Postgraduate Day Abstracts

Residents

3. The effect of testosterone therapy on patient satisfaction and quality of life in male adolescents with delayed puberty and short stature – Christine Bacha, MD
4. A Rare Case of Stercoral Perforation in a Pediatric Patient – Jeremy Baker, DO
5. 9 Year Old Male with Fever - Anna H Brown, DO
6. Severe bradyarrhythmia in Guillain-Barre Syndrome with marked sinus arrest requiring Isuprel: a case report – Bethany H. Brown, DO
7. A Retrospective Review of Hyperbilirubinemia in Infants of Refugee Families – Alexa Coon, DO
8. The role for osteopathic manipulation in an allopathic academic institution – Tamara Guseman, DO
9. Prevalence and Prognosis of Vocal Cord Dysfunction in Patients seen in Pulmonary Clinic from January 2012 to June 2017 - Shannon King, DO
10. Feasibility Of Using TRAZERTM Technology For Assessing Pediatric Subjects: A single-center, prospective, three-armed, pilot study – Matthew Kornswiet, MD
11. Medical Marijuana in Ohio: Akron Children’s Hospital Physician Perspectives – Gregory Kuper, DO
12. Weight as a Risk Factor for Pulmonary Hypertensive Crisis Following Pediatric Cardiothoracic Surgery – Stephanie Lam, DO
13. RISE to Transition: A structured transition protocol for renal transplant recipient children – Jessica Lin, MD
14. Some TORCHES Cast a Wide Shadow – Kristen Makowski, MD
15. Investigations of Burnout Rates in Pediatric Residents at Akron Children’s Hospital and the Effects of Resiliency-based Wellness Curriculum – Oladeinde Oluwatosin, DO
16. Neonatal Outcomes of Preterm Infants in a Quaternary Care Center Breastfeeding versus Bottle Feedings of Breast Milk – Samantha O’Neil, MD and Beth Franklin, MD
17. Examining the Usefulness of The Fasting Challenge Test in At-Risk Neonates: A Three Year Review. – Stacey Ramey, MD
18. Roles of specific/total IgE ratio and subclinical reaction in the mechanism of food tolerance in sensitized individuals – Timothy Richmond, MD
19. Rates of Sexually Transmitted Infection on an Inpatient Behavioral Health Unit – Ethan Scott, MD
21. Disseminated HSV in a 2-day-old presenting with fever only – Kristen Sherman, DO
22. Diagnostic challenge: the youngest reported case of paediatric onset multiple sclerosis – Amanda Timmel, DO
23. Ten Year Review of Neonatal Outcomes of Preterm Infants in a Quaternary Care Center diagnosed with Intraventricular Hemorrhage. – Kara Weichler, DO
24. New diagnosis of ALL in patient with JIA – Jenny White, DO
25. Accuracy of Electronic Medical Record Heart Rate Alerts from Initial ED Triage in Predicting Acute Care Needs in Pediatric Patients – Allison Wood, DO
Fellows & Other Learners

26. Should Pediatric Wrist Buckle Fractures be Splinted in the Emergency Department Without Orthopedic Consult? – Bruce Benton, MD

27. Chart Smart: Improving the Accuracy of Inpatient Pediatric Problem Lists - Inga Aikman, MD, MPH

28. Parent Utilization of the After Visit Summary (AVS) – Inga Aikman, MD, MPH

29. Intra-cardiac Mass in a College Basketball Player - Jason Frampton, MD

30. More Than a Muscle Spasm – Blossom Heindel, DO

31. Patient Experience of the Minority Patient Population at Akron Children's Hospital – Ariana Hoet, PhD

32. Exploring Manual Dexterity Skills in Pediatric and Young Adult Postconcussive Populations – Billy D. Holcombe, PhD

33. An Evaluation of a 12-month Educational Curriculum on ED Resident Documentation and its Impact on Revenue and Resident Understanding – Matthew Maready, MD

34. Peer Review in the Emergency Department – Lauren Mientkiewicz, MD

35. A Pilot Study on investigation of parental depression and its effects on treatment response and outcome of depressed children and teenagers at an outpatient psychiatry clinic – Meenal Pathak, MD, Daniela Marcella-Bromberg, MD, Azhar Abdullah, MD

36. Motor Skills in Children with Congenital Heart Defects (CHD) – Brittany Peters, PhD

37. Depression in Children and Adolescents with Spina Bifida – Daniel Smith, MD

38. Queasease: aromatherapy as a novel approach to the treatment of chemotherapy induced nausea and vomiting – Erin Writh, MD

39. Tic Talks at 5 O’clock: Expanding the use of the Chronic Health Illness Recovery Program to meet the needs of adolescents with Tic Disorders – Lindsey Vater, Psy D

40. Increased Likelihood of Pediatric Recurrent Patellar Dislocations Based on Severity of Radiographic Measures – William Alberio, MD

41. Effects of Hypothyroidism on Articular Cartilage in miniature swine – Joshua A. Bundy
The effect of testosterone therapy on patient satisfaction and quality of life in male adolescents with delayed puberty and short stature

AUTHORS AND INSTITUTIONS: Christine Bacha, MD (Akron Children’s Hospital), Bradley Van Sickle, MD, PhD (Akron Children’s Hospital)

BACKGROUND: A child’s height can have significant impact on their childhood. For a child who is shorter than their peers, it can create worry among parents and the child may be teased or bullied. With these and other concerns, many parents present to Endocrinology clinics seeking medical treatment to help their child reach their adult height potential. While numerous studies exist regarding the effects of androgen and growth hormone therapies on growth, there has been less emphasis on the impact a child’s height has on their self-confidence and overall impact on their quality of life.

The influence of testosterone therapy on a child’s self-perception and overall effect on their quality can be assessed using the Quality of Life in Short Statured Youth (QoLISSY) questionnaire. The QoLISSY is based on items created by subjective experiences of short statured children who were referred for endocrine evaluation (Bullinger, Monica et al). It is a 66-item questionnaire used to assess patients’ and/or their parents’ perceptions regarding the impact of the patient’s height on their quality of life and studies have shown that this is a promising tool to assess the impact of short stature on health related quality of life. In this study, the QoLISSY was used to evaluate the impact of height due to delayed puberty on a child’s self-perception and self-esteem and how this affects their quality of life.

OBJECTIVE: The purpose of this study was to evaluate the impact of testosterone therapy on a child’s self-perception and quality of life in adolescent males with delayed puberty and associated short stature.

METHODS: All male adolescents (age 13 or older) with delayed puberty and short stature who were referred to the Endocrinology Clinic for testosterone therapy at Akron Children’s Hospital along with one of his parents were offered the opportunity to participate in this study. Subjects who agreed to participate and provided consent/assent were given the QoLISSY questionnaire with a unique identification number to complete at the first appointment prior to testosterone therapy, at 6 months from the first visit, and at 12 months from the first visit. Background information regarding each subject such as bone age, initial height, and growth velocity was obtained from the clinical medical record by the investigator. All collected data was entered into electronic format for statistical analysis.

RESULTS: A total of 19 patients were enrolled in the study. Results are pending biostatistician review (all data has been collected)

CONCLUSIONS: Unable to conclude anything at this point in time
A Rare Case of Stercoral Perforation in a Pediatric Patient

AUTHORS: Jeremy Baker DO, James Lee MD

BACKGROUND: Stercoral perforation is a rare but high-mortality condition caused by pressure-induced ulceration of the bowel from a fecaloma. Case reports of this condition have largely been isolated to geriatric patients with histories of severe chronic constipation\(^1\), though there have been scattered reports in younger adults with triggers such as pregnancy\(^2\), opiate abuse\(^3\), or psychiatric illness\(^4\). PubMed review generated only three prior cases of stercoral perforation in a child, including a 2 year old with an unintentional NSAID overdose\(^5\), a VLBW premature neonate\(^6\), and an 11 year old with silent perforation\(^7\).

PATIENT REVIEW: This case focuses on a 13 year old male with developmental delays and a history of chronic constipation who presented to the emergency room with abdominal pain, emesis and distension. Initial x-ray revealed a massive stool burden and CT scan confirmed acute bowel perforation. After initial ED and PICU resuscitation of septic shock, he underwent emergency laparotomy that revealed a left colonic stercoral perforation.

CONCLUSION: Chronic constipation burdens many pediatric patients, with developmentally delayed children being at even higher risk. While stercoral perforation is a very rare complication of severe constipation, mortality rates of 34\% have been appreciated\(^1\). Having stercoral perforation as a differential diagnosis for any child with chronic constipation and acute abdominal findings is crucial for optimizing prompt and effective treatment.

References


9 Year Old Male with Fever

AUTHORS AND INSTITUTIONS: Anna H Brown, DO, Akron Children’s Hospital, Medical Education Prabi Rajbhandari, MD, Akron Children’s Hospital, Pediatric Hospitalist

BACKGROUND: Systemic Lupus Erythematosus (SLE) is a chronic inflammatory disease of unknown etiology with a remitting and relapsing course. It usually presents in women between ages 16-55. Childhood SLE has a median age presentation at 12-13 years and affects girls more often than boys, even in the prepubescent age group.

PATIENT CASE: 9 year old otherwise healthy male presented with a two-week history of high-grade fevers, watery diarrhea and abdominal pain. He was seen multiple times in emergency departments and primary care physician's offices during this time and was diagnosed with a viral illness. Two weeks after the onset of these symptoms, he developed joint pains and was admitted to the hospital. On arrival he was afebrile and hemodynamically stable. Physical exam revealed an alert, non-toxic appearing boy in no distress. Positive findings include a 2/6 mid-systolic murmur and tender swelling in his right fifth interphalangeal joint. Over the course of hospitalization his abdominal pain and diarrhea resolved with supportive care but he continued to be febrile with waxing and waning joint pains involving both small and large joints. An extensive workup including CBC/CMP/X-ray upper and lower extremity/CT scan of abdomen/Echo/MRI of abdomen/chest/pelvis, blood culture and a bone marrow biopsy, which all returned negative. The only positive result on admission was bilateral trace pleural effusion seen on chest CT. Throughout hospitalization he subsequently developed anemia, proteinuria and his laboratory work up came back positive for ANA, anti-Smith antibody along with low complement levels. In light of these findings a diagnosis of Systemic Lupus Erythematosus (SLE) was made and he was started on steroids with improvement within 24 hours. Hydroxychloroquine and Azathioprine was also added to his treatment and he was discharged home.

CONCLUSION: The presenting manifestations of SLE in children are diverse, and any organ system may be involved. On admission, this patient did not meet the criteria American College of Rheumatology (ACR) criteria for SLE; however reevaluation was critical to account for the new data obtained throughout hospitalization. It is important to revisit a broad differential diagnosis as new symptoms and clinical information presents. Delayed diagnosis of SLE is often based on early presentation with insufficient criteria. A high index of suspicion and frequent reevaluation is needed to make the diagnosis.
Severe bradyarrhythmia in Guillain-Barre Syndrome with marked sinus arrest requiring Isuprel: a case report

Bethany H. Brown, DO

BACKGROUND: Guillain-Barre syndrome (GBS) is an acute demyelinating disorder of the peripheral nervous system that results from an aberrant immune response against peripheral nerves by cross-reacting antibodies. It is the most frequent cause of acute neuromuscular paralysis and ventilatory failure. Cardiovascular complications include rhythm abnormalities, blood pressure variability and myocardial involvement that significantly contribute to mortality of the disease. We present a case of severe GBS in a previously healthy teenage patient requiring isoproterenol due to marked sinus arrest.

PATIENT CASE: A 15 year old Caucasian male presented with a five day history of headache and lower extremity paresthesias which progressed to ataxia and associated upper and lower extremity weakness with decreased deep tendon reflexes. Testing for both mononucleosis and Epstein Barr Virus were found to be positive. MRI was significant for cauda equina nerve root enhancement consistent with GBS.

He was transferred to PICU from the general floor the day after admission for acute respiratory failure that subsequently required intubation and mechanical ventilation eight days into his clinical course. Despite receiving IVIG, his disease progressed with worsening autonomic instability and complete paralysis prompting the initiation of plasmapheresis. Seven days into his hospitalization he developed significant hemodynamic instability, with periods of hypertension and tachycardia alternating with bradycardia. Most concerning were episodes of brief asystole lasting several seconds. Glycopyrrolate was trialed in an attempt to decrease vagal tone with mild improvement in the severity of bradycardia. Additionally, he was started on nicardipine for worsening hypertension. When his periods of asystole became more pronounced (up to 17 seconds) isoproterenol was trialed per cardiology recommendations. Both isoproterenol and nicardipine were discontinued when patient showed improvement in his hypertension and the severity of his heart rate variability. On day 21 of hospitalization he then sustained a prolonged, self-resolving asystolic event that lasted 28 seconds, prompting re-initiation of isoproterenol. As his acute period of illness began to resolve, the patient had improvement in his autonomic instability and he was able to be transitioned off isoproterenol and onto glycopyrrolate and caffeine with cardiology’s assistance. The patient did not develop any further asystolic or bradycardic events after transfer out of the PICU to inpatient rehabilitation five weeks after his initial presentation.

