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The Society for Pediatric Radiology
Founded in 1959

2020 SPR and SPR Research and Education Foundation Honoree Highlights

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Abstracts Scheduled to be Presented at the 63rd Annual Meeting & Postgraduate Course Presented in Collaboration with La Sociedad Latino Americana de Radiología Pediátrica

This supplement was not sponsored by outside commercial interests; it was funded entirely by the Society's own resources.

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SPR GENERAL INFORMATION

MISSION STATEMENT

The Society for Pediatric Radiology is dedicated to fostering excellence in pediatric health care through imaging and image-guided care.

DIVERSITY & INCLUSION STATEMENT

The Society for Pediatric Radiology actively promotes diversity and inclusion at all levels of training, practice and leadership for the benefit of our patients, our profession and for the Society as a whole.

SPR 2020 OVERVIEW AND UPDATE

The theme for the SPR 2020 Annual Meeting & Postgraduate Course was "Vision 20/20". The program was designed to provide participants with an improved understanding of the evolving technologies, techniques and applications of imaging evaluation in children.

In light of the World Health Organization's (WHO) declaration of COVID-19 as a pandemic and the guidance from the Centers for Disease Control and Prevention (CDC) to cancel in-person events consisting of 50 people or more, the SPR leadership made the difficult decision to cancel the SPR 2020 Annual Meeting & Postgraduate Course scheduled for May 9-15 in Miami, Florida.

We would like to thank everyone who has put a tremendous amount of time and effort into the planning of SPR 2020. We recognize that canceling the meeting impacts many, including our colleagues from La Sociedad Latino Americana de Radiología Pediátrica, whom we were looking forward to welcoming to Miami. SPR's Annual Meeting represents the largest single gathering of subspecialty pediatric imaging experts and serves as one of the main sources for your educational needs. To that end, the SPR staff will continue to collaborate with our estimeemed faculty to deliver some of the educational components planned for the live meeting in a virtual format. Other components will be postponed to a future meeting. Details will be posted on the SPR website as available.

We wish to both honor the efforts that paper and poster presenters have already contributed to their preparations for the meeting and also disseminate the highly valued educational content these presenations provide. All poster presentations and paper presentations converted to ePoster format will be posted on the SPR Poster Archive Website beginning June 1 and continuing for at least two years thereafter - https://pedrad.abstractarchives.com. Abstracts for all accepted paper and poster presentations are included in this supplement for your review and reference.

Additionally, so that we may honor our 2020 special honorees in person and highlight their contributions to the Society and field of pediatric radiology as is our annual tradition, the Awards Ceremony typically planned for the Annual Meeting will be rescheduled during the week of RSNA 2020. Details will be posted on the SPR website as available. We hope you will be able to join us in Chicago as we celebrate our colleagues highlighted in the pages to follow!

LOOKING FOR WAYS TO STAY CONNECTED WITH YOUR SPR COMMUNITY?

SPR XPress – Online Learning Center

Access the SPR XPress Online Learning Center to browse the catalog of on-demand educational offerings. FREE content, with open access is available to both members and non-members. SPR members receive a discount on materials for purchase. Visit https://myedu.pedrad.org.

SPR XChange – Member Community

The SPR XChange is a dynamic community designed and built just for SPR members. It's the perfect place to exchange knowledge, access resources, develop ideas and network with your colleagues. Visit https://xchange.pedrad.org.

Keep an eye on the SPR website and social media feeds for upcoming meetings and member notices - www.pedrad.org | @socpedrad.

SPR 2020 HONOREES

SPR 2020 GOLD MEDALIST

The Gold Medal of The Society for Pediatric Radiology is our most distinguished honor. The SPR Gold Medal is awarded to pediatric radiologists who have contributed greatly to the SPR and our subspecialty of pediatric radiology as a scientist, teacher, personal mentor and leader.

Richard A. Barth, MD, FACR, FAAP

It is my honor to present the SPR 2020 Gold Medal to Dr. Richard A. Barth, a standout even among the most notable of SPR members.

So how does one achieve such an illustrious career? Let's see what path he took.

As his wife, Lori, relates, Richard's parents were both immigrants – his mother, Vera, from Hungary, was a stay at home mother and an active volunteer in the Jewish community. She was an amazing gourmet cook and had a hot lunch ready for Richard and his brother every day. They would come home from school and were treated to her amazing Hungarian cooking. His father, Sandy, from Poland was a self-made man who started working with his uncle as a butcher and grocer. He eventually became a real estate investor and owned many types of properties from gas stations to apartment buildings and hotels. Later in life, when both parents were unhealthy, the family remembers the extra meaningful effort Rich took in ensuring that they had good medical care. Rich learned the fine art of negotiation from him – a skill that he has used in his work as an SPR leader.

The family lived in Youngstown, Ohio when Dr. Barth was born. When it was time for Rich to go to college, they wanted to keep him close so he was told he could go anywhere he wanted for college in the ENTIRE state of Ohio – hence his choice of Case Western Reserve! It was there that he met his friend now of over 50 years, Arnie Bressler, becoming fraternity brothers and rooming together. They continue to go to Boston YMCA Sandy Island family camp with their families every summer. Arnie describes Rich as his best friend, the relationship maintained even though Arnie lives in New York and Rich in California. Rich has a brother, Ken, with whom he is very close.

Charles Gooding, a mentor for Rich during radiology residency at UCSF, said Rich was so smart and had an extensive fund of knowledge, far ahead of his peers. Perhaps, more importantly, Rich was a true gentleman, a kind and considerate man, who manifested a wonderful sense of humor as a wry smile would cross his face and his eyes would twinkle. Rich's resident and fellowmate Lee Harvey relates a story about Rich's calm demeanor. He shipped all their belongings for fellowship from San Francisco to Boston including his Ford Pinto car in a truck. During transport the car shifted and damaged much of his goods. Even with the "revenge of the Pinto", Rich just smiled and handled it with a twinkle in his eye!

