-month parent-reported outcomes ($p = 0.094$, $p = 0.443$, and $p = 0.133$, respectively).

Conclusions: Patients with severe disability, as assessed by PedsQL, experienced lower absolute PedsQL scores at all timepoints after surgery but had greater improvement in short- and intermediate-term PROs. We conclude that PedsQL is an efficient and accurate tool that can quickly assess patient disability in the preoperative period and predict both short-term and intermediate-term surgical outcomes.

19. Modeling No-Show Rates in the Pediatric Neurosurgery Clinic at Riley Hospital for Children

Kristin N. Zieles, BS, Kristin N. Lee, BS, and Andrew Jea, MD, MHA

Introduction: The Section of Pediatric Neurosurgery utilizes a live-person appointment reminder system. The Pediatric Neurosurgery service sees approximately 500 patients in clinic per month between 5 pediatric neurosurgeons and 4 nurse practitioners.

Recently, the clinic no-show rate has negatively exceeded national benchmarks. Rather than asking office staff with limited hours and bandwidth to make repeated, live-person reminder calls to all patients and families, we would like to adopt a “work smarter, not harder” philosophy.

The purpose of this study is to statistically model our clinic no-show rates to identify at-risk patients and families, and to concentrate efforts at reminding this subgroup about their upcoming clinic appointment.

Methods: Data were collected for all available appointments during the month of December 2019 in our integrated EHR (Cerner Corporation, North Kansas City, MO). Cancelled and rescheduled appointments were excluded. Independent variables were selected based on availability and a conceptual framework for our clinic no-shows (**Table 1**). Median income captured from US Census reports based on geographic zip code (<http://www.census.gov/quickfacts>) was used as a proxy for household income. Time traveled was estimated using Google Maps.

Multivariable logistic regression was used to model the probability of a no-show. A p value of 0.05 was considered statistically significant. We optimized for the maximum pseudo R², and AUC for the ROC of our model.

Results: The data included 504 appointments. Of these appointments, 73 were classified as no-shows for an overall no-show rate of 14%.

Orthopedic Surgery

20. Demographic changes in US trampoline related injuries 1998 through 2017: Cause for alarm

Ryan E Fitzgerald, Serena M Freiman, Robert Kulwin, Randall Loder

After multivariable logistic regression, the following variables were considered important to the model: PROVIDER_1 (p = 0.036), PROVIDER_2 (p = 0.000080), APPTTYPE_HFU (p = 0.022), APPTTYPE_PSBN (p = 0.027), and INCOME (p = 0.057). PROVIDER_1 and PROVIDER_2 represent two of our nurse practitioners. APPTTYPE_HFU and APPTTYPE_PSBN are hospital follow-up and new pediatric spina bifida clinic appointments, respectively. INCOME documents a household income < \$25,000, which represents the Federal poverty level. We included INCOME as it was near statistical significance (p = 0.057) and improved the pseudo R² (0.052 -> 0.059) and AUC of the ROC of our model suggesting a better fit of our model and explanation of variance. A cutoff of 0.5 yielded a sensitivity of 3%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 86%. On the other hand, a cutoff of 0.25 yielded a sensitivity of 47%, specificity of 80%, positive predictive value of 28%, and negative predictive value of 90%.

Conclusions: We created a model of neurosurgical clinic patients who are likely to be no-shows. These patients may be targeted for more intensive intervention to ensure that they will complete their scheduled clinic appointment. More data are required to improve the accuracy of our model. Future directions for research include assessing the effect on no-show rates after implementing this predictive analytic model, and the outcomes of interventions based on standardized live call reminders and automated two-way reminders.

Background: Recreational sports facilities with trampolines have become increasingly popular, and trampoline-related injuries incurred have been increasing. The goal of this study was to determine impact of

recreational sports facilities on trampoline-associated injuries.

Methods: An epidemiological study was performed using data from the National Electronic Injury Surveillance System (NEISS). All patients in the NEISS database coded for trampoline injury were included. Statistical analyses were performed comparing home trampoline injuries (HTIs) and recreational sports facilities-related trampoline injuries (RSIs) for standard demographic variables using appropriated weighted statistical methods.

Results: There were an estimated 1 376 659 emergency department (ED) visits for trampoline related injuries from 1998 to 2017; 125 811 were RSIs and 1 227 881 were HTIs. Between 2004 and 2017, the number of RSIs increased rapidly, while HTIs decreased. RSIs more often presented to large hospitals and HTIs to smaller ones. Strains/sprains were more associated with RSIs, whereas HTIs sustained more internal organ injuries. Lower extremity fractures occurred more frequently in RSIs and upper extremity fractures in HTIs. There was a greater percentage of RSIs in 15-34 years old age group (28.2% vs 13.6%). There were no differences by gender and race between HTIs and RSIs.

Conclusions: The rapid expansion in recreational sports facilities with trampolines coincided with increasing RSIs. RSIs differed from HTIs regarding changes over time, hospital size, diagnosis and injury location. Recreational sports facilities with trampolines pose a public health hazard.

21. The Demographics of Dog Bites in the United States

Randall Loder

Objective: Dog bites are a significant public health issue. There is no comprehensive study of dog bite demographics. It was the purpose of this study to perform such an analysis across the US.

Methods: The National Electronic Injury Surveillance System All Injury Program data for the years 2005 through 2013 was accessed; dog bite injuries were extracted and analyzed. Statistical analyses were performed with SUDAAN 11.0.01™ software to account for the weighted, stratified nature of the data. Incidence values were calculated using population data from the US Census Bureau. A $P < 0.05$ was considered significant.

Results: There was an average 337,103 ED visits each year for dog bites. The average age was 28.9 years; 52.6% were male and 47.4% female. The bites were located on the upper extremity in 47.3%, head/neck in 26.8%, lower extremity in 21.5%, and trunk in 4.4%. Younger patients had more bites involving the head/neck, while older patients the upper extremity. More occurred in the summer and on weekends and 80.2% occurred at home. Hospital admission occurred in 1.7%. Logistic regression analysis demonstrated that the odds of admission was solely dependent upon the age group. The OR for admission was 11.03 [4.68, 26.01] for those > 85 years of age, 4.88 [2.89, 8.24] 75 to 84 years, and 2.79 [1.77, 4.39] those ≤ 4 years of age, with the 10-14-year age group the reference group. The average annual incidence was 1.1 per 1,000 and was slightly higher in males (1.18 vs 1.02 per 1,000). The estimated cost was at least 400 million US\$ per year.

Conclusion: Potential prevention strategies are educational programs directed at both children and parents/caretakers outlining the responsibilities of owning a dog. This information can be disseminated in health care facilities, radio/TV/Internet venues, and dog kennels/shelters.

22. Prevalence and outcomes of Atypical Clubfoot at Riley Hospital for Children

Loder, Randall T.; Caltoum, Christine Beth; Christman, Tyler; Fitzgerald, Ryan; Akinyoola, Akinyele Lawrence

Background: Atypical clubfeet are resistant to correction and standard manipulation and casting may lead to worsened deformity. There is therefore a need for early detection of an atypical club foot so that the modified Ponseti method can be deployed early. Knowing the demographics of such feet would also be helpful in identification of this patient population.

Objective: This study aims to retrospectively review all atypical club feet seen at Riley Hospital for Children from January 2010 to December 2019.