Conclusion: The majority of cardiovascular effects in GBS result from autonomic dysfunction. These include potentially fatal arrhythmias as in this patient’s case. There is very limited published literature regarding treatment options in these severe cases and no uniform treatment approach exists. Potential options that have been reported include the use of isoproterenol, atropine, or the insertion of a temporary pacemaker. Given that there is not currently a standardized approach, which therapy is chosen is left up to the provider’s discretion. In our patient’s case, it was beneficial to wait on pacemaker insertion and manage his dysautonomia medically until the acute period of his disease resolved. Additional investigation is needed to create a more standardized approach for the management of severe dysautonomia in GBS.
A Retrospective Review of Hyperbilirubinemia in Infants of Refugee Families

AUTHORS AND INSTITUTIONS: Alexa Coon, DO, Joel Davidson, MD, and Neil McNinch
Akron Children’s Hospital

BACKGROUND:
Jaundiced newborns are evaluated for hyperbilirubinemia for concern of acute bilirubin encephalopathy and kernicterus. There are multiple risk factors for hyperbilirubinemia including East Asian descent, a frequent risk factor found in infants born to refugee parents (hereafter, refugee infants.)

The Locust Pediatric Care Group (LPCG) at Akron Children’s Hospital cares for newly arrived refugee children and families. Providers hypothesized refugee infants were being admitted more frequently for hyperbilirubinemia than other clinic infants and refugee bilirubin samples were grossly hemolyzed more frequently therefore prompting concern that skewed results which led to unnecessary admissions.

OBJECTIVE:
The purpose of this study was to determine if refugee infants were more likely to be admitted compared to the age-matched controls at LPCG and evaluate clinical characteristics to determine any potential clinical and/or technical factors that increased the likelihood of admission.

METHODS:
Retrospective review of all 688 infants at LPCG from August 2015 through March 2017 yielded 107 infants who had a bilirubin level drawn at their first outpatient visit following discharge from the nursery, 66 refugee and 41 control. Excluded were 446 infants without a bilirubin check, 7 infants with an outside facility/provider bilirubin, 118 infants with previous NICU admission, and 9 patients had missing pertinent data. The data was then analyzed using summary statistics, T-Test with assessment of variance, or Chi Square test of Independence.

RESULTS:
Concerning our primary question, there was no significant association between refugee and admission status (p-value 0.23) nor refugee and unnecessary admission status (p-value 0.33.) There was a significant difference of the mean bilirubin drawn at the outpatient newborn visit for refugee infants compared to controls (15.1, 12.0, p-value 0.004.) There was a significant relationship between admission status and hemolysis in bilirubin levels at the newborn outpatient visit; 69% of admissions had samples that were hemolyzed and 91% of those had gross hemolysis in their sample compared to 36% of patients who were not admitted (p-value 0.0141.)

CONCLUSIONS:
This study supports the null hypothesis that refugee and control infants are admitted at similar rates for hyperbilirubinemia. Despite increased hemolysis in admitted infants, there were only 2 unnecessary admissions. These findings suggest that clinical and technical practices were appropriate. Low incidence of admitted subjects was a study limitation. Refugee infants are at an increased risk for developing hyperbilirubinemia because of their East Asian descent. This study showed that refugee infants have higher bilirubin levels than their control infant counterparts suggesting that refugee infants require close monitoring.
The role for osteopathic manipulation in an allopathic academic institution

AUTHORS AND INSTITUTION: Tamara Guseman¹, D.O., Jessica Castonguay², D.O., Miraides Brown³, M.S.¹ PGY-2, Akron Children’s Hospital, Akron, OH, USA, ² Division of Adolescent Medicine, Akron Children’s Hospital, Akron, OH, USA, ³ Biostatistician with Research Institute, Akron Children’s Hospital, Akron, OH, USA

BACKGROUND: There remains little data on use of osteopathic manipulative medicine (OMM) in pediatrics, limited by small sample sizes and few studies. Akron Children’s Hospital (ACH) trains both DO and MD resident physicians in general pediatrics. Medical education on a national level is approaching a merger between the two accreditation bodies, yet it is unclear how this merger will affect the continued mastery of OMM amongst the DO physicians. At ACH, a traditionally allopathic training program, there is little use of OMM in practice or research.

OBJECTIVE: The primary goal of this study is to investigate provider receptivity and knowledge about OMM given growing osteopathic representation and combined accreditation.

METHODS: A survey of subject demographics and OMM receptivity questions was emailed to all allopathic physicians, doctors of osteopathic medicine, advanced practice providers, and pharmacists. The total number of surveys sent was 812 and 168 surveys were returned anonymously within a 2.5 month period following one reminder email. RedCap was used to collect the survey data. Statistical analysis was performed by using SAS 9.4. Relationships between OMM receptivity and knowledge with medical degree, gender, subspecialty, and/or history of participation in OMM were investigated by using Chi-square test and Spearman correlation.

RESULTS: Participant response rate was 20.6%. It was found that 84% of female and 64% of male respondents were willing to learn more about OMM (p = 0.0082). By degree, 72% of MD physicians and 90% of CNPs stated they would be willing to learn about OMM. Approximately 74% of primary care providers and 84% of subspecialty providers endorsed willingness to learn more about OMM, whereas 60% of surgical providers were unwilling to learn more (p = 0.0063). Twenty-one percent of respondents had been taught OMM, yet 61% responded that they would be willing to learn more about OMM. About 40% of the survey population had experienced OMM in their lifetime and nearly 70% felt that it was a positive experience. Nearly half of the respondents would recommend OMM to pediatric patients, while nearly 20% stated they would not recommend due to not knowing enough about OMM. Respondents state they would most likely recommend OMM for musculoskeletal complaints (55%), followed by headache (40.5%), and abdominal pain/constipation (23%). Of the different OMM techniques listed, participants were most aware of myofascial release, muscle energy technique, high velocity low amplitude, while a substantial number reported not being aware of any techniques. Most (63%) were unsure which techniques to recommend, although many felt myofascial release (24%), muscle energy technique (21%), and strain-counterstrain (18%) were appropriate.

CONCLUSIONS: While most providers at ACH have had little experience with OMM, most are willing to learn more about the practice, predominantly the female and MD populations. Despite inexperience with OMM, most providers were in agreement that myofascial release, muscle energy, and strain counterstrain techniques would be most appropriate to recommend to pediatric patients.
Prevalence and Prognosis of Vocal Cord Dysfunction in Patients seen in Pulmonary Clinic from January 2012 to June 2017

AUTHORS AND INSTITUTION: Shannon King, DO PGY-3 Pediatric Resident, Rajeev Bhatia, MD Pediatric Pulmonology

BACKGROUND: Exercise-induced dyspnea is a clinical presentation often seen in pediatric pulmonology. A frequently diagnosed etiology of exercise-induced dyspnea is vocal cord dysfunction (VCD). This can be seen in lieu of or in conjunction with asthma. Patients with VCD may have a history of non-responsiveness to bronchodilators or may note stridor instead of expiratory wheeze. In this center, VCD is treated with speech therapy and metered breathing exercises. This delineation can assist appropriate management of asthma and vocal cord dysfunction in optimization of patient care.

In this study, we reviewed data related to all patients with diagnosis of VCD or suspected VCD with or without asthma seen in the Pulmonary Clinic at Akron Children’s Hospital from Jan 2012 to June 2017 and investigated the prevalence of this disorder along with outcome following treatment with speech therapy.

OBJECTIVE: To understand the prevalence and population characteristics VCD as well as the treatment outcomes in patients who progressed to speech therapy and those who did not.

METHODS: Retrospective EPIC EMR chart review of patients between the ages of 6-21 years having been seen in the pulmonary clinic at Akron Children's Hospital from Jan 2012 to June 2017 for a previous or current diagnosis of VCD or suspected VCD with or without asthma. Parameters to be included are demographics (age, sex, BMI), history of presenting illness, diagnosis of asthma (exercise or non-exercise induced), co-morbidities of GERD or anxiety, family history of anxiety, relevant social history, history of being seen by speech and reported response to therapy, baseline Spirometry results and differences noted in flow loops, and exercise challenge testing as available.

RESULTS: 71 patients (13 males, 58 females; age 6-20) were enrolled based on inclusion criteria. Preliminary results of the study show 82% of cases presenting in females and 45/71 (60%) of cases in high school students. 37/71 patients (52%) patients have a clinical diagnosis of asthma but only 28/71 (39%) report response to bronchodilator in the presentation of exercise- induced dyspnea. 34/71 (48%) of students note high-achieving grades and 19/71 (27%) have a medical history otherwise significant for anxiety (7/71; 10% with GERD, 3/71; 4% with both). 58/71 (82%) of patients are actively involved in sports. 51/71 (72%) of patients saw speech therapy at least one time for intervention. Of these 51 patients, 3 (6%) had noted full improvement and 20/51 (39%) noted mild-moderate improvement at follow up. 5/51 (10%) report no improvement and the remaining 23/51 (45%) were lost to follow up.

CONCLUSIONS: VCD is relatively common cause of exercise induced dyspnea at our center. Common characteristics of patients described in this study can assist in diagnosis. Speech therapy is an effective treatment when utilized.
Feasibility Of Using TRAZER™ Technology For Assessing Pediatric Subjects: A single-center, prospective, three-armed, pilot study

AUTHORS AND INSTITUTION: Matthew Kornswiet, MS, DO; Joseph Congeni, MD; Ronald Novak PhD, MPH, MPA; Annette Mitzel, DNP, CNS, RN; Akron Children’s Hospital

BACKGROUND: The current standard-of-care for post-mild-traumatic brain injury (mTBI or “concussion”) and post-musculoskeletal injury evaluation is conducted in a physician’s office and, for concussion evaluation, in a computer-based, sedentary environment. In many cases, athletes who perform well on the computer based and physical exam portions of the evaluation have symptoms when they restart activity or have repeat injuries very early in their return-to-play progression.

OBJECTIVE: The primary objective of this protocol is to evaluate the utility of Traq Global’s TRAZER™ technology in the assessment of a high school athlete’s readiness to return-to-play high school sports after either a lower extremity musculoskeletal or concussion injury when compared to current clinical methods for determination of a “ready to play” status. The secondary objective is to evaluate if an athlete recovering from a concussion has an increased incidence of subjective symptoms reported after exerting themselves during post-concussion TRAZER™ testing that would have remained undiscovered without participation in the TRAZER™ workout.

METHODS: This is a single-center, prospective, three armed, pilot study that will evaluate athletes with concussions and athletes with musculoskeletal injuries and compare the results to athletes who complete a sports season without an injury. The study will include male and female high school athletes. All athletes will be evaluated with TRAZER™ technology before their sports season (baseline) and after their sport season. If the athlete sustains a lower extremity musculoskeletal injury or concussion they will have an additional TRAZER™ evaluation when they are cleared to return-to-play to their sport. Athletes will undergo the current standard of care for both injuries.

DISCUSSION: The TRAZER™ testing is a full body sensing virtual reality domain. The athlete is asked to respond to 3D graphics projected on a screen to prompt their movements. The testing evaluates the athlete’s balance, reaction time, speed, acceleration, deceleration, and heart rate including evaluation at maximum heart rate to simulate full activity level. Evaluating the athlete objectively using motion-based testing, rather than using sedentary testing, should produce more reliable information for the clinician making the return-to-play decision for the athlete. We hypothesize that the athletes will have quantifiable deficits in measured metrics after their injury. In addition, we hypothesize that the athletes will develop increased symptoms of their injury when pushed through the exertion based testing when compared to the in office evaluation. We also hypothesize that a certain magnitude of deficits during testing could correlate with re-injury rates.

FUTURE RESEARCH: If TRAZER™ proves to be a valid tool, future research could more directly compare it to the current standard of care by seeing if the testing results would change the physician’s decision to return to the athlete to their sport. In addition, future research could create a predictive index that could identify athletes who are at high risk of injury.
Medical Marijuana in Ohio: Akron Children’s Hospital Physician Perspectives

Principal Investigator: Michelle Bestic, PharmD; Division of Clinical Pharmacology/Toxicology
Co-Investigators: Gregory Kuper, DO; Pediatric Resident

Institution: Akron Children’s Hospital

BACKGROUND: Ohio House Bill 523 (HB 523), passed in September 2016, outlines the establishment of the Ohio Medical Marijuana Control Program under which physicians may recommend medical marijuana for registered patients with approved diagnoses. Despite the fact that this policy will become operational in September 2018, it remains controversial for several reasons, including the continued conflict between State and Federal marijuana laws; there is inconsistent evidence regarding the efficacy of medical marijuana as a treatment modality; lack of consensus regarding effective dosing; and the well-documented adverse effects in the pediatric population, particularly regarding brain development.¹

OBJECTIVE: This survey is a timely attempt to ascertain ACH physicians’ perspectives regarding medical marijuana as a treatment modality in order to identify gaps in knowledge and to anticipate trends in recommendation, with additional implications for future policy recommendations.

METHODS: A survey consisting of ten questions was constructed through collaboration between primary and co-researcher. Questions were informed by current research regarding risks, benefits, and indications of medical marijuana. Additionally, specifics of HB 523 were alluded to in order to identify gaps in knowledge. Potential participants were contacted via email obtained from the Physicians’ mailing list with a link to the survey on RedCap. Advanced Practice Providers were excluded as HB 523 limits recommendation privileges to physicians. Data was collected anonymously. Results were interpreted using descriptive statistical analysis.