Dr. Barth met his wife Lori at a dance while Rich was doing his fellowship at Boston Children's. She was drawn to his intelligence, motivation, charisma, sense of humor-she basically loved everything about him. They moved to Burlington where Dr. Barth worked for 10 years at the University of Vermont Department of Radiology.

While in residency at UCSF Radiology he became friends with another radiology resident Gary Glazer. Gary's father, Norman, a well-known pediatric radiologist, influenced Richard to become a pediatric radiologist. Gary became the Chair of Radiology at Stanford and recruited Rich to work with him and help build the department at Stanford. Rich took on the job as head of pediatric radiology at LPCH at a time when there were only three or four radiologists. He wrote a detailed development program with sub-specialization and the hospital accepted. Since then he has methodically shepherded the development of the department to be a clinical and research powerhouse, recruiting an astonishing faculty including Lane Donnelly, Beverley Newman, David Larson, Helen Nadel, and Don Frush among others. Beverley remembers walking with Rich during the SPR 2005 meeting I ran in New Orleans. On a walk/dance/songfest from the hotel to the river view venue, Rich took the opportunity to tell Beverley his need for senior faculty. Beverley arrived at Stanford in July 2006, wrapping up her successful recruitment. Beverley said Rich is a terrific, dedicated pediatric radiologist and colleague, generous friend, thoughtful and trustworthy chief with exceptional negotiating skills, unwavering ethics and mischievous humor.

Another example of Dr. Barth's unparalleled ability as a faculty recruiter is needed. As Professor Hans Ringertz said, Rich contacted him in 2002 through Gary Glazer to come and work at Stanford. Hans informed him that he could come on a sabbatical starting 2004. Rich jumped on a plane and came to the ECR meeting in Vienna to convince him to come 2003. Hans said no because he had something important to do all of 2003. Rich asked him what could be more important and rewarding than to come and work at LPCH and Stanford. His answer was that he had been the vice chairman of the Nobel Assembly for Medicine and Physiology in 2002 and had to chair it for all of 2003. Hans indeed came to Stanford in 2004 as Rich requested only after he finished his Nobel responsibilities! This was, apparently, the only time in all of Rich's negotiations he had to back down – temporarily!

Dr. Barth has all the characteristics of a wonderful leader that you hear when you talk to colleagues, trainees and friends. Multiple consistent themes emerge. He is a leader who needs no self-accolades. He is likeable, self-effacing, easy-going, and a good listener. He is always available, treats everyone with respect, and creates an atmosphere without hierarchy. He has a talent for finding common ground while working with disparate peoples' interest, and is a wonderful negotiator without being coercive. These characteristics have led him to multiple leadership positions and awards. These include Past President and Chairman of the Board of the Society for Pediatric Radiology and the recipient of the SPR Presidential Recognition Award. He is past president of the Society of Chiefs of Radiology at Children's Hospitals (SCORCH). He is currently Treasurer of the World Federation of Pediatric Imaging so his influence and reach to better pediatric healthcare crosses the globe.

He was chosen outstanding alumnus UCSF Department of Radiology, LPCH Executive Committee, and many other leadership positions of recognition at LPCH and Stanford University. With his exceptional personal skills he has achieved acquisitions for the department that were greatly needed and appreciated, proving, once and for all, nice people can finish first.

Dr. Barth has had major accomplishments in areas most pediatric radiologists would not know or understand, working behind the scenes has been his typical modus operandi. For example, Dr. Barth realized that the US News and World Report survey of children's hospitals did not have radiology input. So he was appointed Chair of the US News Best Children's Hospitals Radiology Steering Committee. He has been able to embed radiology information throughout the survey so that pediatric radiology has influence over the ranking process. He understands that you cannot have an outstanding Children's Hospital without having an outstanding radiology department, and we should be thankful for his work in this regard.

Dr. Barth is an outstanding teacher, teaching undergraduates and lecturing medical students at Stanford University, receiving the Teaching Award from the Department of Obstetrics and Gynecology at Stanford University. This attests to his interest and expertise in fetal imaging and ultrasound in particular.

Dr. Newman mentioned Dr. Barth's commitment to research, with his wonderful talent for facilitating research for others. Lucile Packard Children's Hospital has evolved from a community hospital to a research powerhouse, now one of the dominant departments seen at the annual SPR meeting, standing toe to toe with the best nationally and internationally. He has published over 80 scientific articles, 6 book chapters, received 13 grant awards, and over 220 invited lectures and scientific abstracts.

Furthermore, Dr. Barth has given his time and considerable talents for many years to the American College of Radiology. He is currently the Chair of the ACR Commission on Pediatric Radiology, having previously served on the ACR Commission on Economics and Government Relations. He is very proud that he helped push the abusive head trauma resolution that was recognized by the entire ACR membership. Dr. Frush says that among so many of his accomplishments, his role in advocacy for pediatric radiology through the ACR and lobbying for pediatric interests, be they academic or clinical, sets him apart from other leaders he knows. Dr. Barth rates his advocacy as one contribution he is most proud of, another is setting up a collaboration between Stanford and Fugan Children's Hospital in Shanghai, China. Because of the high volumes of pathology-biliary atresia as a first example-and high quality of medicine practiced there, we will see in the future wonderful new scientific information generated from this bi-institutional cross the pacific collaboration.