Methods: A retrospective chart review of all clubfeet seen and treated over the study period will be performed. Children with clubfeet, typical and atypical, will be identified by the ICD 10 code and ICD 9 code. Exclusion criteria will be those coexisting with arthrogryposis, myelomeningocele and other syndromic club feet, as well as any child treated at another institution before being seen at Riley.

The data to be extracted from the patients' records will include: month of birth, age, gender, race/ethnicity, laterality, birth order, prenatal diagnosis of club foot, family history of foot/limb deformities, associated congenital deformities(if any), medical issues during pregnancy, description of foot deformity, Pirani score(if recorded), method of manipulation(Ponseti/Modified Ponseti), number of casts before tenotomy, age at full correction, presence/absence of a relapse, age at relapse, need for further surgery (and

if so what type), length of follow up and overall outcome. Outcomes will be graded by clinical information and radiographic parameters (where recorded). Clinical information includes (1) Plantigrade foot, (2) ability to wear a normal shoe, (3) no pain, and (4) parent's satisfaction. Radiographic outcomes will include tibio-calcaneal angle, talo-calcaneal angle and talo-first metatarsal angle.

Data analysis will be carried out using appropriate statistical methods. We will be especially interested in comparing the demographics of the typical and atypical groups.

23. The Demographics of Fractures and Dislocations Across the Entire United States Due to Common Sports and Recreational Activities

Cory Meixner, MD, Randall T. Loder, MD

Objective: There is little nationwide data regarding fracture and dislocation patterns across a wide variety of sporting activities for all ages and sex.

Methods: The National Electronic Injury Surveillance System All Injury Program data 2005 through 2013 was accessed; 18 common sports and recreational activities in the US were selected. SUDAAN 11.0.01™ software was used to calculate the numbers of fractures and dislocations, and incidence was calculated using US Census Bureau data. Multivariate logistic regression analysis determined the odds ratios (OR) for the occurrence of a fracture or dislocation.

Results: A fracture occurred in 20.6% and a joint dislocation in 3.6% of the ED visits for sports related injuries; annual ED visit incidence was 1.51 for fractures and 0.27/1,000 for dislocations. Most of the

fractures occurred in football (22.5%). The OR for fracture was highest for in-line skating (OR = 6.03), males (OR = 1.21), Asians, Whites and Amerindians compared to Blacks (OR = 1.46, 1.25, 1.18), and those > 84 years old (OR = 4.77). Most of the dislocations occurred in basketball (25.7%). The OR for dislocation was highest in gymnastics (OR = 4.08), males (OR = 1.50), Asians (OR = 1.75), and in those 20 to 24 years of age (OR = 9.04). The most common fracture involved the finger and dislocation the shoulder.

Conclusion: In-line skating had the highest risk for fracture and gymnastics for joint dislocation. This is a comprehensive study of the incidence, demographics, and risks of sustaining a fracture or dislocation from common sports activities across all age groups.

Otolaryngology

24. Obstructive Sleep Apnea and Concomitant Laryngomalacia in Young Children

Harrison Love, BA, Ryan Mitchell, MD, PhD, Anuja Bandyopadhyay, MBBS

Background: Obstructive sleep apnea (OSA) in infants is associated with changes in cognitive development, temperament and behavior. OSA in children commonly occurs due to fixed airway obstruction secondary to adenotonsillar hypertrophy. In infants, another etiology for OSA is dynamic airway obstruction due to laryngomalacia. While first line of therapy for OSA in children is adenotonsillectomy, laryngomalacia is typically managed conservatively as it improves with age. There is paucity of literature regarding infants with OSA and laryngomalacia. We aimed to describe the demographics and comorbidities associated with OSA in infants (<2-year-old) with and without laryngomalacia.

Methods: Retrospective chart review of infants (<2-year-old) presenting for evaluation of OSA. All infants underwent pre-operative polysomnogram (PSG) followed by drug-induced sleep endoscopy (DISE) directed intervention. Variables documented included demographics, comorbidities, history of adenotonsillectomy, DISE directed surgical interventions and pre and post PSG findings. Laryngomalacia was defined as presence of obstruction (Chan Parikh score > or = 2) at the supraglottis level on DISE evaluation. Cohort was divided into 2 groups based on presence or absence of laryngomalacia. Demographics and prevalence of comorbidities in the two groups were compared using t-test (continuous) and Chi Square (categorical). P value is significant for <0.05.

Results: 85 infants were evaluated from 2015-2019. Infants with laryngomalacia (LM) were younger in age. Prevalence of prematurity (LM 21.1%, no LM 30.0%) and bronchopulmonary dysplasia (LM 5.56%, no LM 10.0%) were similar between the two groups. DISE findings showed that infants without laryngomalacia had a higher prevalence of adenoidal hypertrophy (avg grade LM 1.34, no LM 2.32). OSA-18 questionnaire score was higher in infants with laryngomalacia (39.2) compared to infants without laryngomalacia (17.1). No significant difference was noted in the PSG parameters in the 2 groups (AHI LM 22.0, no LM 21.0)

Conclusion: Infants with OSA and laryngomalacia are younger and have worse parent reported quality of life. Infants with and without laryngomalacia have similar PSG measures. Future studies are needed to explore the relationship between laryngomalacia and infant OSA.

25. Audiological Outcomes in Pediatric Patients who Underwent Mastoidectomy for Acute Coalescent Mastoiditis

Dhruv Sharma, MD; Brady Tucker, BS; Kolin Rubel, MD; William Bennett, MD; Sarah Burgin, MD

Background: Studies assessing hearing outcomes in pediatric patients who undergo mastoidectomy for acute mastoiditis (AM) are absent from the literature.

Objective: To assess post-operative hearing outcomes in pediatric patients who underwent mastoidectomy for acute mastoiditis (AM).

Materials and Methods: The Pediatric Health Information System database was queried from 2009 to 2019 for all patients at a single tertiary children's hospital in Indiana who underwent mastoidectomy for AM. Audiometric data was obtained from audiograms completed less than one year and greater than one year from initial surgery to assess short-term (ST) and long-term (LT) hearing, respectively.

Results: The study identified 49 patients who underwent 50 mastoidectomy operations from 2009 to 2019. In comparing short term and long term hearing for the operative ear, there was a statistically significant difference in the speech reception threshold (ST average: 24.23, LT: 16.96; $p = .027$) and bone conduction pure tone average (BC PTA; ST: 14.35, LT: 10.73; $p = .032$). In patients who had normal tympanometry and air conduction pure tone average (AC PTA) on the short-term audiogram, 89% and 100% continued to be normal on the long-term audiogram, respectively. With regards to comparing the operative ear (OE) with the contralateral ear (CE) for short-term hearing, there were

statistically significant differences in AC PTA (OE: 29.76, CE: 12.65; $p = .040$), BC PTA (OE: 14.35, CE: 7.55; $p = .038$), air-bone gap (OE: 18.78; CE: 5.28; $p = .048$). In terms of the long-term hearing, AC PTA continued to be significantly different (OE: 24.75, CE: 16.48; $p = .019$).

Conclusion: Post-operative audiograms should be obtained in pediatric patients who undergo mastoidectomy for AM, and those who have normal audiograms less than one year from surgery likely do not require further audiometric surveillance

26. Re-operative Rates in Pediatric Patients Who Underwent Mastoidectomy for Acute Coalescent Mastoiditis

Dhruv Sharma, MD; Brady Tucker, BS; Kolin Rubel, MD; Sarah Burgin, MD

Background: Studies assessing overall rates of future surgery in pediatric patients who undergo mastoidectomy for acute mastoiditis (AM) are largely absent.