RESULTS: 433 surveys were distributed and 30% response rate is anticipated. Data collection is ongoing.
Weight as a Risk Factor for Pulmonary Hypertensive Crisis Following Pediatric Cardiothoracic Surgery

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Introduction/Background

Patients with left to right shunts (High Qp lesions) including ventricular septal defects (VSD) and complete atrioventricular canal (cAVC) defects are at risk for developing perioperative pulmonary arterial hypertensive (PAH) crisis [1]. These operations require cardiopulmonary bypass, which increases pulmonary vascular resistance (PVR) through increased production of thromboxane, microemboli, pulmonary sequestration of leukocytes, atelectasis, adrenergic hyperactivity and decreased release of nitric oxide[3].

Inhaled nitric oxide is started in the operating room either for anticipated pulmonary hypertension or failure to separate from bypass due to pulmonary hypertension (iNO-OR, Treatment iNO). However, increased pulmonary vasoreactivity is often latent and can manifest as life threatening PAH crisis in the intensive care unit (PICU/CVICU) and is treated with inhaled nitric oxide (Rescue iNO). Known risk factors for perioperative PAH crisis include older age at time of repair, preoperative elevation of pulmonary artery pressure, Trisomy 21 and high pulmonary to systemic blood flow (Qp:Qs) [2,3,4,5,7].

The degree of pulmonary overcirculation is a function of Qp:Qs. Symptoms of high output heart failure (failure to thrive, tachypnea, tachycardia, diaphoresis and poor weight gain [6]) are attributed to excessive pulmonary blood flow. PVR is initially high in the newborn period, which prevents significant shunting across the defect. PVR continues to decrease with the newborn’s first breaths and reaches normal adult levels around 1 month of age. With lower PVR, shunting increases, pulmonary blood flow increases and symptoms of CHF are seen[6].

In this study, we hypothesize patients with adequate weight gain (weight-for-age Z-score (standard deviation), WFA-Z) have higher baseline PVR and increased risk for Rescue iNO.

Methods

The Akron Children’s Hospital Institutional Review Board approved this study. We conducted a single center, retrospective study using our local Virtual Pediatric Systems (VPS, LLC) database.

PICU admissions after repair of VSD and cAVC for a study period of 66 months ending in December 2014 were identified. VPS severity of illness (PELOD) and mortality scores, as well as the STAT (The Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery) score, a mortality risk assessment tool associated with congenital heart surgery procedures were used.

Using the World Health Organization Child Growth Standards, each patient’s pre-operative weight was plotted according to age and their Z-scores assigned. Descriptive statistics were calculated for those treated with iNO vs the untreated. Parametric and non-parametric tests were applied as appropriate. Significance was defined as p<0.05.

Results

During the study period, of the 492 patients, 93 (19%) had candidate lesions repaired. Patients with candidate lesions had surgery at a younger age (5.6 mos vs 9.9 mos, p<0.01) and 23 (25%) were treated with iNO. There was no age difference between treated and untreated. Ten were treated in the operating room, while 13 received rescue iNO. There was a non-significant trend towards higher WFA-Z among the rescue iNO compared with intraoperative iNO (iNO-OR), WFA-Z 1.68 v 0.10, respectively p>0.05.

Conclusion

While limited by sample size, this single center study shows a provocative non-significant association between a higher WFA-Z score and the need for rescue iNO. As expected, cAVC was overrepresented in children with Trisomy 21. Furthermore, children with Trisomy 21 were seven times more likely to receive iNO at any time. Further investigation is necessary to delineate the differential contribution of Trisomy 21 and lesion specific parameters (lesions size, degree of shunting, etc.). In addition, WFA-Z adjustment for children with Trisomy 21 must be factored into future studies.
RISE to Transition: A structured transition protocol for renal transplant recipient children

AUTHORS AND INSTITUTIONS: Lin, Jessica, Ramundo, Maria, Ben-Zion, Sabrina, Mahesh, Shefali, Raina, Rupesh. Akron Children’s Hospital

BACKGROUND: The transition from pediatric to adult medical services is an important time in the life of an adolescent or young adult with a renal transplant. Failure to properly transition can lead to medical non-adherence and subsequent loss of graft and/or return to dialysis.

OBJECTIVE: To establish a locally-adapted, patient-focused, kidney transplant transition program, we implemented the RISE protocol. This was defined by four competency areas: Recognition, Insight, Self-Reliance, and Establish; identified through literature review and experience (see figure-1). First, patients must have Recognition of their disease process, the reason for transplant, and the health care system. They need Insight into the short and long term impact of their disease and therapy, their emotional needs, and the effects of non-adherence. The patients must be Self-reliant in regards to scheduling and attending appointments, refilling medications, and identifying urgent/emergent changes to their health. And lastly, they need to Establish healthy lifestyle choices, life-long adherence to medications and follow-up, psychosocial skills, and educational/vocational goals.

METHODS: Seventeen patients (6 female and 11 males, mean age 14.5 years), who received a renal transplant in the preceding 2-9 years (mean 5.6 years, median 7), went through transition protocols. The transition process spanned two years to allow sufficient time for patients, caregivers and pediatric nephrologists to prepare the young adult to leave pediatric care for adult care (satisfaction score 90%). During this time there was overlap of medical care between pediatric nephrologists and key adult physicians and related services. The final transition was completed at 21 years of age. Educating the young adult and their family about their kidney condition, the process of transition, their health care rights, the adult health care environment, and how it is different from pediatric health care services were identified as the key factors for RISE transition (90th percentile).

RESULTS: Adolescents and parents did not differ significantly in their general views about the appreciation and support provided by a transition program. However, the parents appreciated the support during transfer significantly more than did the adolescents. Eighty five percent of patients and family felt generally well informed of the RISE transition. However, 70% preferred to receive more information about their disease and overall health during their transfer period. When asked for the key person during the transfer, 62% of respondents identified the pediatric nephrologist, 30% the nurses, and 6% said “others.” The relevant issues during transfer were cited as medication (35%), education and employment (27%), disease knowledge (13%), and environment in the adult service (25%).

CONCLUSIONS: RISE protocol and its four competency areas is key to an effective transition. Self-reliance and the establishment of healthy choices aim to improve patient autonomy and emotional burden, and to minimize disruptions in their daily lives.

Recognition and insight aim to educate the patient in all aspects of their disease. Education about medical, social, vocational/educational, and interpersonal effects of their disease and treatment will help to improve adherence as well as alter patient perspectives of their disease.

Proficiency in all four areas will allow the patient to RISE to transition and establish him/herself in the adult medical world.
Some TORCHES Cast a Wide Shadow

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BACKGROUND:
Aicardi-Goutiéres syndrome (AGS) is a rare autosomal recessive disorder marked by encephalopathy, microcephaly, cerebral calcifications (especially in the basal ganglia), leukodystrophy and cerebral atrophy. Outside the nervous system, thrombocytopenia, hepatosplenomegaly, and elevated transaminases may be present. These features make it challenging to distinguish from congenital TORCH infections that share similar clinical and radiological manifestations. Leukodystrophies like pseudo-Torch syndrome and bilateral striopallidodentate calcinosis may also manifest with intracranial calcifications.

PATIENT CASE:
An 11-week-old, unvaccinated, Amish male born at full term presented with an 8-week history of poor feeding and a 3-week history of fussiness and chest “rattling” per parents. His weight and head circumference were less than the third percentile and physical examination was pertinent for irritability, micrognathia, truncal hypotonia and head lag. Aspartate aminotransferase and lactate were elevated to 146 U/L and 4.1mmol/L, respectively; ammonia was normal. He was admitted for intermittent hypoxia, but a chest x-ray, echocardiogram, and pneumogram were unremarkable. Due to his poor weight gain, microcephaly and irritability, urine organic and amino acids, plasma acylcarnitine, pyruvic acid, TSH and free T4 were obtained which were normal as well as his newborn screen. Head CT revealed supratentorial calcifications in the periventricular and deep white matter, basal ganglia and the brainstem and cerebellum, suspicious for congenital CMV. However, confirmatory testing with urine CMV PCR and culture, as well as Toxoplasma IgG and IgM were all negative. Hearing screen and dilated eye exam were likewise normal. Neurology was consulted and suggested AGS given the patient’s symptoms and negative viral titers. Genetic testing revealed SAMHD1 gene mutation, consistent with AGS5.

CONCLUSIONS:
In addition to the intracranial findings (calcifications, leukodystrophy and cerebral atrophy), other AGS features include truncal hypotonia, poor head control, dystonic movements, upper extremity posturing, glaucoma and chilblains. Eighty percent of patients usually have a normal newborn course with onset around 4 months of age, while 20% present with neonatal abnormalities. Encephalopathy marked by irritability, difficulty feeding and sleep disturbances, is the common initial presenting symptom. Unlike patients with congenital CMV or toxoplasmosis, patients with AGS typically do not present with hearing loss or chorioretinitis.

This patient’s ultimate diagnosis was challenging, given the findings on his head CT along with his microcephaly, possible IUGR, developmental delay and elevated transaminases which were consistent with congenital CMV. We often associate intracranial calcifications in infants with congenital TORCH infections; however, it is important to broaden our differential to include genetic and neurological disease processes that have similar radiologic manifestations.
Investigations of Burnout Rates in Pediatric Residents at Akron Children’s Hospital and the Effects of Resiliency-based Wellness Curriculum

AUTHORS AND INSTITUTIONS:
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BACKGROUND: Burnout is a syndrome that is characterized by emotional exhaustion, cynicism, depersonalization and poor sense of self-efficacy (1). Some of the associated consequences of burnout include compromised professionalism, poor productivity and depression all of which can adversely affect patient care (1). Studies have shown that compared to the general population, medical trainees experience higher rates of burnout (1). With this information the medical education community is placing emphasis on incorporating wellness initiatives with the purpose of mitigating the progression of burnout during training (2). An intervention that builds upon individuals’ ability to recover quickly from adversity (resiliency) through developing skills in coping with stress, promotion of self-care and awareness should help trainees ward off burnout.

OBJECTIVE:
To assess for the presence and degree of burnout in current ACH pediatric residents.
To assess for differences in subcategories of burnout based on postgraduate year and sex.
To assess the effectiveness of a resiliency based wellness curriculum on burnout.

METHODS:
Maslach Burnout Inventories were used to anonymously assess for burnout among Pediatric Residents before and after implementation of resiliency based wellness curriculum during the 2016-2017 training year. A six-session wellness curriculum was administered through noon conference lectures. Data examined via summary statistic for continuous data and frequencies (percentages) for categorical data. Independent Samples T-test with Variance assessment used to analyze pre-post differences in Maslach Domain scores. Effect Sizes were calculated using Cohen’s d for pre-post intervention differences and stratified by PGY level and gender. Statistical analyses were completed using SAS 9.4/13.2. Testing was two-tailed and evaluated at the Type I error rate of alpha=0.05 level of statistical significance.

RESULTS: Pre-intervention group included 24 of 60 residents (38%), 5 (22%) males and 18(78%) females. Post-intervention group included 18 of 60 residents (29%), 5(28%) males and 13 (72%) females. PGY 1 represented 42% respondents in pre-intervention group and 56% in post intervention group. According to the independent samples t-test there was no significant difference in the Maslach domain between both pre and post intervention groups (p> 0.05). However effect sizes as calculated by Cohen d demonstrates little effect on exhaustion (0.08), moderate effect on professional efficacy (0.47) and large effect (0.61) on cynicism. PGY3 demonstrated the largest effect in all Maslach domains while PGY1 experienced the least effect and PGY2 demonstrated most effect in the domain of exhaustion. Males demonstrated improved professional efficacy while females experienced very little effect in that domain.

CONCLUSIONS: The sample was small therefore power is limited along with unmatched results makes it difficult to interpret the true intervention’s effectiveness. What can be concluded from the study is that burnout is present in all residents as demonstrated by high scores in exhaustion and cynicism. On the other hand professional efficacy was rated as high which is recognized as a protective factor. To better assess the effectiveness of the Wellness Curriculum, the study requires a larger sample size to improve the power of the study as well as matched results.
Neonatal Outcomes of Preterm Infants in a Quaternary Care Center Breastfeeding versus Bottle Feedings of Breast Milk

AUTHORS AND INSTITUTIONS: Samantha O’Neill, MD, Beth Franklin, MD, Jennifer L. Grow, MD and Scott Schachinger, DO; Akron Children’s Hospital; Akron, Ohio.

BACKGROUND: Literature has demonstrated breast milk is vital to newborns, especially for those premature. Breast milk has been shown to decrease length of stay in neonatal care settings; however, premature infants often have a delay in oral feedings. Often feedings include bottles as opposed to breastfeeding exclusively. Our breast milk rate at discharge for 2015 (44%) at Akron Children’s Hospital was lower than desired for neonatal intensive care units (NICU) of similar acuity in the Vermont Oxford Network.

OBJECTIVE: We reviewed oral feeding outcomes of infants born premature who received exclusive breastfeeding versus those who were exclusively bottle fed expressed breast milk versus those who received a combination in the three area Akron Children’s Hospital (ACH) NICUs. We explored time to complete oral feedings and time to discharge in relationship with oral feeding practices to determine if bottle-feeding affects breastfeeding duration of our premature patients in the NICU.