Somehow Dr. Barth has found time for a rich personal life and outside interests. People reach out to him who are friends, friends of friends, family, friends of family, neighbors, co-workers, etc… and he is always happy to help in any way he can, giving his medical advice and reaching out into his network to make sure they get the best care as anyone could hope for. Lori says Rich is as good a father as one can possibly be. He is very proud of their kids, his son-in-law and his daughter-in-law. Kids are Amy (and Kevin Blum) and grandson, Micah, who will be 2 in May. Amy is a freelance writer/editor and Kevin is a trademark lawyer for NBC Universal. They live in LA. Dave and Emily (Selwyn) and grandson Jackson Barth who will be 8 months in May. Dave is the Founder and CEO of Run for Fun camps in Palo Alto and Emily is a school teacher. Amy related how often her dad "saves the day" when family problems arise. When Rich's favorite appetizer, mini hot dogs, were not available for her wedding party, Rich assembled them, delivered them on the subway, brought a toaster oven and served them at her party! Outside interests include hiking (they had some interesting experiences at Yosemite with run-ins with bears, snakes, and mountain lion), tennis, skiing, traveling, and being with family. Oh, and let's not forget football. He'll watch anything, but is passionate about Ohio State University and the San Francisco 49ers. The Ohio State fight song is his cellphone ringtone, so everyone gets to hear it often!

So how has Dr. Barth achieved all this? He is a superb leader who brings together collaborators in academia and organizations, all with no regard for his own aggrandizement. The twinkle in his eyes says it all.

I know of no more deserving person to receive the highest honor the Society for Pediatric Radiology can bestow. Thank you, Rich, for your tireless and continuing work for children's healthcare and pediatric radiology and for your personal friendship!

Stuart A. Royal, MD, FACR

SPR 2020 GOLD MEDALIST

Bruce R. Parker, MD, FACR

"A man should keep his little brain attic stocked with all the furniture that he is likely to use, and the rest he can put away in the lumber-room of his library where he can get it if he wants." – Sherlock Holmes

Arthur Conan Doyle, "The Five Orange Pips", (1891)

Bruce Robert Parker, a native of Detroit, graduate of Harvard College (Magma Cum Laude in History of Science) and Harvard Medical School, Radiology resident of Columbia-Presbyterian Medical Center, a Captain in the United States Air Force, past President of SPR (2001-2002), and Professor Emeritus of Radiology at Stanford University and Baylor College of Medicine, is our 2020 SPR Gold Medalist!!

As a radiology resident in New York, Bruce was greatly inspired by Dr. David Baker and Dr. Walter Berdon at the Babies Hospital during his 4-month period of pediatric radiology rotation. He observed that not only were they outstanding radiologists, Dr. Baker and Dr. Berdon demonstrated the critical ability of interacting with the clinicians. They relished their roles as consultants for the pediatricians and pediatric sub-specialists; they were greatly appreciated by all the medical staff. Pediatric Radiologists were part of the team taking care of the pediatric patients.

Shortly after completion of his residency and fulfilling his commitments to the US Air Force, Bruce joined the faculty of the Department of Radiology at Stanford University and started his illustrious career in Pediatric Radiology at the Children's Hospital at Stanford (1969 - 1991) and then at Lucile Packard Children's Hospital (1991 - 1994). Bruce will tell you that it is his extreme good fortune to have had the opportunity to work and partner with Dr. William Northway for over 25 years at Stanford, establishing the excellent section of Pediatric Radiology at Stanford. In his words, "my colleague, partner, and friend during the whole 25 years was Bill Northway, himself a Gold Medal awardee of the SPR. Bill and I never had a serious disagreement in the whole of our relationship, certainly an unusual professional and personal experience. With Bill's dedication to research and my primary interest in clinical radiology, our symbiotic relationship worked wonderfully for two and a half decades." Indeed, Bruce was most interested in providing first-class clinical service and was the Chief of Radiology Service of Children's Hospital at Stanford and Lucile Packard Children's Hospital (1973 - 1994).

While at Stanford University, besides practicing Pediatric Radiology, Bruce was most interested in the education and the development of the undergraduate and medical students. Teaching, mentoring, and shaping the education of the young students and trainees has been one of the highlights of his career. He was on the Committee on Undergraduate Studies (1981-1984; Chairman, 1983-1984) and also on the President's Undergraduate Council (1983-1984). His involvement in the Undergraduates Studies program was one of the most challenging times during his career at Stanford, wrestling with important and conflicting racial issues among the undergraduates. Despite his busy clinical work schedule, Bruce carved out time to be an advisor to pre-medical undergraduate students. He is very proud of the fact that four of his undergraduate advisees became pediatric radiologists and one of them is the current Chair of the Board of Directors of SPR! Bruce also exerted his influence the education at the Medical School. He chaired the Committee on Courses and Curriculum for 4 years and was also on the Committee on the Well-Being of the Medical Students. In the Radiology Department, many radiology residents benefited from his knowledge and wisdom and his no-nonsense way of handling day-to-day clinical problems. Several of his residents chose to follow his footsteps and are current active members of SPR!