Objective: To determine the rates of future pressure equalization tube (PET) placement and major otologic surgery (MOS) in pediatric patients undergoing mastoidectomy for AM.

Materials and Methods: The Pediatric Health Information System (PHIS) database was queried from 2009 to 2019 for all patients at a single tertiary children's hospital in Indiana who underwent mastoidectomy for AM.

Results: The study identified 49 patients who underwent 50 mastoidectomy operations for acute coalescent mastoiditis from 2009 to 2019. The mean age at presentation was 5.5 years (range: 0.1 to 15.7), and there was a slight male predominance (1.4:1). Overall, 16.3% (8/49) required future MOS. Future MOS

correlated with older age at surgery for AM with a mean age of 8.6 years (range: 1.5 to 15.7) for patients requiring future MOS compared to 4.9 years (range: 0.1 to 13.9) in patients who did not have MOS ($p = .0236$). The future MOS cohort was also more likely to have had prior ear surgery ($p = .0006$) and not have had prior PET ($p = .0167$). Interestingly, 34.1% (15/44) of available cultures collected during surgery from the mastoid cavity were negative for bacterial growth. 26.5% (13/49) of patients required future PET placement, and this cohort was more likely to have had negative cultures at time of mastoidectomy ($p = .0164$). In terms of microbiology, *S. pneumonia* was the predominant etiologic agent from 2009 to 2014, growing in 56% of positive cultures from mastoid cavities. Among patients treated from 2014 to 2019, *S. pyogenes* took over as the predominant etiology, growing in 45% of positive cultures while *S. pneumonia* decreased to 25%.

Conclusion: A significant portion of patients who undergo mastoidectomy for AM require a future ear operation or PET placement. Microbial patterns are evolving in the post-pneumococcal vaccination era, and *S. pyogenes* may now be the predominant etiologic agent of pediatric AM. Pathogen identification may be protective against the need for future tube placement; however, the contribution of the middle ear microbiome to development of chronic ear disease is not yet fully understood and warrants further investigation.

Pediatric Critical Care

27. Association of Multi-Organ Dysfunction and Mortality in Pediatric Traumatic Brain Injury Patients

Alyson Baker, Laurie Ackerman, John Stout, Rachel Hardacker, Riad Lutfi, Courtney Rowan

Objectives: Traumatic brain injury (TBI) is a leading cause of death and disability in the pediatric population. There is limited data regarding the presence of multi-organ dysfunction and its impact on mortality in this population. The aim was to identify organ dysfunction and the affect of mortality in patients with pediatric TBI.

Methods: A retrospective cohort study of severe TBI patients (GCS<8) admitted to the Riley PICU from 2015 to 2018. Goldstein criteria was applied to classify organ dysfunction. KDIGO was used to classify kidney injury and PALICC criteria were used to categorize pediatric acute respiratory distress syndrome (pARDS). Continuous variables are reported as medians (interquartile ranges) and compared with Mann Whitney U test. Categorical variables are presented as percentages and compared with Chi squared.

Results: 161 children with severe TBI were included in the study. Hospital mortality was 29%. Non-survivors were younger (1.5 (0,6) vs 8 (2,12), $p=0.0001$). Non-survivors had more organ injury on each day of the first 72 hours of PICU admission ($p<0.001$ for each day). On day 0, non-survivors had more respiratory (100% vs 89.6%, $p=0.02$), hematologic (32.3% vs 2.3%, $p=0.0005$), and cardiovascular (78% vs 13%, $p<0.0001$) dysfunction. On day 1, non-survivors had more respiratory (100% vs 71.4%, $p<0.0001$), hematologic (20% vs 1.4%, $p=0.003$), and cardiovascular (86.8% vs 16.1%, $p<0.0001$) dysfunction. On day 2, non-survivors had more respiratory (100% vs 69.7%, $p=0.0002$) and cardiovascular (75.9% vs 20.2%, $p<0.0001$) dysfunction. Non-survivors had more pARDS on day 0

(57.1% vs 34.6%, $p=0.05$), on day 1 (61.8% vs 27.6%, $p=0.002$), and at any point (85% vs 43.1%, $p<0.0001$).

Conclusions: Pediatric TBI has significant mortality at 29%. In this cohort, there was more organ dysfunction in non-survivors; particularly with the development of pARDS or AKI in the first 72 hours. Multi-organ dysfunction may play a role in overall TBI-related mortality

Pediatric Surgery

28. It's Complex: Predicting Gastroschisis Outcomes Using Prenatal Imaging

Fisher, Sarah G; Anderson, Cassandra M; Steinhardt, Nicole P; Howser, Lauren A; Bhamidipalli, Surya S MPH; Brown, Brandon P MD; Gray, Brian W MD

Introduction: Gastroschisis occurs in 1 out of 2,000 births with survival rates partially contingent on intestinal complications and time to establishing feeding. Enhancements in prenatal imaging have given better insight into postnatal outcomes. The goal of this study was to examine the gastroschisis patient population at a single children's hospital in the modern era and to utilize prenatal ultrasound to develop new prenatal prognostic indicators.

Methods: We performed a retrospective review of gastroschisis patients at a quaternary care referral children's hospital from 2010 through 2018. We recorded demographics, prenatal data and imaging, early postnatal data, operative data, and patient outcomes. We compared patients within our cohort born with complex gastroschisis (bowel atresia/ perforation) to uncomplicated gastroschisis patients. First and last prenatal ultrasounds (US) were evaluated for changes in amount of external

bowel, bowel dilatation, and bowel wall edema to identify prognostic indicators of the status of the bowel at birth.

Results: 134 patients were included in the study: complex (24), uncomplicated (110). Compared to uncomplicated gastroschisis, complex patients required longer median days to feeding initiation (44 vs 10, $p<0.001$), full feeding (80 vs 23, $p<0.001$), length of stay (LOS) (83 vs 33, $p<0.001$), and TPN at discharge ($p=0.004$). Full US data was available on 81% of patients, and partial data was identified on 19%. Prenatal US analysis showed significantly more complex patients had polyhydramnios amniotic fluid on last prenatal US (23.5% vs 4.3%, $p=0.018$). Multiple multivariable logistic regression analyses revealed amniotic fluid on last prenatal US to be the most significant predictor of complex gastroschisis. However, there were no differences in perioperative or long-term complications in the complex group when compared to the group with uncomplicated gastroschisis.

Conclusions: Markers on prenatal ultrasound can predict intestinal complications at birth. Complex gastroschisis is associated with increased time to feeds and LOS.

29. Long Term Outcomes after Partial Splenectomy in Children

Niloufar Hafezi MD, Kyle L. Carpenter MD MPH, Brian W. Gray MD, Frederick J. Rescorla MD

Introduction: Partial splenectomy is an accepted alternative to total splenectomy for management of hematologic disorders in children who would otherwise be left susceptible to over-whelming post-splenectomy sepsis (OPSS), at the expense of

potential subsequent reoperation for total splenectomy or cholecystectomy. Here, we present our experience of patients undergoing partial splenectomy, to determine the rate of reoperation and if any factors affected this return.

Methods: All patients who underwent partial splenectomy at a single large children's hospital were retrospectively reviewed from 2002 through 2019 after IRB approval.