METHODS: Approximately 600 neonates were reviewed for inclusion. A total of 66 infants (31F, 35M) born between 240 and 336 weeks gestation admitted to one of the ACH’s NICUs between January 1, 2015 and December 31, 2015 whose diet consisted of mostly breast milk met inclusion criteria and were retrospectively reviewed. Neonates who died before discharge, were transferred, did not receive oral feeds, or with pathology of the gut were excluded. In addition to demographic data, data obtained included age at first enteral feed, age at full enteral feeds, age at first time to breast, age at first time to bottle, number of times to breast, age at last nasogastric feed, length of stay (LOS) from birth, LOS after 32 weeks gestational age, age at discharge, and on which feeding method each patient went home (breastfeeding, bottle feeding, or combination of the two). Data analyzed using Graphpad statistical software.

RESULTS: Demographic data shows there was no difference between the two groups. There was no significant difference in outcomes between the two groups with respect to timing of first enteral feed, postmenstrual age (PMA) that full feeds reached, first time to breast, last NG feed, or the LOS after 32 weeks PMA. Although most infants were likely to spend some time breastfeeding during the NICU stay, there was a significant (P value <0.01) difference in the number of times to breast with babies who both breast and bottle feed going to breast 46 times versus 18 with those just bottle feeding.

CONCLUSION: With premature infants in our NICU, the data does not support bottle-feeding as opposed to breast-feeding as a method to reach total or complete oral feedings faster or decrease length of stay in the NICU. By demonstrating that time to complete oral feedings and length of stay was not different between the groups, this can dispel a medical myth that infants will “feed faster” at bottles rather than at breast and be discharged earlier. This offers support to improve breastfeeding rates in our NICU and spend time working with mother and infants to spend time breastfeeding when desired by the mother. Spending more time at breast in our local neonatal setting will not delay discharge for infants from the neonatal intensive care unit.
Examining the Usefulness of The Fasting Challenge Test in At-Risk Neonates: A Three Year Review.

AUTHORS AND INSTITUTION: Stacey Ramey, MD PGY3, Dr. Alison Protain DO. Akron Children’s Hospital

BACKGROUND: In 2011, the American Academy of Pediatrics (AAP) published guidelines for screening and management of postnatal glucose homeostasis in late preterm and term infants. The guidelines provided a framework for assessing and treating at-risk neonates within the first twenty four hours after birth. To address concerns that at-risk neonates can have issues with hypoglycemia after this time period, The Pediatric Endocrine Society (PES) published guidelines in 2015. These recommendations focused on the recognition and management of neonates at increased risk for a persistent hypoglycemia disorder, which can be associated with significant morbidity and poor neuro-developmental outcomes. The at-risk population traditionally included neonates who had signs of low blood glucose, those who were large for gestational age, infants of diabetic mothers, neonates with intrauterine growth restriction (small for gestational age), and prematurity. The PES expanded upon this list (in some cases with low level evidence) to include the following: history of perinatal stress (birth asphyxia/ischemia), cesarean delivery for fetal distress (category II or III tracing), maternal preeclampsia/eclampsia or hypertension, meconium aspiration syndrome, erythroblastosis fetalis, polycythemia, and hypothermia, postmature delivery, family history of genetic forms of hypoglycemia, and congenital syndromes. The PES also recommends performing a fasting challenge test prior to discharge home to exclude persistent hypoglycemia for the following situations: neonates with a family history of genetic forms of hypoglycemia, congenital syndromes/abnormal physical features such as microphalus or midline facial malformations, symptomatic hypoglycemia, need for IV dextrose to treat hypoglycemia, and inability to maintain preprandial glucose > 50mg/dl for up to forty eight hours of age, or > 60mg/dl after forty eight hours of age. The fasting challenge test is performed after forty eight hours of age and includes a 6 hour fast in the NICU, with blood glucose checks at 3 and 6 hours. While appears reasonable to exclude persistent hypoglycemia in neonates with a family history of hyperinsulinism or known congenital syndrome associated with prolonged hypoglycemia, the evidence is lacking for the other scenarios.

OBJECTIVE: To assess the usefulness of the fasting challenge, by determining how many at-risk neonates received a fasting challenge test prior to discharge home and evaluate whether they passed or failed, and the risk factors that were present. We hope to identify risk factors that may help predict those who may require fail the fasting challenge. With the current recommendations, the fasting challenge may be being over performed.

METHODS: A retrospective chart review of all at-risk neonates for hypoglycemia and those without risk factors with symptomatic hypoglycemia who were admitted to Akron Children’s NICUs at Main Campus, Akron General, and Summa Akron City from 2015- 2017.

Inclusion criteria: Neonates born after 34 weeks gestation with symptomatic hypoglycemia or with the following risk factors- prematurity, SGA, IUGR, IDM, LGA, slow transition to extrauterine life, polycythemia, post term delivery..

Exclusion criteria: Neonates born before 34 weeks gestation, or those who were not discharged home from the NICU

RESULTS: Pending analysis of data.

CONCLUSIONS: Pending analysis of data.
Roles of specific/total IgE ratio and subclinical reaction in the mechanism of food tolerance in sensitized individuals

AUTHORS AND INSTITUTION: Timothy Richmond, Neil McNinch, Jinzhu Li (Akron Children’s Hospital, Akron, OH)

BACKGROUND: Skin prick testing for food allergy sometimes yields positive results in patients without food allergy symptoms, leading to inappropriate food avoidance in the healthy population. The physiology responsible for this phenomenon is unknown.

OBJECTIVE: This study seeks to explore a correlation between the specific-to-total IgE ratio (sIgE/tIgE) and the severity of allergy sensitization (SPT size) in food-tolerant, sensitized individuals. In the same population, we attempt to determine whether a subclinical allergic reaction occurs after exposure to a food that causes a positive SPT result, by measuring serum tryptase and vital signs before and after food challenge.

METHODS: An online survey was advertised to Akron Children’s Employees to obtain medical history and limited demographic data. Individuals age 18-50 years without food allergy history were eligible for skin prick testing (SPT). SPT was performed by skin scratch inoculation using 14 food extracts; SPT results were quantified by measuring long and short diameters, and qualitatively evaluated against positive and negative controls. Serum IgE was measured using ImmunoCAP (Phadia); total and food-specific IgE were measured, and plotted against SPT size. During food challenge, subjects were given 30g of selected food to eat, and blood samples and vital signs were collected pre-meal and at 15min intervals. Tryptase was measured at 0min and 60min post-meal.

RESULTS: The online survey yielded 254 unique responses, 60% of survey respondents were eligible for SPT. Respondents reported food allergy (13%), environmental allergy (66%), asthma (21%), and eczema (19%). There were 72 SPT visits, with 5 subjects having at least 1 positive SPT result (6.9%). Elevated tIgE was seen in two SPT-positive subjects, and sIgE levels were variable, ranging from elevated to below detection for positive SPT foods. Plotting sIgE/tIgE against SPT size yielded an exponential best-fit line with R² value of 0.98. Three SPT(+) and 2 randomly selected SPT(-) subjects underwent food challenge; and there was no significant change or trend in tryptase levels or vital signs during the testing period.

CONCLUSIONS: Reported allergic co-morbidities had higher prevalence in the surveyed population compared to population studies, and selection bias is a likely cause of this finding. We observed ~7% prevalence of SPT(+) in tested subjects using 14 tested foods, similar to reported prevalence. Subjects with quantifiable sIgE levels showed a positive correlation between [sIgE/tIgE] ratio and SPT size. There is no evidence of allergic response in SPT(+) individuals after eating a food causing positive SPT, despite the presence of allergic response by the skin of these individuals; the cause of this phenomenon remains unknown. Low sample size precludes robust statistical analysis of current data, and continued study recruitment and testing is currently underway.
Rates of Sexually Transmitted Infection on an Inpatient Behavioral Health Unit

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BACKGROUND:
Newly diagnosed sexually transmitted infections (STI) cost the US health care system over 16 million dollars. The highest rates of STI are in adolescents and young adults, accounting for over half of STI cases. Timely diagnosis and treatment of STI is important to prevent transmission and associated complications. There is an established relationship between high risk sexual behavior and depression in adolescents. Risk factors and behaviors associated with depression and high risk sexual behavior including substance use, inconsistent condom use, and obesity have been reported in adolescents. Previous literature has shown incarcerated adolescents, another high risk subpopulation, have higher rates of chlamydia than age matched peers. No studies to date have examined the rates of STI and associated risk factors for patients admitted to a pediatric behavioral health unit.

OBJECTIVE:
The primary objective was to determine if rates of STI of adolescents admitted to a behavioral health unit were higher than adolescents in the general population. Secondary outcomes included analyzing the rates of associated risk factors with poor mental health and high risk sexual behavior including inconsistent condom use, substance use, and obesity. Finally, we examined the rates of STI testing in patients who were eligible for STI testing and reported current sexual activity.

METHODS:
A retrospective chart review of 988 patients ages 10-17 admitted to the Akron Children’s Behavioral Health Unit in 2016 was completed. Baseline demographics as well as rates of Chlamydia, Gonorrhea, sexual activity, STI testing, condom use, substance use, and BMI were obtained. Statistical analysis was performed using SAS 9.4. Tests for proportions with Agresti-Coull and confidence intervals were provided. All tests were 2-sided, and significant level set p < 0.05. These rates were compared against the CDC’s Youth Risk Behavior Survey and the National Survey of Drug Use and Health.

RESULTS:
The inpatient behavioral health unit had statistically significant higher rates of Chlamydia compared to the national average in patients 10-14 (P<0.0001). There was significantly higher rates of sexual activity (P<0.0001), lower rates of condom use (p<0.0001), higher rates of obesity (p<0.0001), and higher rates of substance abuse(p <0.0001). STI testing was completed on 34% of sexually active patients similar to national trends which is less than 40%. This includes patients who were not offered testing or who declined testing. There was no statistically significant increase in rates of Chlamydia in the 15-17 year age group or Gonorrhea in either age group.
Approach to Diagnosing and Treating Renovascular Hypertension in Children: A Case Report
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Background: Renovascular hypertension accounts for about 5-10% of secondary causes of hypertension in children, and most cases will require interventional or surgical treatment. Children with renovascular hypertension often have vascular abnormalities leading to a hypoplastic kidney. With renal artery stenosis, renin becomes elevated, thus contributing to the hypertension. Investigation for the cause of secondary hypertension includes a variety of imaging modalities, including the [¹⁹⁵₉TC] dimercaptosuccinic acid (DMSA) scan. If a DMSA scan shows less than 10% uptake, the recommendation is nephrectomy. If the scan shows greater than 15% uptake, medical management is recommended. However, there are no specifications for scans that show no uptake. No uptake on a DMSA scan generally signifies lack of function for that kidney; meaning it should not be contributing to the hypertension. Is it safe to assume a kidney without uptake on a DMSA scan is not contributing to the hypertension, or is further imaging or workup needed to confirm?

Case: A 23-month old male with a history of cutaneous mastocytosis was admitted for emesis, dehydration and constipation and found to have persistent hypertension. He was started on antihypertensive medications for the duration of his workup. Initial evaluation included a renal ultrasound that demonstrated a hypoplastic right kidney and an appropriately hypertrophic left kidney. Doppler did not show any evidence of renal artery stenosis. The patient also had elevated renin, potassium wasting and elevated aldosterone levels. However, the DMSA scan showed no uptake in the right kidney, suggesting no function of the right kidney, which contradicts the elevated renin. Due to conflicting results, a computed tomography angiography (CTA) was performed to evaluate for renal artery stenosis. The CTA showed a small caliber right renal artery with minimal cortical enhancement. The patient then underwent a right nephrectomy, repeat renin was normal, and was able to be weaned off all antihypertensive medications.

Conclusion: This case demonstrates the difficulty in evaluating secondary hypertension in children, particularly when the DMSA scan shows no uptake. The patient underwent a CTA showing a rim of enhancement demonstrating some right kidney function. A right nephrectomy was then performed, the hypertension improved, and medications were stopped. If clinicians have high suspicion for renovascular hypertension, but the DMSA scan shows no renal uptake with elevated renin and a normal opposing kidney, clinicians should consider further confirmatory imaging.
Disseminated HSV in a 2-day-old presenting with fever only

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BACKGROUND: Herpes simplex virus (HSV) infection in a neonate is a very serious infection with significant associated morbidity and mortality. What makes it even more daunting is that it can be difficult to diagnose in absence of characteristic symptoms such as vesicular rash or history of maternal infection. HSV infections in neonates are categorized as skin, eye, mucous membrane (SEM) involvement, central nervous system (CNS) infection, or disseminated. Disseminated HSV is the most severe infection with the highest associated mortality. It is defined as an infection involving multiple organ systems, most commonly liver and lungs, but also including blood abnormalities (most commonly thrombocytopenia), skin infection, and can progress to shock. Oftentimes, children with HSV infection, especially disseminated, can present with nonspecific clinical findings such as fever, altered mental status, and/or respiratory distress. In children that present with fever in absence of rash, it is standard to start empiric antibiotic therapy pursue workup for bacterial infection. It is not standardized to pursue HSV work up and empiric treatment, which can be detrimental in children with HSV infection.