Bruce is a builder of programs and enjoys strategic planning with always the ultimate goal of achieving the best patient care for the pediatric patients with the latest technology and most optimal staffing, not just radiologists, but also technologists, and administrative staff. He was instrumental in the planning of the Lucile Packard Children's Hospital (LPCH) which opened its doors in 1991. In 1994, Bruce was persuaded by Dr. Edward Singleton, past SPR President (1964-1965) and Dr. Milton Wagner of Houston to leave the department at LPCH, which he helped to design and build, and lead the Edward B. Singleton Department of Diagnostic Imaging at Texas Children's Hospital (TCH), then the largest stand-alone children's hospitals in the nation. Bruce succeeded Ed Singleton as the 2nd Head of the department in the history of TCH. He convinced and secured commitment from TCH administration and completed the very first totally filmless department in a pediatric institution in 1999-2000. This included an IT/PACS administrative group housed within the

Diagnostic Imaging Department - a key to success. Between 1994 and 2004, Bruce transformed the department from a 5-person department to an 18-person group (16 radiologists and 2 medical physicists); this expansion provided for the referral physicians and TCH enterprise the needed sub-specialization of imaging services in neuroradiology, interventional radiology, fetal imaging, cardiovascular imaging, and advanced body imaging. His work laid the groundwork for the development of what is now one of the top departments of pediatric radiology for clinical practice, research, and training. It is truly fitting that Bruce has been bestowed Emeritus Professorships at both Stanford University School of Medicine and Baylor College of Medicine. Through his tremendous contributions to the foundations of both departments at LPCH and TCH, Bruce has directly and indirectly enhanced the training and professional and academic development of numerous pediatric radiologists.

Bruce credits his good friend, Dr. Tom Slovis, past SPR President (1999-2000), for encouraging him to become active in the administration of the Society. Bruce disclosed that "whatever accomplishments I had in these roles was largely the work of Ms. Jennifer Boylan (then the Executive Director of SPR) who is far more deserving of her Gold Medal than I am of mine." During his years on the Board, he helped in organizing and securing the finances of the Society and cultivated an amicable relationship with the ESPR. In his usual quiet but assertive manner and always strategizing, Bruce directed efforts in SPR towards education for the SPR membership. Under his leadership and the support of the Board of SPR, the 1st SPR Cardiac MR Basic Course was started in 2002 and jointly organized by Texas Children's Hospital and The Hospital for Sick Children in Toronto. Aside from the CT-ALARA Course (2001), this was the very first comprehensive sub-specialty educational course offered by SPR for its membership. Several years later, the Board of SPR initiated regularly scheduled weekend educational courses, as we now come to expect twice a year.

As for all his successes of his long career, Bruce credits the unwavering support from his spouse of 60 years, Nan, and his sons, Brett (Director of non-profit social services program for homeless clients) and Jason (Jazz musician and educator). In his words: "I suppose it's a cliché to give credit to one's spouse, partner, and children, but clichés exist because they almost always speak to truth. In my case the support of my wife, Nan, and our two sons was key to my professional life as well as my personal one. 'No man (or woman) is an island[1]'." Bruce is a die-hard Detroit Tigers fan, a long-time loyal viewer of the annual Harvard-Yale football games no matter how bad they are, a distinguished, tall, red-hair gentleman who adores well-tailored English suits, well-made leather shoes, and stylish sun-glasses; he cherishes fine wine and gourmet cuisine but also enjoys good peanut butter; he is an avid reader and serious collector of British Spy Fiction along with a very special interest in tales of Sherlock Holmes by Sir Arthur Conan Doyle…Bruce is a "Sherlockian" (Sherlockians believe that Holmes is alive as there has never been an obituary printed for Holmes in Times of London…surely he has to be alive then!!) and belongs to the Baker Street Irregulars (BSI) and the Sherlock Holmes Society of London; he attends the annual BSI Sherlock Holmes birthday party in New York…perhaps more often than the annual meetings of SPR!! He even taught an undergraduate Freshman Seminar: "The History of British Detective and Espionage Fiction" at the Stanford Overseas Campus in Oxford, an incredibly rewarding experience for Bruce. Perhaps to Bruce, the approach to the interpretation of an imaging study is "elementary[2]…when you have eliminated the impossible, whatever remains, however improbable, must be the truth?[3]"

Above all, Bruce's most favorite thing in his life is his family:
His dearest beloved wife, Nan Scholnick Parker; his older son: Brett Reid Parker and his wife, Paula Walters Parker, and two grandchildren, Bayard Reuben Parker and Lenore Bulah Josephine Parker; his younger son, Jason Todd Parker and his wife, Darrah Barth Parker, and two grandchildren, Sadie Rose Parker and Hannah Madeline Parker.

Taylor Chung, MD, FAAP

SPR 2020 PIONEER AWARD

Pioneer Honorees were first acknowledged in 1990 as a means to honor certain physicians who made special contributions to theearly development of our specialty. The Pioneer Award now honors individuals who have advanced pediatric radiology through innovation, forethought and leadership.

Steven Don, MD

Steven Don M.D. has earned The Society for Pediatric Radiology's 2020 Pioneer Award for his innovative work in the development of digital radiography and digital imaging. I first met Steve twenty-seven years ago when I was President of The SPR. Steve's presentations of his early research into computers and their interactions with radiographs brought him to my attention. I am proud to have successfully recruited him to the Mallinckrodt Institute of Radiology and am honored to present him this year's Pioneer Award.

Steve was raised in Chicago by the late Richard Don and Arlene Don. His father, a businessman with an enthusiasm and involvement in early computer development, sparked Steve's interest in technology. Steve graduated from Johns Hopkins University and Vanderbilt University School of Medicine. After completion of a Pediatrics Internship at the University of Minnesota School of Medicine, Steve continued his training at Indiana University School of Medicine serving as a Radiology Resident, a Pediatric Radiology Fellow and an Assistant Professor under the leadership of Eugene C. Klatte M.D., a Founding Member of the Society for Pediatric Radiology. Steve's research began by developing animal models to simulate neonatal chest disease and studying the effects of dose reduction on observer performance in Computed Radiography. He then developed a neonatal chest phantom, now sold by Gammex-RMI, that is an industry standard. These projects were supported by The SPR, RSNA, and NIH Small Business Technology Transfer grants. For this early work Steve earned the Caffey award two times and the Silver Award for his research before the Caffey award was split into basic science and clinical awards.