Results: Twenty-eight patients had partial splenectomy, at median age 6.0 years (IQR 4.0-7.5), and were followed over 8.1 years (IQR 3.4-10.3). 25% (n= 7) of patients required completion splenectomies. There was no significant difference in age at index operation (p=0.84), splenic volume (p=0.14), mean preoperative and post-operative hemoglobin (p= 0.19 and 0.88, respectively), mean preoperative and post-operative reticulocyte count (p= 0.98 and 0.31, respectively), or transfusion requirements after index operation (p=0.42) when comparing patients who did not require completion splenectomy to those who did. 32% (n= 9) of patients had a cholecystectomy with partial splenectomy, and of those who did not, 26% (n= 5) required a cholecystectomy later on. Among those who did not undergo concomitant cholecystectomy, the presence of gallstones on preoperative ultrasound was not associated with the rate of subsequent cholecystectomy (p=1.00). Median time to completion splenectomy was 2.9 years (IQR 1.5-7.2), and to delayed cholecystectomy was 3.8 years (IQR 2.8-6.8). There were no cases of OPSS or deaths.

Conclusion: Partial splenectomy is a safe alternative to total splenectomy in children with hematologic disease with decreased susceptibility to OPSS, however, families

must be counseled that there is a 25% chance of reoperation to total splenectomy, and 26% chance of subsequent cholecystectomy if not completed at index operation, regardless of other physiologic variables.

30. Surgical Needs and Survival in Trisomy 13 and 18: A Thirty-Year Review

Niloufar Hafezi MD, Amanda R. Jensen MD MS, Zoe M. Saenz BS, Cameron L. Colgate MS, Zeynep N. Salih MD, Brian W. Gray MD

Background: Trisomy 13 and 18 are common autosomal trisomies with a wide range of associated congenital anomalies and surgical disease. However, due to their classically described early mortality, surgical risks and implications on survival are unclear; in turn, making patient selection and family counseling difficult for healthcare providers. Here, we reviewed the surgical needs, surgical outcomes, and short and long-term survival of patients with Trisomy 13 and 18.

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

Results: Eighty-eight patients were identified, with 61%(n=54) trisomy 18 and 39%(n=34) trisomy 13. Collectively, 72%(n=63) were female, 75%(n=66) had at least four organ systems involvement, 67%(n=57) survived to initial hospital discharge lasting median 13.5 days, and 80% of deaths occurred by three months with median date of death of 19.2 days. Patients with higher birth weight and gestational age had significantly higher likelihood for

survival, while the presence of cardiac, orthopedic, and general surgical needs significantly decreased this. Nearly half (48.3%, n=42) underwent an invasive procedure, with 47.6%(n=20) occurring during initial hospitalization, and median survival times were significantly higher than non-operative patients ($p = <0.001$). The most common surgical procedures were related to feeding dysfunction (29.5%) and otolaryngologic conditions (27.3%). Higher birth weight significantly improved postoperative survival($p=0.027$), while undergoing general ($p= 0.030$) or orthopedic($p=0.040$) operations significantly worsened survival compared to those undergoing other procedures.

Conclusions: Patients with trisomy 13 and 18 suffer from many comorbidities and have vast surgical needs. Overall, undergoing general and orthopedic surgery was associated with lower survival rate, but those who tolerated minor and major surgery survived longer.

31. Bridging the Gap: Opioid Prescription and Consumption Patterns in Pediatric Appendicitis

Niloufar Hafezi MD, Matthew P. Landman MD MPH, Jill I. Coss NP, Kristine D. Nagle NP, Melissa R. Scott RN, Deborah F. Billmire MD

Introduction: Opioid misuse is a national crisis that involves children and adolescents, but limited data are available in this age group. Prescription medications provide a common entry point for narcotic access in the community. Appendicitis is the most common emergency operative procedure in children, and opioid medications are frequently prescribed at time of discharge. We chose to investigate prescribing patterns in our pediatric population to compare to

self-reported use of these prescriptions upon discharge.

Methods: Chart review was undertaken of pediatric patients undergoing appendectomy for acute appendicitis over a one-month period. Narcotic medication use in the 24 hours preceding discharge was recorded, as well as the number of narcotic doses prescribed upon discharge. During routine follow up phone call after discharge, the parents were asked about number of narcotic doses used.

Results: Thirty-eight patients age 2 to 17 years were included. Three-hundred forty-one doses of narcotic pain medications were prescribed in total on discharge. Forty-four doses were reported by family to be used amongst the 38 patients on follow up phone calls. In one month, this left 297 unused doses of prescribed narcotic medications. Extrapolated over one-year, a projected 3,564 unused doses of narcotics could be generated within the community if current prescribing practices were continued.

Conclusions: Current practice of narcotic prescribing at discharge for acute appendicitis greatly surpasses the amount needed for appropriate pain control. An education program for physicians, nurse practitioners, bedside nurses and families is in development to reduce consumption and excess prescription dosing. Guidelines for discharge prescriptions have been created based on in-hospital and early discharge consumption. Data review will be repeated when education is complete.

32. Primary versus Vessel Loop Closure - A Look at Pediatric Ostomy Takedown Techniques

Niloufar Hafezi MD, Bryant S. Morocho MS, Alan P. Ladd MD

Background: Ostomy closures carry a disproportionate burden of surgical site infections (SSI) within pediatric surgery. While comprehensive recovery protocols describe best perioperative practices for optimal recovery, little exists on the impact that stoma closure technique has on these outcomes. Here, we describe a novel closure method, vessel loop closure (VLC), and review its impact on SSI rates compared to conventional primary closure (PC).

Methods: A retrospective review of all ostomy closures in children 0-18 years at a tertiary children's hospital was carried out from 2015-2019 after IRB approval. Closures of stomas with tube cannulation devices or techniques apart from PC or VLC were excluded. Vessel loop closure consists of near-complete closure of skin and subcutaneous tissue around a drain laid over closed fascia, allowing for drainage along lateral aspects of the wound. Data was reported as percent rates, median [IQR], or odds ratio [95% CI]. p-values were found using Mann-Whitney U for continuous variables, and Fisher's exact test for categorical variables; $p \leq 0.05$ was significant.

Results: Two hundred thirty-eight stoma closures occurred over the five-year period. After exclusions, 110 VLC and 85 PC were identified for study, at median age 10 months [9.4], over median follow up time 2.0 years [1.3]. Overall rate of postoperative SSI rate was 9.4%, at median age 3 months [8]. The leading primary diagnosis overall and in those with SSI was necrotizing enterocolitis. There was no overall significant difference in the rate of SSI in VLC or PC overall and by subgroup analysis of age, type of bowel closed, and diagnosis.

Conclusions: Ostomy closure technique does not affect SSI outcomes in pediatric patients. Vessel loop closure technique

provides a safe alternative for abdominal wall closure and should be considered when there is concern for postoperative drainage.

33. Children Under Five Presenting as "Found Down:" A Case for Trauma Activation

Niloufar Hafezi MD, Jodi L. Raymond MPH, Dawn M. Daniels PhD, Ralph A. Hicks MD, Thomas M. Rouse MD, Matthew P. Landman MD MPH

Introduction: Non-accidental trauma (NAT) is a significant cause of morbidity and a leading cause of death in early childhood, necessitating expeditious trauma evaluation. In cases of young children presenting as "found down" without a clear etiology, we hypothesized that a significant proportion would be due to NAT.

Methods: In 2015, the highest trauma activation criteria was updated at a Level 1 pediatric trauma center to include all children under age five years "found down" without a clear medical etiology. After IRB approval, the trauma registry was queried for these children between January 2015 and July 2019 for relevant presenting characteristics and clinical outcomes.