PATIENT CASE: A full term 2-day-old male was brought to the emergency department by his father for evaluation of rectal temperature of 101.4°F and only significant history being maternal fever 48 hours after delivery without any history of HSV lesions or illness prior to delivery. Extensive laboratory work up was done upon arrival to the ED including standard serious bacterial infection labs and CSF studies, HSV PCRs of the blood and CSF, as well as HSV isolation swabs were performed. Patient was started on empiric acyclovir and antibiotics. The HSV PCR of the blood as well as the eye and mouth swabs resulted positive for HSV type 1. Course was complicated by pneumonitis with respiratory distress requiring supplemental oxygen for 5 days as well as thrombocytopenia to 81 10^9/L. All bacterial cultures were negative. Given these findings, he was diagnosed with disseminated HSV, received IV acyclovir followed by oral for total of 6 months, and had minimal complications in short term follow up. He did develop fever and vesicular rash consistent with HSV flair at 20 months of age.

CONCLUSIONS: This case raises the importance of having a high index of suspicion in a neonate presenting with fever for HSV. It’s imperative to treat empirically for HSV in the absence of classic HSV risk factors (mom without known history of HSV infection), as well as absence of classic clinical finding of vesicular rash in these children without other explanation for fever. Notably, the majority of infants who contract HSV are born to asymptomatic women with no history of genital HSV. History of maternal fever is also important to gather, as this has been found to be suggestive of neonatal HSV infection specifically in the absence of vesicular rash, most prominently associated with the disseminated type. What also makes this case unique is that disseminated HSV typically presents between 1 and 2 weeks of age, not within the first 48 hours of life as well as the most notable clinical finding being resolved fever followed by several days of persistent hypoxia. Had this child not been treated empirically with acyclovir, he could have had a poor outcome as the mortality rate is as high as 85% in children with disseminated HSV infection that are untreated.
Diagnostic challenge: the youngest reported case of paediatric onset multiple sclerosis

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BACKGROUND: Paediatric Onset Multiple Sclerosis (POMS) is exceedingly rare in pre-pubertal patients. The previously youngest reported patient to meet diagnostic criteria was 2 years old. Our patient met International Paediatric MS Study Group (IPMSSG) 2013 criteria for POMS at 19 months.

PATIENT CASE: Following a febrile illness, this previously healthy, fully vaccinated, normally developing 15 month old boy developed acute disseminated encephalomyelitis (ADEM). He was diagnosed and treated at 16 months. He subsequently had non-encephalopathic relapses at 19, 21, 23, 25, and 26 months, requiring high dose steroids and prolonged tapers. He retrospectively met IPMSSG 2013 diagnostic criteria for POMS at 19 months, but diagnosis was delayed until 27 months.

Work Up: MRIs initially revealed bilateral diffuse white matter lesions and a diffuse right cerebellar lesion. Subsequent MRIs revealed volume loss, tumefactive cerebellar lesions (left predominant) with intermittent extension into the pons, new supratentorial lesions, and optic neuritis. Repeat lumbar punctures at 16, 19, 28, and 33 months were non-diagnostic, showing neutrophilic pleocytosis at several time points without oligoclonal banding or elevated IgG synthesis. Extensive metabolic and genetic analyses failed to identify alternative diagnoses, though a Leber’s Hereditary Optic Neuropathy associated mtDNA mutation m.14484T>C in MT-ND6 was identified, and felt to be asymptomatic but is of unclear clinical significance.

Treatment and outcomes: During his work up, the patient suffered speech delays, residual ataxia, steroid-related weight gain, cushingoid facies, behavioral problems, and hypertension. Factors delaying diagnosis included his young age, atypical appearing demyelinating lesions, recurrent tumefactive cerebellar lesions, a paucity of spine or corpus callosum involvement, and very difficult clinical interactions due to his fear of medical personnel. Rituximab initiated at 29 months prevented relapse and allowed steroid freedom for 3 months. Following relapses at 32 and 33 months, cyclophosphamide treatment began, resulting in clinical stability.

CONCLUSIONS: To our knowledge, this is the youngest patient to meet diagnostic criteria for POMS. His case underscores the diagnostic challenges and treatment dilemmas for very young patients presenting with chronic relapsing demyelinating disease.
Ten Year Review of Neonatal Outcomes of Preterm Infants in a Quaternary Care Center diagnosed with Intraventricular Hemorrhage.

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BACKGROUND: Intraventricular hemorrhage (IVH) is a significant cause of brain injury in infants. Incidence of IVH increases with decreasing birth weight and gestational age, making premature infants at higher risk. Post-hemorrhagic hydrocephalus is a complication of neonates with IVH. These infants often require temporary interventions such as ventricular access devices (VAD) with some requiring long-term management with ventriculoperitoneal (VP) shunts. These interventions come with complications including malfunctions and infections requiring revisions. Neonatal care has made numerous advances in care, however IVH still carries significant morbidity and mortality for infants.

OBJECTIVE: We reviewed the trends of significant IVH in the neonatal intensive care unit at Akron Children’s Hospital to promote future investigations to decrease morbidity. The primary objective was to review the VLBW patient population with the diagnosis of IVH. In particular, we reviewed the trends of shunt revisions and infection over a ten-year span.

METHODS: Premature infants from 2006-2016 between 22<sup>0</sup>-29<sup>6</sup> gestational age were included. Exclusion criteria included infants who were not diagnosed with intraventricular hemorrhage, those who transferred out to another facility, or those who were transferred into our facility after neurosurgical intervention. Demographics, maternal risk factors, delivery factors and NICU course were evaluated. The infants were then narrowed to those who required VAD or VP shunts. Their complications including malfunctions and infections were then examined, as well as day of life of needed interventions, infections and revisions. GraphPad Prism 7 statistical software was used. Analysis was done utilizing the Mann Whitney U test and Chi-squared test.

RESULTS: In the 10 years examined, 129 premature infants were included in the analysis. Ninety-eight of the 129 were discharged home, 45/98 of which received shunts and 53/98 who did not. Thirty-one of the 129 infants died prior to discharge. Mortality rate was found to be higher in the group of infants who received either a VAD or shunt at 40%, whereas infants who did not had a 2% mortality rate (p<0.0001). In analysis of prenatal demographics and delivery interventions and outcomes there was no statistically significant difference between the two groups. No difference was found in morbidities during their NICU stay. Of the infants with shunts or VADs, 19% developed a CSF infection, and of this group 80% had received revisions. Infection rate was found to be higher in infants receiving VA shunts at 67%, compared to VP shunts at 17% and VADs at 21%. VA shunts more often required revision as compared to VP shunts(p<0.05). When evaluating all infants requiring a revision of their shunt, all were grade IVH.

CONCLUSIONS: From these results, there were no identified predictors of prenatal factors or delivery interventions or outcomes for determining which premature infant’s would develop severe IVH or need a VAD/shunt. Data is suggestive that revisions of shunts lead to an increased risk of CSF infections and VA shunts may be at increased risk for further revisions compared to VP shunts. Overall, severe IVH increases mortality risk and remains a significant problem in the premature infant NICU population.
New diagnosis of ALL in patient with JIA

AUTHORS AND INSTITUTIONS: Jenny White, Daniel Pettee, Erin Wright
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BACKGROUND: Juvenile idiopathic arthritis (JIA) is an autoimmune disorder characterized by persistent synovitis in more than one joint in a patient before the age of 16 years old. Signs and symptoms can include joint pain, fever, weight loss, and/or fatigue. All of these findings can also be presenting signs of acute lymphoblastic leukemia (ALL). Treatment for JIA includes NSAIDS, corticosteroids, and methotrexate which can interfere with the results of a bone marrow aspirate and potentially mask a concurrent ALL diagnosis.

PATIENT CASE: Our patient initially presented as a formerly healthy 4 year old Hispanic male with non-specific, migratory polyarticular arthralgias. At the initial rheumatologic evaluation, the patient’s exam revealed swelling in the knees, elbows, wrists, and ankles with restriction in joint mobility as well. No lymphadenopathy, rashes, or hepatosplenomegaly was found on exam at that time. Patient’s family reported no fevers, night sweats, or weight loss. The laboratory work up revealed a normal CBC and the patient was diagnosed with juvenile idiopathic arthritis (JIA). He was treated with an oral steroid course and naproxen for two weeks with rapid improvement in symptoms. He remained asymptomatic for approximately 5 months until the same arthralgias returned. He was re-started on steroids and NSAIDs along with oral weekly methotrexate for approximately one month with improvement in symptoms. The patient’s symptoms returned approximately one month later and the medications were restarted, again, with improvement. One year after initial presentation, while taking steroids and methotrexate, a routine CBC was obtained which showed pancytopenia. The medications were held and he then underwent a bone marrow procedure which revealed a small, immature hematogone population of cells expressing CD34, HLA-DR, CD10, CD22, CD19, CD38 and TdT- although the sample was not diagnostic of ALL. Bone marrow procedure was repeated two days later with a similar hematogone population seen. FISH was obtained on this sample and showed 11% of cells with a gain of RUNX1 (Runt-related transcription factor-1). Following the bone marrow procedures the patient was taken off methotrexate and started on Etanercept and continued on the steroids. He experienced continued arthralgias and continued pancytopenia. All medications were stopped and ultimately 3 months later a repeat bone marrow was performed and a diagnosis of pre-B cell ALL was established. He is considered high risk because of his previous treatment and appropriate chemotherapy was initiated per protocol.

Discussion: Studies have shown that patients with a diagnosis of JIA have a higher incidence of developing acute leukemia however it is unclear in our patient if the ALL developed in conjunction with JIA or if the treatments for JIA masked an ALL that was present from initial symptoms. Providers evaluating patients with symptoms of JIA should carefully consider acute leukemia in their differential diagnosis. The presence of RUNX1 in this case also raises the question of a possible role of RUNX1 as a disease-causing cytogenetic change that could be an avenue of future study.
Accuracy of Electronic Medical Record Heart Rate Alerts from Initial ED Triage in Predicting Acute Care Needs in Pediatric Patients


BACKGROUND: In the pediatric population, tachycardia is commonly encountered and in many instances may be benign or secondary to fear, pain, and fever, but in some cases may indicate an underlying illness such as early compensated shock. This can cause difficulty for clinicians in the emergency setting to initially identify pediatric patients that will require admission. Vital signs are flagged in the electronic medical record (EMR) system if they fall outside of the normal range but do not help delineate the cause of the abnormality.

OBJECTIVE: The aim of this study was to analyze the outcome of flagged heart rates in the EMR system from initial triage in the Pediatric Emergency Department and evaluate whether the patient was admitted (floor or PICU setting) or discharged home.

METHODS: The analysis was performed using SAS (version 9.4; SAS Institute Inc., Cary, NC, USA). The normality of the distribution of quantitative variables was assessed by the Kolmogorov-Smirnov test. The Chi-square test was used to evaluate associations between categorical variables and groups. Difference in means was assessed by using Student t test, and when non-normality was determined, Wilcoxon Sum Rank test was used as a substitute. Lastly, logistic regression model was developed to evaluate the likelihood of patient disposition using ED triage alert and covariates selected at the univariate analysis. All tests were two–sided. The significance level was set at P < 0.05.

RESULTS: A total of 20,195 patients between the ages of 1 month to 18 years were evaluated and of those patients 2744 (13.59%) had a HR that was alerted in the EMR system. Admission rate was greater for patients with an alerted HR without fever (22.41% versus 14.08%) and PICU admission rate was also higher (19.08%) compared to the patients with fever and an alerted HR (11.83%). The adjusted odds of admission were higher for patients with alerted HR without fever compared to patients with alerted HR with fever (AOR 3.09, 95% CI [2.71; 3.53]).

CONCLUSION: The results of this study show the EMR alert system was effective in identifying patients with acute care needs. The odds of admission were greater for patients with an alerted HR without fever and there were a greater number of these patients requiring critical care. This study shows the majority of patients with an altered HR do not require acute care but a small percentage do and clinicians need to be aware of this patient population when evaluating pediatric patients entering the ED.
Should Pediatric Wrist Buckle Fractures be Splinted in the Emergency Department Without Orthopedic Consult?

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BACKGROUND: Pediatric buckle (torus) fractures of the distal forearm are stable fractures that typically heal within 4 weeks of immobilization. Recent literature suggests that splinting is superior to casting and that if these fractures are correctly diagnosed, they do not need pediatric orthopedic care or radiographs. However, many Emergency Department (ED) physicians continue to consult orthopedics and the orthopaedic surgeons continue to see, cast, and subsequently radiograph these fractures.

OBJECTIVE: The purpose of this study is to determine if distal forearm buckle fractures can be safely splinted by ED physicians and discharged without orthopedic consult and to analyze current practices regarding the treatment of these fractures to determine the risks, benefits, and perceived barriers to splinting at a single institution.