Ruth M. Holdener, RT(R), (CT), (M) Senior Research Coordinator, Washington University School of Medicine notes "I have worked with Steve for over 18 years on several pediatric studies. I have the utmost respect for him. He takes his research very seriously and is very involved in its protocols. I have worked with him on several studies where the main purpose is to reduce the dose, especially in the neonatal patients. He has a great working relationship with the radiologists that are collaborating with him and with the other researchers and programmers inside and outside of Washington University."

Steve's innovative research concepts have resulted in the award of two patents. His research in digital radiography led to his first patent on image simulation of low-dose digital radiographs. Carestream purchased this product.

David Foos, Senior Director of Research and Development, Carestream Health adds "It has been a privilege to have had the opportunity to work collaboratively with Dr. Steve Don for more than 20 years. Steve has truly been a leader in the field of pediatric radiology, and one of the pioneers of the Image Gently movement. Steve and I have collaborated on numerous dose reduction-related digital radiography projects. These projects have all been relevant to dose reduction initiatives for the radiographic imaging of children and have largely focused on the neonatal ICU patient population. An important common denominator among these studies was to approach dose efficiency optimization from the perspective of physics first-principles. In all of our collaborative activities, Dr. Don was the principle investigator, and key driver in identifying and driving the clinical focus for the work. It has been a pleasure for me to have had the chance to work with Steve, and I look forward to continuing to work together in the critically important pediatric clinical application."

Steve's research led to national recognition in radiology. He co-chaired the Image Gently CR/DR Committee and served on the Steering Committee of Image Gently. He co-chaired the Back-To-Basics CR/DR Campaign. He received the FDA Leveraging/Collaboration Award for his collaborative work in dose reduction.

In 2010, Steve co-chaired the Image Gently Pediatric Digital Radiography Summit that culminated in acceptance of the international exposure standard. In this summit he negotiated an agreement among vendors, the Medical Imaging and Technology Alliance (MITA),

the International Electrotechnical Commission, the American Association of Physicists in Medicine, and the Food and Drug Administration to establish a single, world-wide exposure terminology for digital radiography.

Bruce Apgar, Chairman CRDR Workgroup - X-Ray Section MITA and the Agfa Corporation Global Application Lead - Imaging elucidates "Dr. Don recognized the advantages of Computed Radiography (CR) and Digital Radiography (DR) for pediatric applications, but also the potential pitfalls in terms of dose and image quality if not utilized correctly. To address those concerns, he spent much of his career developing tools and providing knowledge on DR to assist radiologists, physicists and technologists while encouraging manufacturers to do so as well. Steve developed a unique and now widely used neonatal chest phantom that enables users to easily evaluate the effect of dose on image quality and optimize exposure techniques. Dr. Don recognized the need for exposure standardization in digital radiography and in 2010 at a Digital Radiography summit organized by Steve, the Medical Industry and Technology Alliance (MITA) agreed to adopt a new standard for all new CR and DR products. The impetus to develop the new standard and the implementation of it were a direct result of Steve's efforts."

Steve serves as a Section Editor of Physics and Radiation Dose for Pediatric Radiology. He writes the periodic column on "Exposure". Peter Strouse, MD, Editor-in-Chief of Pediatric Radiology, and Chief of Pediatric Radiology, CS Mott Children's Hospital commented "Steve is one of the smartest people in our profession. His understanding of radiation exposure and dose and how to manage it is amazing. He has been a terrific supporter of Pediatric Radiology (the journal) in this realm as a guest editor, author and reviewer. I am also grateful for his authorship of "Exposure", a feature with a bibliography of some key articles in other publications on radiation-related issues of interest to our readers."

Steve mentored two doctoral candidates. The first candidate's research on Machine Learning won an award for one of the 5 best Machine Learning papers in 2008. The second candidate participated in a study in which Steven is a co-investigator on an RO1 grant on CT Observer Performance.

Besides mentoring doctoral candidates, Steve has educated others on the issues of image quality and dose reduction. His practicums for residents, student technologists and technologists on fluoroscopy and dose reduction are highly received. He is a member of the Advisory Committee of the Radiologic Technology Program of St. Louis Community College at Forest Park.

Steve is also a dedicated clinician. His colleague, Thomas Herman, MD, Associate Professor of Radiology, Mallinckrodt Institute of Radiology feels "Steve has always been most eager to consider new approaches to things, and always eager to discuss complex cases."

Steve and his wife Elizabeth, a Fine Art Appraiser, have been married for thirty-three years. Together they raised two children: Robert, an Audio Professional based in New York city and Emily Rose, a graduate student pursuing her master's degree in Experience Design. Steve's children shared with me "Dad is a passionate and engaged researcher. We are very proud of his dedication and have immense respect for the integrity with which he approaches his work."

Steve also finds time to enjoy his hobbies. He is an instrument rated pilot, earning his wings while in college. He flies gliders too. One day he hopes to build his own airplane.

Never at a loss for projects, Steve is now working on a new observer performance metric for CT. He currently Chairs the American College of Radiology Dose Index Registry for Digital Radiography.

He recently was awarded his second patent in computer vision and augmented reality. The device improves the workflow for technologists, while reducing repeat images and optimizing dose. He co-founded a company to develop this invention into a marketable product. This innovation is the culmination of Steve's research and clinical experience. Perhaps his research colleague for the last 27 years at Mallinckrodt, Charles HIldebolt, Emeritus Professor of Radiology Washington University School of Medicine, DDS, PhD, Fellow of the American Association for the Advancement of Science, Fellowship in the American Academy of Oral and Maxillofacial Radiology summarizes his achievements best: "Steve Don is an outstanding scientific researcher who has advanced and continues to advance scientific knowledge performing clinically meaningful research that has had positive impacts on pediatric radiology, including the comparison of computed radiography with film-screen radiography in models that simulate neonates and projects devoted to reducing exposures in neonates. His research in digital imaging includes workstation design, implementation of picture archiving and communication systems (PACS), and image distribution. Dr. Don is in the process of developing a novel device that incorporates a color video and depth camera with proprietary software that will automatically measure patient thickness, set exposure parameters, and detect errors in positioning and motion before the patient is exposed, with the goal being to reduce exposures resulting from computed and digital radiography. His current research is cutting edge and will have a positive impact upon how pediatric radiology is performed."