Results: 65 patients were identified. The median age was 4 months (IQR 2-12), with 65% males, and median ISS of 25.5 (IQR 25-27). 25 patients (38%) were confirmed victims of NAT, 9 (14%) patients were highly suspicious for abuse, 15 (23%) patients had a history of unsafe sleep, 6 (9%) patients were found to have a medical etiology, 9 (14%) of patients unknown etiology, and 1(2%) patient presented after an unwitnessed fall. When comparing NAT or suspected NAT patients (n=34, 52.3%) to all other patients, there was no difference in presenting vital signs, shock index, or labs. NAT and suspected NAT patients had a

median age of 6.5 months (IQR 3-17) compared to other patients at 2.75 months (IQR 2-5) ($p=0.007$), were more likely to present with bruising ($p<0.001$), and had prior history involving child protective services ($p=0.04$). The overall mortality was 71%.

Conclusion: Over half of patients under age five presenting as “found down” without obvious medical etiology were victims of NAT or suspected NAT. Apart from bruising, it may be difficult to distinguish these patients on admission, making the highest-level trauma activation key to expeditious trauma evaluation.

34. Traumatic Abdominal Wall Hernias in Children: A Case for Early Exploration

Niloufar Hafezi MD, Jodi L. Raymond MPH, Erin D. Mayo CPNP-AC, Thomas M. Rouse MD, Deborah F. Billmire MD, Brian W. Gray MD

Introduction: Traumatic abdominal wall hernia (TAWH) is a rare consequence of blunt abdominal trauma in children. We examined a series of patients who suffered TAWH to evaluate its frequency, rate of associated intrabdominal injuries, correlation with CT imaging, management and outcomes.

Methods: The trauma registry at a Level 1 pediatric trauma center was queried for children age 0 to 18 suffering TAWH from blunt abdominal trauma during 2009-2019 after IRB approval. Charts were reviewed for demographics, mechanism of injury, radiologic and operative findings, and clinical course.

Results: 9370 patients admitted after blunt abdominal trauma were reviewed in the

trauma registry. TAWH was observed in 11 children with incidence of 0.1%. Eight of 11 children (73%) were male, at mean age 10 years old, and mean ISS of 16. Six cases (55%) were due to MVC, three (27%) were impaled by a handlebar or pole, and two (18%) were dragged under a large vehicle. Seven (64%) patients had a concurrent intrabdominal injury requiring operative or interventional management. Patients with concurrent intrabdominal injuries were similar to those without other injury on presentation and CT scans had a sensitivity of 20% and specificity of 50% for detecting these injuries. Eight hernias were repaired in total, five of which were immediate primary repairs. Three hernias went unrepaired, one found to be resolved on follow up ultrasound and two asymptomatic and unrepaired to date. There were no complications.

Conclusions: Children with blunt TAWH have high rate of concurrent intrabdominal injuries that require operative repair. CT scans have low sensitivity and specificity for detecting these associated injuries, thus a high suspicion of injury and low threshold for abdominal exploration must be maintained in a child with TAWH. NAT or suspected NAT. Apart from bruising, it may be difficult to distinguish these patients on admission, making the highest level trauma activation key to expeditious trauma evaluation.

35. Pre-Hospital High Volume Crystalloid Resuscitation Increases Mortality in Pediatric Traumatic Brain Injury Patients

Brian Hosfield MD, Katherine Leckie MD, Cody Jones BA, Alyson Baker MD, Jodi Raymond MPH, Courtney Rowan MD, Laurie Ackerman MD, Matthew Landman MD, MPH, FACS, FAAP

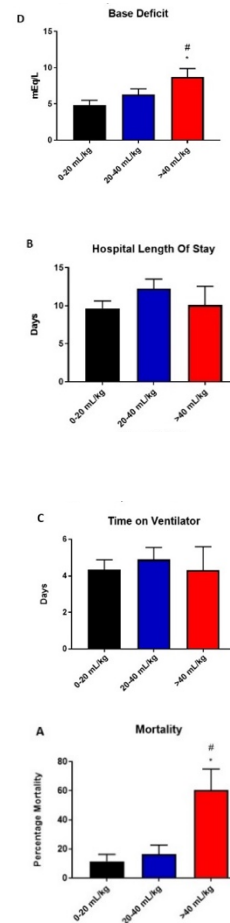
TOP ABSTRACT

Objective: Aggressive fluid resuscitation has been shown to be harmful to adult trauma patients. While pediatric patients were originally thought to be resistant to over resuscitation, there is emerging data that excessive fluids may be harmful to children as well. We hypothesized that high volume pre-hospital resuscitation with isotonic crystalloids would be associated with worse outcomes in pediatric TBI patients.

Methods: We completed a retrospective review of severe TBI patients' age 0-18 years old at Riley Children's Hospital from January 2015 to December 2018. Total isotonic crystalloid resuscitation was calculated from the scene of injury to admission to the PICU. Three groups were established: 0-20 ml/kg, 20-40 ml/kg, >40 ml/kg. Primary outcome was in-hospital mortality. Secondary outcomes included length of stay (LOS), ventilator days, critical anemia (Hgb<8g/dl), critical thrombocytopenia (platelets<100,000units/l), base deficit, and ICP opening pressure. Multivariable linear regression and logistic regression models were fitted, p<0.05 was significant

Results: 170 patients were included in the study. When controlling for age, sex, Glasgow coma score on presentation, injury severity score, and abbreviated injury scale head, pre-admission resuscitation volume greater than 40 ml/kg was associated with an increase in mortality (0-20ml/kg=16.9%, 20-40ml/kg=28.9%, >40ml/kg=65.2%, p=0.001368). There was no significant difference in hospital LOS in days (0-20ml/kg=9.7, 20-40ml/kg=12.3, >40ml/kg=10.1, p= 0.253714) or ventilator days between the different fluid groups (0-20ml/kg=4.3, 20-40ml/kg=4.9, >40ml/kg=4.3, p=0.807620). Despite more resuscitation, the high-volume group still had a significantly worse base deficit (8.71)

than the moderate (6.32) and low volume groups (4.8), p= 0.0160253. Volume of resuscitation was not associated with severe anemia, thrombocytopenia, or increasing ICP.



A. High volume resuscitation patients had an increase in mortality compared to other groups, *p<0.05 vs. 0-20 ml/kg, #p<0.05 vs. 20-40 ml/kg
 B. There was no difference in length of stay between the low, moderate, and high volume resuscitation groups

C. There was no difference in ventilator days between the low, moderate, and high volume resuscitation groups
 D. High volume resuscitation patients had a larger base deficit compared to other groups, *p<0.05 vs. 0-20 ml/kg, #p<0.05 vs. 20-40 ml/kg

Conclusions: Pre-hospital administration of high-volume isotonic crystalloids is independently associated with an increase in mortality in children with severe traumatic brain injury. Further study is warranted to explore the potential harmful effects of over resuscitation in children with severe head injuries.

36. Neonatal Bowel Resections Occurring in the NICU are Associated with Lower Survival Rates than the OR

Lauren Howser, BS; Carly Goehring; Cassandra Anderson; Eamaan Turk; Sarah Fisher, BS; Yan Han, PhD, MS; Dr. Brian Gray, MD

Background: Neonatal operations frequently occur in the neonatal intensive care unit (NICU) rather than the operating room (OR). The goal of this study was to isolate risk factors for bowel resections in the NICU, compare outcomes of bowel resections in both locations, and evaluate modifiable factors.