METHODS: An IRB-approved retrospective review identified 110 pediatric wrist buckle fractures over a 2-year period presenting to the ED of a single pediatric institution with 24-hour pediatric radiology and orthopedic coverage. Orthopedics was consulted on all fractures, but at different times. If the patient presented to the main ED with resident orthopedic coverage, orthopedics provided a definitive diagnosis and casted the fracture. If the fracture presented to a satellite ED, the fracture was splinted in the ED and at the first orthopedic office visit it was definitively diagnosed and typically casted. Fractures were considered unstable if the orthopedic surgeon determined the fracture to involve the distal radial physis or if there was angulation. Buckle fractures definitively diagnosed by the orthopedic surgeon, with no other injuries and complete follow-up, were divided into two groups based on initial treatment given (cast, splint). These groups were then compared including age at presentation, gender, time to first orthopedic office visit, number of orthopedic visits, and number of radiographs taken. Descriptive statistics were used to compare the groups.

RESULTS: Of the 110 buckle fractures identified by the pediatric radiologist in the ED, 8% (n = 9) were determined not to be buckle fractures by the attending orthopedic surgeon, including 3 physeal fractures identified at initial consult and 2 at the first office visit after initial consult. Cast and other complications were minimal. Of the 87 buckle fractures meeting inclusion criteria for group comparison, 58 were initially casted and 29 splinted. The casted and splinted groups were similar in terms of age, gender, fracture location, and number of radiographs taken (initially and in total). Compared to the casted group, the splinted group was seen earlier (4 vs 19 days), and had more orthopedic office visits (2 vs 1 visit).

CONCLUSIONS: The high number of potentially unstable fractures that were not identified by the pediatric radiologist on initial evaluation may preclude ED discharge of the patient in a splint without orthopedic consult or follow-up. Casting of buckle fractures by the orthopedic resident in the ED potentially prevented the negative associated sequelae of unstable fractures missed on initial orthopedic consult. However, the current practice of splinting and then casting known buckle fractures resulted in increased costs and utilization of orthopedic staff (office visits, materials).
Chart Smart: Improving the Accuracy of Inpatient Pediatric Problem Lists

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BACKGROUND: The problem list is an integral component of the electronic health record (EHR), accompanying patients as they transition between care settings, highlighting their pertinent diagnoses and allowing specific patient populations to be easily identified. Despite these benefits, we found great variability in the maintenance of an accurate problem list at our institution.

OBJECTIVE: The goal of this QI project was to increase the accuracy of problem lists of pediatric hospitalist patients at Akron Children’s Hospital through several SMART objectives which included having 90% of charts with the same principal diagnosis on the problem list, discharge summary and after visit summary (AVS), and decreasing the number of duplicate and irrelevant problems on problem lists from 20% to 5%, between September 2016 and March 2018.

METHODS: A team of pediatric hospitalists, EHR liaisons, chief residents and pediatric residents was formed. Process and key driver diagrams were created and baseline chart review was done between August and October 2016. Several PDSA cycles were carried out, with interventions in 3 realms: provider education and feedback, provider workflow and EHR functionality. Monthly education sessions were held for residents on the inpatient service teams, and larger sessions were held at a house staff meeting and noon conference. EHR orientation for incoming pediatric interns was re-formatted to emphasize problem list review. Hospitalist attendings participated in education sessions, and were provided monthly feedback detailing the percentage of charts meeting SMART objectives. Problem list review was made a component of the inpatient admission and discharge navigators of the EHR, and residents were expected to use laptop computers in patient rooms during the admission process to review problem lists with families. Chart review was done monthly.

RESULTS: The percentage of charts with the same principal problem on the problem list, discharge summary and AVS increased from 25% in August 2016 to 85% in January 2018, with the median increasing from 55% in the pre-intervention period to 92% in the post-intervention period. Duplicate problems decreased from a peak of 30% in September 2016 to 18% in January 2018, with the median decreasing from 20% pre-intervention to 10% post-intervention. Irrelevant problems decreased from a peak of 25% in September 2016 to 5% in January 2018, with the median decreasing from 22.5% pre-intervention to 6% post-intervention.

CONCLUSIONS: The inclusion of resolved problems on the AVS had the largest impact on increasing the number of charts with the same final diagnosis on the problem list, discharge summary and AVS. Monthly resident education and reformating intern EHR training to emphasize problem list review, and laptop computer use in patient rooms during admissions had a significant impact on decreasing duplicate and irrelevant problems. Given that new groups of residents rotate on the hospitalist service every month, continued reinforcement of problem list review is essential to maintain accuracy, and is expected to lead to sustained culture change.
Parent Utilization of the After Visit Summary (AVS)

AUTHORS AND INSTITUTIONS: Inga Aikman, MD, MPH, Neil L. McNinch, MS, RN & Jeffrey Solomon, MD

BACKGROUND: The AVS is a paper or electronic document that summarizes patient health encounters and promotes communication between doctors and patients by listing diagnoses, medications, and care instructions. Data detailing how parents utilize the AVS after pediatric encounters is lacking.

OBJECTIVE: This study sought to increase knowledge of parents’ use of the AVS after their children’s hospital discharge.

METHODS: This was a pilot, prospective single cohort study utilizing survey methodology administered to a convenience sample to examine parent use of the AVS. English-speaking parents of patients 0-17 years discharged from the pediatric hospitalist service at Akron Children’s Hospital were eligible to participate and recruited from June to October 2017. Surveys were sent via email or mail, per parent preference, 1 week after discharge. Reminders were sent at 2 and 4 week intervals after the initial survey; parents were excluded if they did not respond within 2 weeks of the final reminder. Summary statistics for continuous data and frequencies and percentages for categorical data were calculated. The Chi² Test of Independence and Fisher’s Exact Testing were used to examine potential associations of responses with demographic information.

RESULTS: Of the 152 eligible parents, 63 completed surveys (41%). Ninety-eight percent (N=61) found the AVS easy to understand, citing simple layout and language and verbal reiteration of written instructions as contributing factors. Over 56% filed the AVS with their child’s medical records, while 50% used it to reference follow up appointments (N=62). Over 50% (N=60) found several components of the AVS useful including dates of admission, lists of physicians involved in care, follow up instructions and appointments. There were no statistically significant differences between parents’ level of education (p=0.78), race/ethnicity (p=0.83) or having a child with a chronic medical condition (p=0.43) and their understanding of the AVS.

CONCLUSIONS: Most respondents had a positive perception of the AVS content, found it easy to understand, and used it to reference care instructions and appointments. Limitations included small sample size, being performed in a single center, and using survey methodology which increases potential for selection, response and non-response bias. Investigation using a larger, more heterogeneous population from multiple centers may provide further insight into the components of the AVS that parents find useful.
Intra-cardiac Mass in a College Basketball Player

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BACKGROUND: Cardiac tumors are rare, with an incidence of 0.0017-0.33%. Furthermore, primary cardiac tumors comprise 5% of all cardiac tumors. Myxomas make up 50-70% of primary cardiac tumors, while fibroelastomas account for 5% of benign cardiac tumors. Fibroelastomas are responsible for three fourths of all tumors of the cardiac valves, and the average age of affected individuals is 60 years. Cardiac tumors may manifest with a variety of symptoms. Tumors in the atria or near/on the AV valves may present with symptoms of obstruction (e.g. mitral stenosis, paroxysmal/positional heart failure symptoms). Tumor infiltration into the neural pathways or myocardium can result in arrhythmia. Cardiac tumors may also be discovered following an embolic event such as a CVA, embolism of peripheral vasculature, or pulmonary artery embolism. This variety of presentations implores the clinician to thoroughly consider potential etiologies when evaluating the above symptoms.

PATIENT CASE: 20 YO removed from basketball game secondary to complete vision loss, with associated lightheadedness and dizziness/sensation of rotation. Evaluated on bench, with complaint of L-sided hemianopsia and continued lightheadedness. Athlete moved to training room, where visual field assessment by confrontation revealed normal peripheral vision, but subjective loss in focal superolateral region into which he could move examiner’s hand. Denied h/o migraines, dietary changes, supplements, stimulants, PED. Reported syncopal episode 2 days prior to game, with preceding lightheadedness, vision changes. At that time, episode believed to be secondary to overtraining, and dehydration.

With exception of subjective visual field deficit, as above, physical exam was normal. Evaluated by Optometrist, who suggested ocular migraine. Case discussed with Cardiologist, who recommended echocardiogram following morning. EKG following morning demonstrated significant T-wave inversions in anterior leads, and echocardiogram demonstrated large mobile structure on mitral annulus. Athlete subsequently admitted for mitral valve surgery and excision of mass, which, on pathology report, was 0.5 x 0.4cm.

MRI obtained, demonstrating multiple punctate foci of restricted diffusion in cerebellar hemispheres and left occipital lobe, consistent with ischemia and likely an embolic source. Final pathology report highly suggestive for fibroelastoma, and no infectious cause identified. Outpatient antiphospholipid antibody syndrome testing negative. Athlete currently undergoing rehab, with anticipated full return to basketball.

CONCLUSIONS: Non-specific neurological symptoms in a 20 YOM college basketball player result in a broad differential diagnosis. At time of on-court evaluation, athlete’s current symptoms could very plausibly be secondary to dehydration/poor nutrition or an ocular migraine. However, on further history collection, this athlete’s constellation of symptoms no longer appeared benign. This timely and appropriate work-up and intervention resulted in a positive outcome and return to sport, and it may have ultimately saved this young man’s life. This case demonstrates the absolute importance of thorough history collection and rapid/accurate coordination of care.
More Than a Muscle Spasm

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BACKGROUND:
Spinal epidural abscess (SEA) and pyomyositis are two rare infections, particularly in the pediatric population. Most SEA patients are adults over the age of 60 with identifiable risk factors including diabetes, IV drug use, alcohol abuse, degenerative joint disease, recent trauma or surgery, the presence of spinal stimulators or catheters, and local or systemic infections. Approximately 2 in 20,000 admissions are for SEA and one review of spontaneous pediatric SEA cases found just 12 cases reported from 2001-2014.

Similarly, the incidence of primary pyomyositis in the pediatric population is uncommon, with one review at a major US children’s hospital over a five year period reporting only 45 cases. This study found infections in the thigh and pelvis most common, representing 68% of cases. Risk factors for pyomyositis include tropical climates, history of trauma, HIV or immune compromise, and underlying chronic disease such as diabetes, rheumatologic disease, or malignancy.

Diagnosing these conditions is often difficult because both can present with insidious onset and without all or any of the classic features: the triad of fever, back pain and neurologic deficits in SEA; and fever, muscle pain, and swelling in pyomyositis. The aforementioned review of pediatric SEA found that all cases studied were initially misdiagnosed. Proper diagnosis is essential because of the potential for serious neurologic and functional sequelae.

Treatment of these conditions involves IV antibiotics and usually invasive/surgical procedures ranging from muscle drainage for pyomyositis to drainage and laminectomy for SEA.

PATIENT CASE:
We present a case of a previously healthy 17 year old male multisport athlete who presented with acute low back pain and was ultimately found to have both SEA and paraspinal pyomyositis. He noted onset of left sided low back pain after stretching and hearing a pop, and had no risk factors for infection. Initial history was unremarkable for any red flags of back pain, and neurologic exam was normal. He proceeded to have a rapid deterioration leading to fever, radiculopathy, myelopathy and cauda equina syndrome. Over the course of a 14 day period from onset of symptoms to diagnosis, he had a total of 10 provider visits in varied settings before the correct diagnosis was made. He was treated by emergent drainage and laminectomy, along with a six week course of antibiotics and physical therapy. At present time, now 10 weeks post diagnosis, his only persistent deficit is quadriceps weakness and he is expected to regain further strength in this domain.

CONCLUSIONS:
Both SEA and paraspinal pyomyositis are serious but rare infections, particularly in pediatrics. Our case demonstrates the difficulty in diagnosing these conditions in a pediatric patient with no known risk factors. Thus, it is important to keep a high index of suspicion when a patient presents with atypical symptoms or unexpected clinical progression. Further exploration of the prevalence and etiology of pediatric spinal infections is one area of further research that would be helpful in identifying and treating these cases earlier in their course.
Patient Experience of the Minority Patient Population at Akron Children's Hospital

AUTHORS AND INSTITUTIONS: Ariana Hoet, Ph.D. and Kevin Triemstra, Ph.D.; Akron Children’s Hospital

BACKGROUND: In the Unite States, racial/ethnic minorities make up about one third of the population (US Census Bureau, 2012) and one quarter of the children live in immigrant families (Calvo & Hawkins, 2015). Current literature indicates that parents of racial/ethnic minority children report lower satisfaction with their healthcare than parents of Caucasian children (Arauz Boudreau et al., 2010; Lee et al., 2016; Murray, 2015; Schwei, Kadunc, Nguyen, & Jacobs, 2014). This decreased satisfaction and trust of providers and health institutions are associated with negative outcomes (Schwei, Kadunc, Nguyen, & Jacobs, 2014).

OBJECTIVE: The purpose of this study is to explore differences between racial/ethnic minorities in patient satisfaction with their healthcare at Akron Children’s.

METHODS: Data was obtained from ACH’s Patient Experience surveys completed by patients in both inpatient and outpatient settings. Survey data from January 1 to March 25, 2018 was utilized. Six “question pods” were created by grouping similar survey questions: 1) Likelihood to recommend, 2) Feeling respected, 3) Feeling things were explained in a way they could understand, 4) Trust of providers, 5) Feeling listened to, 6) Feeling enough time was spent with patient. 6 separate one-way ANOVAs were used to analyze differences between racial groups’ (White, Black, Latino, Asian, and Middle Eastern) responses.