On a personal note Steve is an awesome radiologist. He continues to excel in clinical care. I never cease to be amazed at his ability to juggle his clinical and research work along with mentoring and teaching. Dr. Don's tireless efforts to improve the imaging care of children encompass all the ideals of the Pioneer Award and make him a most deserving recipient. We all thank you Steve.

William H. McAlister, MD, FACR

SPR 2020 SINGLETON-TAYBI AWARD

The Edward B. Singleton-Hooshang Taybi Award is given in honor of Edward B. Singleton and Hooshang Taybi, in recognition of their personal commitment to the educational goals of the SPR. Initiated in 2006, the award is presented annually to a senior member of the SPR whose professional lifetime dedication to the education of medical students, residents, fellows, and colleagues has brought honor to him/her and to the discipline of pediatric radiology.

Alan Oestreich, MD, FACR

Polymath – "A person of much or varied learning; one acquainted with various subjects of study."
Oxford English Dictionary, 2nd edition 1989

This award recognizes the awardee, the two luminaries it celebrates, and thereby SPR's rich history. Alan Oestreich, an interesting man with many interests, has written for and taught students, residents, fellows and colleagues about entities common and esoteric. Alan describes his career teaching specialty as "plain radiographs, a topic often downgraded in the world of cross-sectional imaging, but still very important." Indeed, much can be learned from plain radiography through careful observation, deduction, induction, and curiosity: skills for which SPR's greats were legendary.

Alan is independent, smart and most importantly curious. Born in New York City to radiologist parents, he graduated magna cum laude in Mathematics from Princeton University after having written two theses (Junior and Senior years) on Markov chains: "Convergency Properties of Finite Markov Chains," and "Markovian Operators on n by n Matrices." (yeah, look that up). He was elected to Phi Beta Kappa at Princeton and later to Sigma Xi.

Johns Hopkins University School of Medicine awarded Alan his MD in 1965 which was followed by radiology residency at the University of Rochester (NY) Strong Memorial Hospital and 2 years military service at the U.S. Army Hospital at Fort Polk, Louisiana. Alan's early interests and publications involved computer aided diagnosis, including bone age determination, likely stemming from his mathematics background. Later publications included ones which addressed musculoskeletal radiology, child abuse, bone growth, responses, and findings following prior physeal stress and injury, the danger of ingested magnets, and many other topics including several regarding Radiology history and Radiologists of Color.

Alan has had a career long interest in International Radiology, belonging to Gesellschaft für Pädiatrische Radiologie and holding Honorary Memberships in the ESPR, SIRMN (Italian Radiology Society) and The Hungarian Radiology Society.

Alan reads and/or speaks some German, French, Spanish, Hungarian, and a tiny bit of Uzbek. It follows that many of us were introduced to Alan in issues of Radiology as its Foreign Book Review Editor 1984-1997. The many international publishing, editorial, and advisory boards on which he has served or still serves include French, German, European, and Hungarian journals.

Alan's international and civil rights interests might have been rooted in his childhood. His mother was the first Jewish woman to be accepted into the medical school in Vienna, Austria where she met his father, a classmate. After graduation they fled to the United States, escaping the rise of the Nazis in Austria and Europe. Later on, after experiencing discrimination in New York City, his parents moved to Buffalo, N. Y. where they had a successful radiology practice. Alan grew up in an internationally influenced home with frequent visits by a diverse group of his parents' friends. These experiences not only swayed him towards the field of radiology, but also gave him a compassion for civil rights.

In the fight for civil rights some marched, some fought, and others were thrown in jail. Alan played a silent, but very significant role through his dedication to the education of Radiologists of Color. During his years at the University of Rochester, he would often drive to Meharry Medical School in Nashville where he volunteered to teach residents, pediatricians, and dentists in the radiology department. Years later, as one of his fellows, he encouraged me (KG) to work on projects and give scientific presentations at various radiology meetings. One such conference was at the National Medical Association (NMA), Section on Radiology, where Alan was elected as the

first and only white chairman following his many years of service and commitment to the section and to the education of radiologists and other physicians of color. That honor became one of the proudest moments for this modest and humble man.

Between 1991 to 1996 the National Medical Association Section on Radiology awarded Alan the Outstanding Achievement Award, the Distinguished Service Award, and named him the Centennial Hartman Orator. One of the many books he authored was written in honor of members of the Section on Radiology of the NMA, A Centennial History of African Americans in Radiology.

Alan served as Pediatric Section Editor, 2001-2012 Year Book of Diagnostic Radiology (Mosby, St. Louis). Yearbook editors performed the educational role of selecting, summarizing, and commenting on the most important pediatric radiology papers of the year.

Teaching became the focus and passion of Alan's career in radiology, largely due to inspiration from Dr. Lionel Young (SPR President 1984-85) whom Alan met during his residency at the University of Rochester. Lionel not only sparked Alan's interest in pediatric radiology, but also helped plant a fascination in teaching which still resides in Alan today. Alan's enthusiasm for teaching accompanies a knack for making radiology fun and interesting for medical students and residents. His first academic job was at the University of Missouri-Columbia radiology department where he instituted "guerilla radiology" for first year medical students. Alan would pop up at unexpected times carrying films and ask students to point out findings. He was selected as one of the students' "Giants of Medicine" multiple years in a row. While on staff at Cincinnati Children's Hospital, he would drive to Lexington, KY to read images, to teach, and to initiate the participation of radiologists in child abuse team discussions. He instituted interactive introductory conferences for new radiology residents in the form of the "T meetings" ("T" is for Teaching), in the spirit of those sessions by legendary U of Cincinnati Radiologist and Teacher, Dr. Ben Felson. Alan continues today to teach medical students and residents in informal small group sessions.