Materials and Methods: We reviewed 139 neonates at a single quaternary care children's hospital who underwent bowel resection in the NICU or OR from 2014-2018. Statistical analysis included bivariate, multivariable, Kaplan-Meier, and propensity score matching analyses.

Results: Of the 139 operations, 33 occurred in the NICU and 106 occurred in the OR (60.6% vs 94.2% survived 30 days). Bivariate analysis revealed that diagnosis of NEC (OR 4.33, $p<0.001$), spontaneous intestinal perforation (OR 5.55, $p<0.001$) were predictors of operative location. Propensity score matching (15 matched pairs) showed survival rates were lower in the NICU group ($p=0.016$). Of the 15 propensity score matched OR patients, 100% survived until 30 days post-op while only 53.33% of the NICU patients survived 30 days. The hazard of death for a NICU operation was approximately 7.876 times the OR group. Modifiable risk factors, such as the usage of a heating device and temperature monitoring during surgery were positively correlated with survival ($p<0.001$).

Conclusions: Patients undergoing bowel resection in the NICU vs OR have more severe markers of prematurity, particular diagnosis patterns, and worse survival, even when correcting for some of these factors. Several modifiable factors can be studied to further improve survival of patients undergoing operations in both locations.

37. Multidisciplinary En Bloc Resection of Retroperitoneal Intramuscular Hemangioma

Mackenzie K. Madison MS, Natalie A. Drucker MD, Todd E. Bertrand MD, Brian W. Gray MD

Objective: While most grow asymptotically, symptomatic intramuscular hemangiomas (IMH) require surgical resection to relieve tumor burden. Here, we report a surgical approach to a rare case of IMH extending from the retroperitoneum to medial thigh via the obturator foramen.

Methods: A 15-year-old male presented with an eight-year history of a slow growing mass in the left inguinal region. MRI revealed extension of the lesion into the left medial and posterior thigh, through the obturator foramen into the retroperitoneal space with mass effect on bladder and rectum as well as involvement of the posterior gluteal region through the left greater sciatic foramen.

The decision was made to surgically resect the lesion. Tumor was freed circumferentially from the obturator canal with sacrifice of the neurovascular bundle and 4cm of superior pubic ramus was removed. The femoral vessels were mobilized laterally, and dissection continued

through the medial adductors. Posteriorly, the mass was freed from femur, ischium and inferior pubic ramus. The spermatic cord was skeletonized but able to be preserved. The mass was dissected from the pelvic floor and sidewall. Finally, tumor was cleared from the sciatic foramen preserving the sciatic nerve. The pelvic and medial thigh components were able to be resected en bloc.

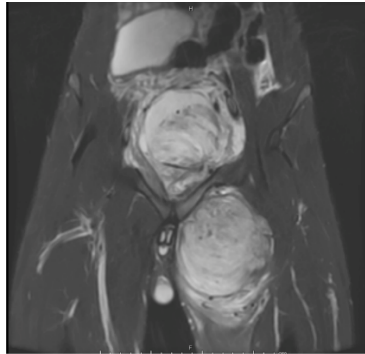


Image 1. MRI demonstrating extension of IMH through the obturator foramen into the medial thigh.

Results: At two-week follow up, the patient reported slight weakness on hip flexion, and denied urinary or bowel changes, numbness or tingling. He had no complications from skeletonization of the spermatic cord and has been intentional about maintaining his testicle in his scrotum.

Conclusion: IMH frequently recur. When considering surgical resection, a careful balance between negative margins and risk for functional impairment must be weighed. En bloc excision demonstrates the lowest rate of local recurrence, but often at the expense of functionality. To the authors' knowledge, there are no other reports of IMH extending through the pelvic foramina.

38. A Hydrogen Sulfide Derivative of Mesalamine Rescues Intestinal Cells from Death Secondary to Oxidative Stress

Anthony Pecoraro MD, Brian Hosfield MD, Hongge Li PhD, W. Chris Shelley, Troy Markel MD, FACS, FAAP

Introduction: Intestinal ischemia is a potentially devastating condition with significant morbidity and mortality. Current treatment restores adequate perfusion to the intestine, but the epithelium may be irreparably injured at the time of reperfusion. ATB-429, an H₂S-releasing derivative of mesalamine, has demonstrated benefit in ameliorating intestinal injury in a colitis model. We hypothesize that ATB-429 would attenuate cell death in an in vitro model of oxidative stress.

Methods: Human intestinal epithelial cells (HIEC-6, ATCC) were cultured in Opti-Mem I reduced serum medium with L-glutamine (10mM), HEPES (20mM), epidermal growth factor (10ng/ml), and fetal bovine serum (FBS, 4%). Cells underwent experiment at passage 22. Cells were transferred to a 12-well plate and adhered for 24 hours (37°C, 5% CO₂). To induce oxidative stress, medium was replaced with complete growth medium containing 200µM hydrogen peroxide (H₂O₂). After exposure for 21 hours, treatment was applied in the form of 20mM mesalamine or 20mM ATB-429 (H₂S-Mesalamine). After 3 hours cells were lifted from experimental plate and washed thoroughly. Annexin V-FITC/PI was added to cell pellet and flow cytometric analysis was performed. One-way ANOVA was performed for statistical analysis.

Results: Cells were identified by flow cytometry as being in early apoptosis, late apoptosis/necrosis, or live. H₂O₂ alone resulted in marked levels of injury, with 69% cells alive at the conclusion of exposure. This is lower than mesalamine treatment, which resulted in 75.6% live cells. ATB-429

conferred the greatest rescue effect, with 96.2% ($p=0.0000226$) of cells live at the conclusion of the experiment. The relative percentages of injured and live cells are demonstrated in figure 1.

Conclusion: ATB-429 demonstrated benefit in preserving live human intestinal epithelial cells following oxidative injury. The mechanism of protection remains undetermined. Further studies are needed to elucidate this mechanism and evaluate in an in vivo model of drug tolerance and effect.

Plastic Surgery

39. Safety and Utilization of Surgery for the Upper Extremity Manifestations of Cerebral Palsy

Scott N. Loewenstein, MD; Rachel Danforth, MD; Joshua Adkinson, MD

Objective: Reconstructive surgery for the upper extremity manifestations of cerebral palsy (CP) has been demonstrated to be effective, and we sought to characterize the nationwide utilization and safety of these surgeries.

Methods: We performed a retrospective analysis of all CP-related upper extremity surgeries performed at member institutions of the Pediatric Health Information System from January 2007 through December 2018. We analyzed demographic, surgical, and patient variables.

Results: Within the sample of 68,147 CP patients, 1184 surgeries for upper extremity spasticity were performed on 865 unique patients (1.3%) during the study period. Surgeries were distributed across the country, and the majority (51%) were funded through government-sponsored

medical insurance. The average patient age at surgery was 13.6 (± 4.6) years and 62% were male. Surgical encounters were ambulatory in 767 (64.8%), observation in 298 (25.5%), and inpatient in 112 (9.5%) cases. For non-ambulatory surgeries, the average hospital length of stay was 1.2 (± 0.9) days, and only 16 patients (1.4%) stayed greater than 2 days. The majority (63%) of patients underwent multiple upper extremity procedures during the same surgery. There were 53 postoperative ED encounters (4.5%), 15 discrete surgical complications (1.3%), and no mortalities within 30 days of surgery. Three-hundred and nineteen (27%) patients had at least one additional surgery for spasticity during the study period.