RESULTS: There was a significant effect of race on likelihood to recommend at the p < .05 level [F(5, 27,303) = 17.89, p = .000]. Post hoc comparisons indicated that the mean score for the Asian and Middle Eastern group was significantly different from the other three ethnic/racial groups. Similar patterns were observed in the other 5 question pods, where findings indicate that the Asian and Middle Eastern groups reported significantly lower satisfaction than the other ethnic/racial groups. Additionally, post hoc comparisons indicated that the mean for each of the ethnic/racial groups was significantly different from the Caucasian group for the pods related to how respected patients felt, how much patients trusted those providing care, how much patients understood, and how much patients felt listened to. For the pod asking if providers spent enough time with the patient, the mean of the Black and Asian groups significantly differed from the Caucasian group.

CONCLUSIONS: These results indicate that the minority patients at ACH do not always report the same level of satisfaction as their Caucasian counterparts. This was especially observed for the Asian and Middle Eastern group, which is important to note in ACH due to the high refugee population in this geographic region. Our minority patients would benefit from continued research related to their experience and continued development of programs to help them feel more satisfied of the services received at Akron Children’s Hospital.
Exploring Manual Dexterity Skills in Pediatric and Young Adult Postconcussive Populations

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BACKGROUND:
Neurocognitive deficits following mild traumatic brain injury (mTBI; referred to as concussion) are well-documented in the literature and are evidenced by disruptions in attention and executive functioning. These deficits typically resolve following an acute period that lasts from a few days to weeks. Motor deficits following the acute period have also been found in studies and are generally characterized by balance and gross motor coordination issues. While few studies have shown long-term fine motor issues, mice models and meta-analyses of children have demonstrated small to medium effect sizes following single or repeated mTBIs. Building upon these findings, the present study explored differences in fine motor manual dexterity skills based on the lifetime number of concussions.

OBJECTIVE: The objective of the study was to explore performances in speeded fine motor manual dexterity based on lifetime concussion frequency.

METHODS:
Patients were ages 8-22 years (N = 279) who were previously diagnosed with concussion(s) and did not have histories of epilepsy or prematurity based on medical records and/or a completed child history questionnaire. Patients with a single concussion (n=147) were compared to those with multiple concussions (n=132). Neuropsychological data were abstracted from a larger clinical database, and standardized scores from the dominant and non-dominant hand trials of the Grooved Pegboard task were examined.

RESULTS:
A one-way multivariate analysis of variance (MANOVA) was conducted to compare speeded manual dexterity performances between groups. Overall, results did not indicate significant differences on the Grooved Pegboard based on lifetime concussion frequency (p > .05, Wilk’s λ = .48, partial η²=.01). Correlations between lifetime concussion frequency and hand trial (dominant hand r = .28; non-dominant hand r = .25) were also non-significant (p > .05).

CONCLUSIONS: Significant relationships between lifetime concussion frequency and manual dexterity skills were not found. However, future studies should explore differences in manual dexterity performance using a non-concussed sample as the control group to distinguish between the effect of one or more concussions and no concussion.
An Evaluation of a 12-month Educational Curriculum on ED Resident Documentation and its Impact on Revenue and Resident Understanding

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BACKGROUND:
Variance data, the difference between maximum billable level and actual billed level, has demonstrated deficiencies in resident documentation resulting in lost revenue. Available literature shows that billing and coding education for residents of all specialties is lacking nationwide. The Center for Medicaid & Medicare Services has laid out clear requirements for each billable level in the ED. However, residents seem unaware of these requirements which results in unnecessary financial loses in the ED.

OBJECTIVE:
The primary outcome will be assessing revenue changes after implementation of a resident education curriculum. In addition, secondary outcomes included assessing improvement in resident comfort and knowledge about billing and coding objectives.

METHODS:
Variance data in our Emergency Department was collected by our coders at the end of each month and was compared to patient census that month to allow evaluation for trends in lost funds. Control data for variance was obtained by looking at data from the 2016 calendar year during which time only attending education was ongoing. Resident education took place during the months of January to December 2017. We provided a weekly, standardized educational program designed to teach residents how their documentation relates to billing. In addition, we provided laminated lanyard cards and workstation placards for reference material. We collected anonymous pre- and post-intervention surveys from each resident rotating through the ED using Survey Monkey. Survey included Likert-scale questions as well as a quiz on requirements for coding.

RESULTS:
Pre-intervention revenue lost due to down-coding was approximately $9463.5 per month ($1.738 per patient seen) averaged from January – December 2016. Loses per patient seen were increasing monthly from August – December 2016. Post-intervention loses shows approximately $8686.4 per month ($1.548 per patient seen) and are still down-trending. Survey data showed statistically significant improvements in resident comfort (p < 0.0001), perceived knowledge (p = 0.0001), and correct response on quizzes (p = 0.0017) after the implementation of the educational curriculum.

CONCLUSIONS:
Our study demonstrated that resident education on billing and coding practices had a significant impact on decreasing revenue losses for the ED. In addition, the overall comfort and knowledge of the ED residents showed drastic improvement with educational intervention. A limitation of this study was survey response rates of less than 50%. This educational program is being converted into an online module made mandatory for residents coming into the ED and we will continue to monitor revenue changes.
Peer Review in the Emergency Department

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Introduction- Peer review (PR) evaluates performance and identifies areas of improvement among individual practitioners. Published literature describes some PR triggers, findings and outcomes. The literature lacks robust pediatric or pediatric emergency medicine (PEM) benchmarks for comparison of case volumes and findings. We seek to describe a long-standing PEM PR program.

Methods- This study describe PEM PR in a large academic freestanding children’s hospital and includes satellite emergency departments (ED). The study period extends from 2010 to 2016. The PR process includes bimonthly committee meetings consisting of a PR specialist facilitating case reviews for a 6-provider PR committee. The Midas+ Solutions software (Tuscon, AZ) houses a custom database containing critical fields for each PR case including event date, triggers, findings, and relevant patient outcomes. The database was interrogated using simple statistics and a run chart was employed to depict results.

Results- During the study period, there were 681,823 ED visits with 1,116 cases triggered for PR (0.16%). The most common PR trigger accounting for 656 cases (58.8%) was “unplanned return to the ED within 48 hours requiring hospital admission”. The next most common trigger was “clinical care complaints” (n=108, 9.7%), followed by “patient mortality” (n=106, 9.5%), with additional PR triggers shown in Figure 1. The PR committee found an opportunity for improvement in documentation in 10.2% (n=114) of cases, opportunity for improvement in clinical management in 26.2% (n=292) of cases, and no identified opportunity for improvement in 45.8% (n=511) cases. Five (n=5, 0.5%) cases were found to have a significant deviation from the standard of care. The remaining cases (n=194, 17.9%) were triaged out of PR committee bases on the preliminary case review. There was an increase in PR case review rates from a baseline of 0.14% PR rate to a 0.22% PR rate.

Conclusion- PR is an important aspect of performance review. The process is designed to ensure that providers consistently offer high quality patient care. This study demonstrates various triggers and outcomes for the PR process, with “unplanned return to the ED within 48 hours requiring hospital admission” being the most common trigger. An increase in PR case rates is also noted during the study period, perhaps representing cultural acceptance and trust of the PR process. We believe this study serves as comparative data for PR triggers and PR findings as PR processes mature in the field of PEM.
A Pilot Study on investigation of parental depression and its effects on treatment response and outcome of depressed children and teenagers at an outpatient psychiatry clinic

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BACKGROUND: There is a growing literature proving that children’s mental wellbeing is significantly correlated to that of their parents. Children of depressed parents demonstrated overall functional improvement with parental remission of symptoms. Only one study examined the relationship between mood symptoms in children and their parents and found a significant positive correlation between the symptomatic experience of the parents and that of the child. Aim of this pilot study is to screen both depression and psychiatric treatment history in the parents of children who already are receiving treatment for depression and examine the relationship between parental depression& psychiatric history and their child’s severity of depression, treatment response and clinical outcomes.

OBJECTIVE: Identify the prevalence of depressive symptoms among parents of depressed children and teenagers who are in treatment in ACH child psychiatry outpatient clinic. Identify the impact of parental depressive symptoms on that of the children’s depression severity, treatment response and outcome.

METHODS: 39 subject pairs (parent and child) in total consented to participate to the study. Each parent/guardian completed the Beck Depression Inventory II (BDI-II) as well as a brief survey of personal past medical and psychiatric histories. EMR records of child subjects were reviewed to obtain the following measures: demographics, child’s diagnoses (primary diagnosis depression, secondary co-morbid diagnoses), depression severity, treatment response, functional outcome, inpatient psychiatry hospitalization, suicide attempts and number of medications. Examination of data included calculation of descriptive statistics. Fisher’s Exact Test was conducted for evaluation of potential associations between severity of parental depression and key demographic / clinical characteristics of children.
Statistical analyses were completed using SAS 9.4 / 13.2 ©. All testing was two–tailed and evaluated at the Type I Error Rate of alpha=0.05 level of statistical significance.

RESULTS: Statistically significant associations were found between severity of child’s depression and parental history of another mental health disorder, mental health treatment for depression, psychiatric admissions, and suicidal gestures and suicidal attempts. Statistical trend was noted for history of parental self harm behaviors. If the sample size was larger, this could have been statistically significant value and could be clinically significant at this time for future considerations.

CONCLUSIONS: At Akron Children’s outpatient psychiatry clinic, the study found that the severity of depression in children was significantly associated with parental depression specifically, parental history of undergoing treatment for depression, suicidal attempts, diagnosis of other mental health disorders, and psychiatric hospitalizations. For future considerations it would be beneficial to screen parents for history of depression, and make appropriate referrals for their timely treatment which will be helpful in reducing the severity of depression in children.
Motor Skills in Children with Congenital Heart Defects (CHD)

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BACKGROUND:
Congenital heart defects (CHD’s) are the most common birth defects, and children with CHD’s are at risk for deficits in motor, intellectual, language, and executive functioning compared to healthy peers. These deficits have been attributed to alterations in brain structure and functioning that result from abnormal cerebral blood flow pre- and postnatally and during cardiopulmonary bypass procedures during surgical correction of CHD’s. There is significant variability in neuropsychological functioning within this population, and several medical factors have been shown to be associated with neuropsychological outcome (e.g., type and severity of CHD, surgical procedures, presence of co-occurring medical conditions). Motor functioning is one area of development that is at risk in this population, and the literature indicates that motor skills are associated with school readiness and adaptive functioning in children. However, the literature is inconsistent with regard to the relationships between specific medical factors and motor outcomes in children and adolescents with CHD.

OBJECTIVE:
The aim of this study was to better understand the relationship between motor functioning in children and adolescents with CHD and the presence of co-occurring medical conditions. We compared motor skills between children with and without co-occurring medical conditions to determine whether there were significant differences. Motor skills of interest included fine motor dexterity, visuomotor skills (i.e., hand-eye coordination), and manual motor strength. We hypothesized that children with CHD and co-morbid medical conditions would have poorer motor skills due to the cumulative neurologic impact of multiple conditions.

METHODS:
Information was collected from a pre-existing NDSC database which includes information from patients who have undergone neuropsychological evaluations. Patients between 3 and 18 years of age, who were evaluated between 2012 and 2018, and who have diagnoses of CHD were selected (N = 32). Mann Whitney analyses were used to compare results from measures of fine motor dexterity (Grooved Pegboard), manual motor strength (Dynamometer), and visuo-motor integration (Beery VMI: Visual-Motor Integration [VMI], Visual Perception [VP] and Motor Coordination [MC] subtests) between the two groups (CHD only [n = 15] and CHD plus other medical conditions [n = 17]). Co-morbid medical conditions included chromosomal/genetic abnormalities, perinatal complications, epilepsy, traumatic brain injury, and other CNS infarcts/abnormalities. Other factors known to impact neuropsychological outcomes could not be explored due to small sample size.

RESULTS & Conclusions:
Group medians differed significantly for Grooved Pegboard (dominant hand), $U = 39.0, p = .038, d = .915$, and VMI, $U = 74.0, p = .044, d = .765$, while all others were nonsignificant. The CHD group with co-occurring medical conditions had significantly lower median scores on the Grooved Pegboard and VMI tasks than the CHD only group. Results suggest that specific aspects of fine motor and visuomotor skills are inordinately affected by the presence of co-occurring medical conditions in children with CHD. Additionally, they highlight the importance of screening for fine motor problems in children with CHD, particularly when there is a co-occurring condition. However, the relationships between motor skills, specific medical factors, and other cognitive factors (e.g., attention, processing speed) warrant exploration.
Depression in Children and Adolescents with Spina Bifida

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BACKGROUND: Depressive disorders in children and adolescents in the US have been increasing, but there are varying reports amongst chronic illness models and specific chronic conditions, such as Spina Bifida (SB) disorders. Further, research has focused predominately on patients 18 years and older.

OBJECTIVE: Describe prevalence and identify correlates of depressive symptoms in children and adolescents with SB. We hypothesized a positive correlation of depressive symptoms with age, SB severity and pain; and a negative correlation with participation.