Almost 4 decades ago Alan introduced SPR to its first logo, a clever design by Tamar, his artist, dancer, and fellow world traveler wife of 47 years. This logo served SPR many years and was replaced by the current one only a few years ago. Tamar has illustrated some of Alan's radiology books, and when they lived in Missouri she illustrated a privately printed small booklet of Alan's poems, "Hour Images." Tamar and Alan have one son, Michael, a long time geologist with the National Park Service.

Alan's many interests outside radiology include languages (especially English and German), poetry, music (he plays the piano), dance (he does jazzercise with his wife), reading (history, history of radiology), stamp collecting, and comic books collecting.

KG writes: Alan reminds me of the "absent minded professor" in his mannerisms, dress, and demeanor (oh, that bowtie!). But that couldn't be further from the truth. He is brilliant, multifaceted, and a very giving individual, giving of his time, his talent, his wit. He has a dry sense of humor that few understand, but those of us who do "get" him enjoy a very rich and intellectually stimulating relationship. I am a better pediatric radiologist because of Alan Oestreich who took me under his wing, mentored me and made sure I rose to my greatest potential.

And for that I will be forever grateful!

Kathy Garrett, MD
Michael DiPietro, MD

The SPR also graciously acknowledges the contribution of Tamar Kahane Oestreich who designed the first official logo of the Society in 1985. The logo proudly represented the Society until August of 2013 when the new logo was unveiled. Thank you, Mrs. Oestreich.

SPR 2020 PRESIDENTIAL RECOGNITION AWARD

The Society bestows Presidential Recognition Awards on members or other individuals whose energy and creativity have made a significant impact on the work of the Society and its service to its members.

Beth Marie Kline-Fath, MD, FAIUM

The Presidential Recognition Award for 2020 is given, with great admiration and utmost respect, to Beth Kline-Fath, MD for her dedication and life-long contributions to the development and advancement of the subspecialty of fetal imaging.

Fetal imaging, of course, has been fundamental to prenatal diagnosis since the latter half of the 20th century with the standard use of ultrasound, introduced in the US as routine in obstetric care in the 1980's. MRI as an adjunct investigatory and diagnostic tool, however, was used only very selectively by a variety of subspecialists at certain quaternary care centers until about two decades ago; since then, in a relatively short time, fetal MR has become a standard and critical part of the work-up of complex fetal anomalies by pediatric radiologists, highly valued for their contributions to best fetal and family care, and in large measure we owe that transformation in North America to such champions as Beth.

As so often happens, when Beth began her career she could not have foreseen the path it would take. Although born, raised, educated and married (to her college sweetheart) in Ohio, her first position as a general pediatric radiologist was in St. Petersburg, Florida, where she and Tom moved with their two young daughters. At the time there was no MRI service at the institution, so Beth started one, training physicians and technologists and developing the protocols, including for neuro, body and musculoskeletal applications. Family support can be critical with small children and full-time jobs; Beth and Tom returned to Dayton, and Beth relocated to the Children's Medical Center. She loved the work, and the people, and was particularly devoted to the MRI service, for which she developed a cardiac MRI program, introduced high level neuro techniques and read the occasional fetal MRI, to which she felt she could add tremendous value. It was frustrating to know that she might add even more value with a broader knowledge of and background in neuroradiology. This passion led to a second Fellowship at Cincinnati Children's, where she had trained as a Fellow in pediatrics, a position on the faculty, and an introduction to the nascent fetal surgical service at CCHMC, led by Tim Crombleholme, who had recently been recruited from CHOP. Fate hands us opportunities; we take them, or we don't. In that first year, conjoined twins were born to Beth's brother and sister-in-law, and the experience committed Beth to ensuring that every family who wanted accurate knowledge and the chance to prepare for a difficult transition should be able to have it. On her own, she established, developed and expanded a fetal imaging service at CCHMC that incorporated MR and used all of her pediatric and neuroimaging skills to full advantage. From Dr. Crombleholme: "Beth's commitment to Fetal Imaging as a distinct subspecialty was a major factor in the success of the Fetal Care Center of Cincinnati's becoming a national leader in prenatal diagnosis and fetal surgery. Beth…is inspiring to work with".

Out of the tremendous experience that Beth gained, and because she is intellectually curious, hard-working, devoted to her patients and generous, came hundreds of peer-reviewed publications and scientific presentations, invitations to speak at multiple international conferences, Visiting Professorships at prestigious medical centers, and an offer to reorganize, update and revise a classic text in fetal imaging, Diagnostic Ultrasound of Fetal Anomalies, edited by Nyberg, McGahan, Pretorius and Pilu. Now named Fundamental and Advanced Fetal Imaging, with a second edition due this year and co-edited with SPR Gold Medalist Dorothy Bulas, MD and AIUM Holmes Pioneer Award winner Wesley Lee, MD, this text immediately became the most important reference for fetal imagers synergistically combining US and MRI for comprehensive imaging diagnosis. It is a marvelous achievement, with all of Beth's hallmark insistence on clarity and consistency, and infused with her love of embryology. Beth had again set the standard from which we could all offer the best to our patients.