Conclusions: Reconstructive surgery for the upper extremity manifestations of CP is safe, and despite the complexity of many of these reconstructions, requires minimal hospital resources. Patients and families should be counseled preoperatively, however, that they may require additional reconstructive surgery.

Urology

40. Decisional Regret in Children and Their Parents Regarding Sacral Neuromodulation Placement

Cyrus Adams, Matthieu Peycelon, Sally Dunn, Shelly King, Rosalia Misseri, Joshua Roth, Konrad Szymanski, Benjamin Whittam

Introduction. Refractory voiding dysfunction (RVD) is a difficult pediatric condition to treat. We offer sacral neuromodulation (SNM) for patients in our practice who have failed all modalities of therapy including behavioral modifications, pelvic floor

physical therapy, and medical therapy. The aim of this study was to assess decisional regret (DR) amongst the patients with RVD and their parents who have undergone SNM placement.

Methods: Pediatric patients who underwent SNM placement and their parents were surveyed at follow up clinic appointments utilizing the Decisional Regret Scale. A higher DR Scale scores indicates greater DR (range 0-100). Statistical analysis used univariate analysis (paired t-test and Fisher's exact test).

Results: A total of 39 patients had a SNM placed at a median (IQR) age of 9.8 (8-12) years and completed the DR questionnaire at a median of 1.3 (0.3-3.9) years after surgery. Of these patients, 35 had a parent also complete the DR questionnaire separately. The median DR score was 10 (0-25) for the patients and 0 (0-10) for the parents ($p=0.02$). Overall, 38% of the patients and 57% of the parents reported no regret ($p=0.2$). Of those patients who reported regret, 75% reported only mild regret, and of the parents who reported regret, 93% reported only mild regret ($p=0.03$). Only 1 patient and no parent reported very strong regret ($p=0.99$).

Conclusions: Children with RVR and their parents reported low levels of DR after SNM placement to manage their symptoms and when present, DR is usually mild.

41. Risk Factors For 1-Month Complication After Robotic-Assisted Laparoscopic Pyeloplasty In A Pediatric Cohort

Cyrus Adams, Matthieu Peycelon, Kahlil Saad, Benjamin Whittam

Introduction: Robotic-assisted laparoscopic pyeloplasty (RALP) is believed to offer benefits over open pyeloplasty: including

decreased length of stay, less pain and smaller incisions. We sought to review our experience and to identify risk factors for one-month complications after RALP in a pediatric cohort.

Methods: We retrospectively reviewed all RALP from 2012–present done in our institution. Our primary outcome of interest was incidence of Clavian grade 2 or higher complications. Demographics and clinical information were abstracted from the patient charts. Age, gender, ethnicity, BMI, symptoms at presentation, laterality, hydronephrosis grade, differential renal function, length of the procedure, anatomical difficulties, and type of stent (diameter, length, placement, with or without string) were analyzed. Univariate and multivariate analyses were performed to identify risk factors for complications. Statistical analysis was carried out using Fisher's exact and t-tests.

Results: A total of 178 patients underwent RALP during the study period at median (IQR) age of 9.7 (6.5-13.7) years. Median follow-up was 195 (54-422) days. 28 (15.7%) patients had a complication Clavian grade 2 or higher within 1 month. Gender, race, weight, height, BMI, presentation (hematuria), grade of hydronephrosis prior to surgery on US and CT, differential renal function, length of the procedure, anatomic difficulties were not predictive of complications on univariate analysis. Complications mainly included UTI (50%) and stent-related issues (29%).

Complications were more likely to develop in patients who were younger (8.7 (6.6-10.5) versus 10.3 (6.2-14), $p<0.05$) as well as in patients in whom a JJ ureteral stent narrower than 4.8FR was inserted. However, the length of the stent, the string status, and the technique for stent

placement were not associated with complications.

Conclusion: In this series, younger age at surgery and a narrower ureteral stent were independently associated with a higher risk of developing complications.

42. Split Appendix Catheterizable Urinary Channels Are at No Higher Risk of Undergoing Revision Compared to Channels Made with The Intact Appendix

Cyrus M. Adams, Benjamin M. Whittam, Martin Kaefer, Katherine H. Chan, Richard C. Rink, Rosalia Misseri, Konrad M. Szymanski

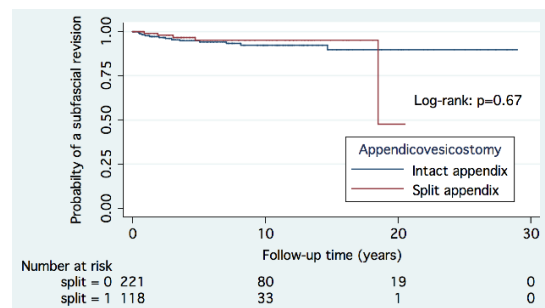
Introduction and Objective: The appendicovesicostomy (APV) is integral to the creation of a continent catheterizable urinary channel using the Mitrofanoff principle. The proximal appendix may be left in-situ to create a concomitant Malone antegrade continence enema procedure (MACE) using the distal end for the APV. However, the relative long-term complication rates between this “split-appendix” technique and intact appendix channels have not been adequately compared. Our goal was to assess long-term APV durability and to compare split-appendix and intact appendix APVs in a large patient cohort.

Methods: This retrospective cohort study included consecutive patients ≤ 21 years old undergoing an APV at our institution (1990-2019). We collected data on demographics, channel type, location, stomal and subfascial revisions. We did not assess non-surgical or endoscopic management. Kaplan Meier survival and Cox proportional hazards analysis were used to assess risk and predictors of stomal or subfascial revision.

Results: A total of 339 patients underwent APV creation at a median 7.4 years old (41% female vs. 59% male; 37% umbilical stoma vs. 63% other). In total, 36 patients underwent a stomal revision and 19 a subfascial revision (median follow-up 6.3 years). On survival analysis, the risk of stomal revision was 9.5% at 5 years, 13.4% at 10 years and 17.6% at 15 years. Risk of subfascial revision was 4.9% at 5 years, 6.8% at 10 years and 8.8% at 15 years.

A split-appendix APV was performed in 118 (34.8%) of the 339 patients. These patients had a shorter follow-up of 5.1 years compared to those with an intact APV of 7.0 years ($p=0.03$). After correcting for differential follow-up time, there was no significant difference between the two groups for either stomal revisions (HR 1.11, $p= 0.76$) or subfascial revisions (HR 0.80, $p=0.67$) (Figure 1). Risk of revision was not independent of stomal location and age at surgery ($p>=0.019$).

Figure 1. Kaplan-Meier estimates of remaining without a subfascial revision stratified by channel type (split vs. intact).



Conclusions: We demonstrate the split-appendix technique has durable long-term results which are comparable to the technique utilizing the intact appendix. The risk of channel complications continues over the channel’s lifetime, as 1 in 7 APVs in the entire cohort underwent a stomal revision

and 1 in 14 underwent a subfascial revision at 10 years after surgery.

43. Development of A Parent-Centered Hypospadias Decision Aid Prototype

Katherine H. Chan, MD, MPH, Rosalia Misseri, MD, Aaron Carroll, MD, MS, Richard Frankel, PhD, Courtney Moore, BFA, Brandon Cockrum, MFA and Sarah Wiehe, MD, MPH

Objective: The objective of this study was to engage parents of boys with hypospadias and pediatric providers in the co-design of a decision aid (DA) prototype to help parents make decisions about hypospadias surgery.