METHODS: We recruited children ages 7-17 years with SB in the SB Clinic at Akron Children’s Hospital. Non-English speaking patients were excluded. Study measures included demographic data, pain rating, SB severity composite, Child and Adolescent Scale of Participation© (CASP), and Children’s Depression Inventory – 2©: Self-Report Short (CDI:SR) and Parent (CDI:P) forms. Participants received a gift card as incentive for participation. This is a cross-sectional observational analysis. Univariate analyses were run to compare separate outcome measures to CDI:SR and CDI:P scores.

RESULTS: Forty-eight patients, 26 male and 20 female (mean age 10.4 years), and their parents completed the study. Thirty-one percent (14/45) of CDI-SR forms and 25% (11/44) of CDI-P forms were elevated (T-score ≥ 60). There was no statistically significant relationship between age and depression (CDI-SR, p=0.808; CDI-P, p=0.608). Child self-report and parent-report of child depression were significantly correlated (p<0.001). Interestingly, no significant correlations were found between SB severity, pain, and participation and child self-report of depression. With respect to parent report of child depression, we found several statistically significant relationships. All four CASP subsections, Home (p=0.014), Community (p=0.018), School (p=0.014), and Living Activities (p=0.006), were found to have a negative correlation with CDI-P scores. Pain (p=0.005) was also found to have a positive correlation with CDI-P scores. However, SB severity was not found to have a significant relationship with CDI-P. A multivariate model to predict the parent report of child depression found Pain (p=0.046) and CASP Living Activities (p=0.029) to be the strongest predictors of CDI-P.

CONCLUSIONS: We did not find a statistically significant relationship between child depressive symptom scores and age. Given the average age of our sample being 10.7 years, with participants as young as 7 years old, this highlights the importance of starting depression screening on patients with SB prior to the age of 11 years, when depression screening is recommended by the AAP. This is further supported by the lack of significant predictive factors found for child depressive symptoms. The difference in statistically significant findings between the parent- and child-report may be reflective of the variation in each measure, with the CDI-SR inquiring about internalizing symptoms, and the CDI-P inquiring about externalizing symptoms.
Queasease: aromatherapy as a novel approach to the treatment of chemotherapy induced nausea and vomiting

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Background: Chemotherapy induced nausea and vomiting (CINV) is a common side effect for patients undergoing treatment for malignancy. While not all patients experience these side effects, studies have shown that up to 70% of children will have symptoms of nausea and vomiting related to treatment and up to 60% will still experience CINV even with pharmacologic anti-emetic therapy. There are few studies in children looking at alternative therapies to help with this problem. Aromatherapy, or the use of inhaled essential oils, has been used as an independent and adjuvant therapy in patients to treat anxiety, nausea, vomiting, and to help with relaxation. St. Jude Children’s Research Hospital presented a poster which concluded that aromatherapy was easy to use as reported by the patients and their families. There are multiple reports of anecdotal evidence in addition to these studies that support the use of aromatherapy, however very few placebo controlled studies exist and even less studies documented have been performed in children. QueaseEASE® is a brand of specifically formulated essential oils in an aromatic solution created to help with nausea and vomiting and is an all-natural product that has minimal side effects as opposed to its pharmacologic counterparts. QueaseEASE® has been shown to improve nausea and vomiting in adult populations. Our study evaluated the efficacy of this aromatherapy in the pediatric oncology population at Akron Children’s Hospital.

Objective: To compare CINV in the acute phase as well as perceived quality of life in patients receiving aromatherapy with QueaseEASE®.

Design/Methods: A double blind placebo controlled trial was designed with 3 strata including mild, moderate and high emetogenicity groups. Quality of life (QOL) data and Baxter Retching Faces (BARF) questionnaires were obtained during a single cycle of chemotherapy. BARF nausea scores were obtained prior to and after drug/placebo administration.

Results: 32 patients aged 4-18 were enrolled for a single cycle of chemotherapy. A total of 13 patients had full data for interim analysis. Cohen’s effect size was performed to evaluate means between the 2 groups as part of interim analysis. Cohen’s D for parent QOL was 1.14, patient QOL was 0.49 and Barf scores -0.76.

Conclusion: Currently, there is a large effect in parent perceived quality of life for the patient and an improvement in BARF scores. There is a medium effect in patient perceived quality of life. The goal will be to continue to gather data to ensure we have appropriate power and then further analyze the information for statistical significance.
Tic Talks at 5 O’clock: Expanding the use of the *Chronic Health Illness Recovery Program* to meet the needs of adolescents with Tic Disorders

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**BACKGROUND:** Tourette Disorder (TD) is a common neuropsychiatric disorder in children characterized by sudden, rapid, nonrhythmic movements or sounds, often preceded by premonitory sensations or urges. Some individuals also have psychiatric comorbidities, notably attention-deficit hyperactivity disorder, anxiety disorders, or obsessive–compulsive disorder. Habit Reversal Training (Azrin, 1973) is an evidenced-base therapy used to reduce tics and other compulsive behaviors. HRT has been expanded to include other cognitive-behavioral strategies, now described as *Comprehensive Behavioral Intervention for Tics (CBIT)*. *Chronic Health and Illness Recovery Program (CHIRP)* is an evidence-based invention for adolescents with chronic health conditions. While recent studies have concluded that CBIT is an efficacious treatment with enduring tic reduction and behavioral benefits (Scahill et al., 2013), and CHIRP demonstrates improvement in functioning in adolescents with chronic illness (Carter et al., 2013), a review of the literature suggests that few studies have explored significant differences in outcomes between treatment methodologies.

**OBJECTIVE:** An adolescent group was created utilizing core components from the CBIT and CHIRP treatment protocols. The purpose of the following study is to examine group intervention outcomes for adolescents with TD. Findings will provide guidance for better understanding regarding the individual and group intervention modalities on patient outcomes and satisfaction.

**METHODS:** Invitations for participation in the 4-week group were sent out to all CBIT graduates and current patients between the ages of 12-18. CHIRP group interventions were adapted to meet the needs of the adolescent TD population. Pre- and Post-group data for TD symptoms, CHIRP mastery, and standardized behavioral measures assessing often co-morbid psychological symptoms were collected from families during participants’ first and last sessions.

**RESULTS:** A total of 7 adolescents diagnosed with a Tic disorder or Tourette disorder participated in the intervention. Paired-samples t-tests were conducted to compare functioning at the start of treatment and at the end of the 4-week treatment. Findings suggest a significant difference with clinician’s report of the adolescents’ mastery of CHIRP variables for week 1 (M=28.00) and week 4 (M=78.00); t=-10.040, p=.001 and adolescent report for week 1 (M=51.50) to week 4 (M=68.00); t=-3.713, p=.034. Parent reported CHIRP did not significantly change over time. Adolescent report of common TD symptoms and comorbid diagnoses symptoms significantly changed from week 1 (M=77.50) to week 4 (M=53.00); t=5.99, p=.009. Anxiety scores significantly decreased over time (t=2.40, p=.074). Overall adolescent self-report of Quality of Life (t=2.60, p=.060) raw scores decreased from week 1 (M=38.60) to week 4 (M=28.60).

**CONCLUSIONS:** Parents and adolescents rated their satisfaction with Tic Talk at 5 o’clock as *Very Satisfied*. Adolescents reported a significant reduction in Tourette/Tic symptoms, and other frequently co-morbid psychological symptoms. Clinician and adolescent rating scales suggest adolescent comprehension of CHIRP concepts including interpersonal relationships, assertiveness, and thought-changing skills. Finally, the adolescents reported overall higher quality of life in areas such as physical, emotional, social, and school functioning. Overall, the small sample size of the discussed research limits statistical significance. Future research is needed to continue to assess the effectiveness of group verses individualized interventions for TD and investigate the social benefits of group interventions.
Increased Likelihood of Pediatric Recurrent Patellar Dislocations Based on Severity of Radiographic Measures


BACKGROUND: The etiology for recurrent patellar dislocations in children with patellofemoral instability (PFI) is not always clearly established. Radiographic measures help guide the clinician; however, there is paucity in the literature regarding “normal” and “pathologic” measures and the significance based on severity. There is also uncertainty regarding the parameters for pathologic instability.

OBJECTIVE: This study compares common imaging measures for PFI in two groups of pediatric patients, those with no known history of PFI and those with previous PFI events, to determine the likelihood of PFI based on the severity of each individual measure.

METHODS: An IRB-approved retrospective review of knee MRIs and radiographs at a single pediatric institution identified 108 limbs (102 patients) meeting inclusion criteria. Sixty-nine limbs had no known patellar pathology (control group) and 39 had surgery for recurrent patellar dislocations (surgical group). MRI measures included tibial tuberosity-trochlear groove distance (TT-TG), tibial tuberosity-posterior cruciate ligament distance (TT-PCL), and lateral trochlear inclination (LTI). Radiographic measures included the Caton-Deschamps Index (CDI) and Insall-Salvati Index (ISI). These measures are representative of PFI risk factors, specifically patellar tendon malalignment, trochlear dysplasia, and patella alta. Binomial logistic regression was used to relate the anatomical parameters to the probability of PFI.

RESULTS: The surgical and control groups were similar in terms of age, height and weight. The logistic regression analysis indicated that the TT-TG (p = 0.001) and LTI (p < 0.001) were correlated with PFI. The odds ratio (95% confidence interval) was 1.19 (1.07-1.31) for TT-TG, giving the increased probability of a knee to experience PFI for each 1 mm increase. The odds ratio was 0.85 (0.77-0.93) for LTI, showing a decrease in the probability of instability with each 1° increase. Neither CDI nor ISI measures significantly correlated with probability of PFI (p = 0.30 and p = 0.18, respectively). The TT-PCL measure resulted in no difference between the study groups (p=0.25). The two parameters of TT-TG and LTI accounted for 42% (Nagelkerke R²) of the variance between the control and surgical groups.

CONCLUSIONS: This study suggests that the likelihood of pediatric PFI is dependent on the severity of the abnormal imaging parameters, specifically those representing degree of patellar tendon alignment and trochlear dysplasia. Determining the risk of recurrent PFI based on an abnormal parameter for a specific anatomic pathology can lead to best practices regarding when to perform surgery and choice of surgical procedures that addresses the reason for instability.
Effects of Hypothyroidism on Articular Cartilage in Miniature Swine

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BACKGROUND: Articular cartilage is a highly specialized connective tissue composed of chondrocytes and extracellular matrix. Thyroid hormones, implicated in the growth and development of articular cartilage, have unknown effects on this tissue in a disease state such as hypothyroidism. Articular cartilage is difficult to obtain from growing children for research purposes, so a study of thyroid hormones and hypothyroidism lends itself to further investigation with an animal model. In this context, previous work established a defined hypothyroid condition in immature miniature swine. Similarities between swine and human proximal femoral anatomy were also suggested in the literature.

OBJECTIVE: The purpose of this study is to compare the proximal femur articular cartilage structure from hypothyroid-induced immature miniature swine to the same structure from normal control animals.

CLINICAL SIGNIFICANCE: If thyroid hormones alter immature articular cartilage, continued study may provide better understanding of cartilage growth and maturation and cartilage repair mechanisms.

METHODS: Two normal, 11-week-old, male Sinclair miniature swine were hypothyroid-induced by administration of 6-Propyl-2-thiouracil (PTU) in their drinking water; two animals identical in age and gender but without PTU served as controls. Proximal femurs from 25-week-old animals were studied by histology, immunohistochemistry (IHC), and histomorphometry. Histology (Safranin-O red staining) was used to identify proteoglycans in tissue sections, IHC assessed types II and X collagen, and histomorphometry measured articular cartilage mean tissue height and cell density. Nested mixed effects ANOVA examined histomorphometric data statistically with p ≤ 0.05 considered significant.

RESULTS: Compared to controls, hypothyroid articular cartilage had distinctly different proteoglycan and type II collagen staining patterns and intensities. Type X collagen was absent in hypothyroid and control articular cartilage but present in control physeal cartilage. On comparing hypothyroid articular cartilage to controls, a statistically significant increase was found in respective mean tissue height (2337.0 ± 132.8 µm vs 1076.1 ± 132.7 µm, p = 0.021) as well as a statistically significant decrease in respective mean cell density (27.6 ± 1.0 cells/cm² vs 31.0 ± 1.0 cells/cm², p = 0.016).

CONCLUSIONS: Hypothyroidism in immature miniature swine resulted in proteoglycan and type II collagen staining differences in articular cartilage compared to controls. Hypothyroidism also yielded statistically significant histomorphometric changes in articular cartilage mean tissue height and mean cell density compared to controls. Despite small (n = 2) sampling in this study, statistical considerations suggest analyses of additional numbers of animals would reproduce similar statistically significant differences in articular cartilage mean tissue height and mean cell density. Thus, the histomorphometric changes are important and compelling. Histomorphometric results and altered proteoglycan and type II collagen staining in hypothyroid compared to control specimens indicate delayed progression of development of articular cartilage in hypothyroid animals. These data support the concept that thyroid hormones are fundamental to articular cartilage growth and development. Understanding the role of thyroid hormones more completely in this animal model of hypothyroidism may provide greater insight into normal and pathological development of human articular cartilage.