Methods: We conducted three co-design workshops from August 2018-January 2019 with parents of sons with hypospadias, general pediatric and pediatric urology providers to discuss their recommendations for a DA prototype. All activities were audio recorded and professionally transcribed. Transcripts and worksheets were analyzed by six coders using a collaborative coding process, commonly used in human-centered design research, to identify key aspects of a hypospadias DA desired by stakeholders. We conducted a collaborative design and prototyping session where we established key website features and requirements and created a sitemap visualizing this work followed by a DA prototype.

Results: Participants included parents (6 mothers, 4 fathers; 8 Caucasian, 2 African-American; ages 28-40), pediatric urology (n=7) and general pediatric providers (n=10): median age 47.5 years, 83.3% Caucasian, 58.3% male, 58.3% MD's and 41.7% nurse practitioners. Participants created user-friendly, interactive DA prototypes with "24/7" availability that had three key functions: 1) provide accurate, customizable, educational content, 2)

connect parents in an online forum, and 3) engage them in a decision-making activity. The prototype consisted of five modules (Figure 1). "Hypospadias Basics" includes epidemiology and a hypospadias severity scale. "Surgery Basics" includes goals, illustrated steps, and pros/cons of surgery. "Testimonials" includes videos of parents and adolescents discussing their experiences. "Help me Decide" includes a decisional conflict scale and a values clarification exercise. "Frequently Asked Questions" covers general hypospadias information, perioperative expectations and a review of postoperative care.

Conclusions: We created a parent-centered hypospadias DA prototype that provides decision support in an online, interactive format. Future directions include further testing with usability experts, providers and parents.

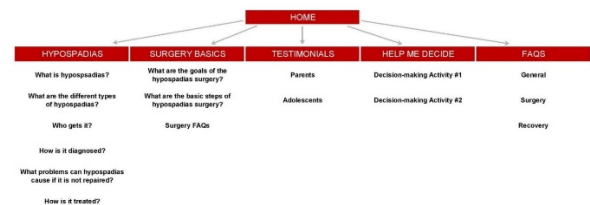


Figure 1: Site map of the hypospadias decision aid prototype

44. User testing of a hypospadias decision aid prototype at a pediatric medical conference

Katherine H. Chan, MD, MPH, Rosalia Misseri, MD, Aaron Carroll, MD, MS, Richard Frankel, PhD, Courtney Moore, BFA, Brandon Cockrum, MFA and Sarah Wiehe, MD, MPH

Objective: We created a web-based hypospadias decision aid (DA) prototype based on our qualitative work to facilitate

shared decision-making regarding hypospadias. The objective of this study was to obtain rapid feedback on the prototype using crowdsourcing methodology as part of an iterative, user-centered design process.

Methods: We conducted this study at a statewide, pediatric educational conference in May 2019, recruiting attendees by verbal/written announcements. The DA consists of hypospadias overview and surgery “storyboard”, frequently asked questions, parent testimonials and a values clarification exercise. Participants viewed the DA on a tablet as they participated in semi-structured, qualitative interviews covering website acceptability, usability and preference for surgical photographs versus illustrations. Three coders used qualitative content analysis to identify themes and resolved disagreements by consensus.

Results: Of 295 conference attendees, all 50 who approached us agreed to participate. Responses from 49 participants were available for analysis: 67% female, ages 20-69, 65% Caucasian, 55% MDs. 96% of participants thought the website design matched its purpose; 59.1% preferred surgical illustrations, 8.2% preferred photos, 30.6% preferred both and 2.0% did not like either. Participants recommended improvements in: a) usability/accessibility (e.g. site navigation, visual layout, page length), b) content coverage (e.g. epidemiology, consequences of no/delayed surgery, lifelong risks), c) parent-centeredness (e.g. appropriate reading level/writing style) and d) implementation/context of use (provider tools, printable handouts). Figure 1 shows a revised image of the first step of a hypospadias repair based on feedback about participants’ preferences for illustrations rather than photographs.

Conclusions: The vast majority of participants responded positively about the design of the hypospadias DA matching its

purpose. Most preferred surgical illustrations rather than photos to demonstrate the steps of hypospadias surgery. They suggested specific improvements in usability/accessibility, content coverage, parent centeredness and implementation strategies for inclusion in the next version of the prototype.

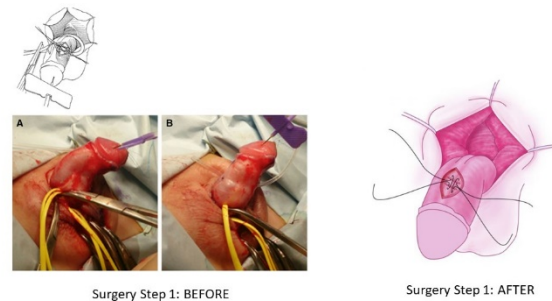


Figure 1:

LEFT: Depiction of surgery step 1 **before** the pediatric medical conference depicting a black-and-white illustration of dorsal plication and its corresponding surgical photographs with a needle in the glans.

RIGHT: Revised surgery step 1 **after** feedback from the pediatric medical conference depicting a colorful, cartoon-like illustration of dorsal plication with no needle.

AWARDS

Top Abstracts

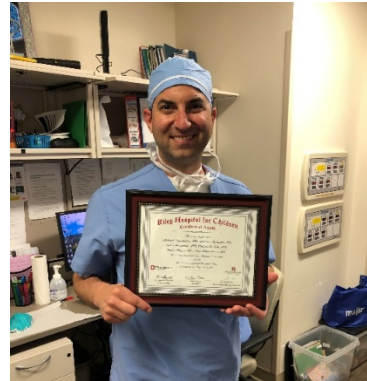
1. Pre-Hospital High Volume Crystalloid Resuscitation Increases Mortality in Pediatric Traumatic Brain Injury Patients

Brian Hosfield MD, Katherine Leckie MD, Cody Jones BA, Alyson Baker MD, Jodi Raymond MPH, Courtney Rowan MD, Laurie Ackerman MD, Matthew Landman MD, MPH, FACS, FAAP



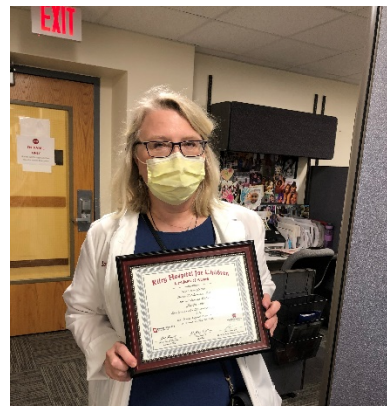
2. Spinal Anesthesia Reduces Opioid Use, Improves Hemodynamics and Improves Operating Room Efficiency for Infants Undergoing Percutaneous Achilles Tendon Lengthening (OATL)

Michael Acquaviva, MD; Christine Caltoum, MD; Tyler Christman, MD; Robert Bielski, MD; Tanna Boyer, DO; Anne Elisa Cossu, MD



3. Use of Tranexamic Acid with Subcutaneous Injection of Epinephrine and Triamcinolone Reduces Blood Loss, Transfusion Rates and Length of Stay in Open Sagittal Craniosynostosis Repair

Laurie L Ackerman, MD; Anna Ackerman Snider; Jian Ye, MD



Most Abstracts Submitted

1. *Pediatric Surgery – 11 abstracts*



2. *Anesthesiology – 10 abstracts*
3. *Neurosurgery – 6 abstracts*

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