It is a great tribute to Beth's skills as a teacher and communicator, and to her unflagging enthusiasm, that she has influenced many of the Fellows from Cincinnati's superb program to take up and promote fetal imaging as they have traveled out to become the next generation of pediatric radiologists. Many others have traveled in to CCHMC to get additional training specifically with Beth. In effect, she has directly trained most of the professionals responsible for interpreting fetal MR in the US, and if we include all of the meetings, courses and special events Beth has attended by popular demand, she has taught us all. On behalf of our smallest patients and their families, we owe a great debt of gratitude for her intelligence and her compassion, and her sharing both so generously.

For the SPR, Beth has been no less selfless. As Chair of the Fetal and Neonatal Committees she doggedly pursued the establishment of reimbursement coding for fetal MR on a national level that would appropriately recognize the time involved in best fetal practice. She has served on the Nominations Committee, the Public Policy Committee, and the Board of Directors. She has won both a Caffey Award (2011) and a Slovis Award (2013) for best basic science paper published in Pediatric Radiology, on which she is an Editorial Board member. Beth has helped guide what has been a biannual SPR Fetal Imaging course since 2011. I hope she will continue to influence the SPR along her model of positive change to benefit families for the foreseeable future.

Beth – personally, because you have motivated me to be the best I can be in my own work, and on behalf of a Society that recognizes your exceptional contributions to our profession – thank you. As Tim says, you have been an inspiration.

Christopher I. Cassady, MD, FAAP, FRANZCR

SPR 2020 HONORARY MEMBER

The Society extends Honorary Membership to individuals outside of the SPR who have made outstanding contributions to the care of children.

José Lipsich, MD

It is my pleasure and honor to present my dear friend Dr. José Lipsich who has been awarded as an Honorary Member to the Society for Pediatric Radiology.

Dr. Lipsich is one of the key leaders of Latin American Pediatric Radiology. He is the current President of the Latin American Society for Pediatric Radiology (SLARP) which he has supported since it was established, and has been the central figure in Argentinian Pediatric Radiology for many years.

Dr. Lipsich was born in Villa Angela, a small city in the northern part of Argentina. The city's hospital school, is named "Dr. José Lipsich" in recognition for what José has done for his hometown. José grew up in Argentina where he went to medical school. He subsequently pursued post-graduate training, completing a residency in Pediatrics, and later in Diagnostic Radiology and Pediatric Radiology. After finishing his training in Argentina, Dr. Lipsich traveled to Paris to obtain further training at the Hôpital Bicêtre. In Paris he mastered diagnostic and interventional radiology, with a particular emphasis on hepatobiliary diseases. Professor Danielle Pariente, one of the greatest experts in this area in the world, was his teacher and mentor. Professor Pariente and Dr. Lipsich have collaborated closely over the years. After completing his training in Paris, Dr. Lipsich went to Montreal where he worked for two years at the Hôpital Saint Justine. He then returned to Buenos Aires to work at the Hospital Garrahan.

In terms of his training and subsequent career, Dr. Lipsich's life has been linked inextricably with the Garrahan Children's Hospital. The Juan P. Garrahan Hospital, since its inception, has been the major referral center for sick children in Argentina. When the Garrahan Hospital opened its doors in 1987, Dr. Lipsich was its first pediatric radiology fellow. The hospital has grown in size and reputation, and with over 600 beds is perhaps the largest Children's Hospital in Latin America and one of the top pediatric institutions in the world.

At the Garrahan Hospital his presence was totally transformational. He began by creating an Interventional Radiology with a C-arm and a borrowed ultrasound machine; the service became the model for similar services throughout Latin America. In 2008 he became the Chair of the Department of Radiology, a post that he has held since. During his tenure the Department has grown to become highly subspecialized and sophisticated with state-of-the-art equipment. The Interventional Radiology Department is particularly impressive. Above all, Dr. Lipsich has created an environment where the sick child comes first, where patients receive the best possible therapies, and where hard work coexists with friendship, great humor and fun.

Dr. Lipsich is a great teacher, and his passion for radiology is palpable in his talks. His book "Ecografía Pediátrica" is an outstanding textbook. His publications deal primarily with pediatric abdominal problems. His love for the study of the liver disease in children began in Paris and continues to this date, and his understanding of complex biliary problems is second to none.

Dr. Lipsich is a great physician who cares profoundly about the children for whom he cares. He is a natural leader and has been one of the main forces behind the development of SLARP and the Argentinian Society of Pediatric Radiology, which has over 200 members. His great heart beats in tune with an active mind and an expansive, warm, personality. He has developed great friendships with colleagues all over the world. Dr. Lipsich continues to be closely connected with the French Radiology community, and he was recently awarded the Medal of Honor of the French Society for Radiology. His Department is visited every year by pediatric radiologists from all corners of the world.

José and his wife, Marta Plotnicoff have a beautiful family, and their children Federico and Carolina are two very talented young adults. José always has a kind word for those around him. His smile and laughter are uplifting and inspiring. It is a pleasure and an honor to work with him and to be able to enjoy his friendship.

Diego Jaramillo, MD, MPH

SPR 2020 HONORARY MEMBER

Keith J. Strauss, MSc, FACR

"Selflessness, a profound knowledge of the physics of pediatric imaging, humility, generosity. When Keith speaks, people listen."
- John Boone, PhD, Professor of Radiology and Biomedical Imaging, UC Davis Health

"To say that Keith has transformed how we image children would be an understatement."
- Brian Coley, MD, Radiologist-in-Chief, Cincinnati Children's Hospital

"It is doubtless there will ever be another physicist as impactful as Keith Strauss to the field of pediatric imaging. It may sound like hyperbole, but there is little doubt in my mind that by means of the improved imaging and reduced radiation doses Keith fought so hard to have implemented, Keith's efforts have saved many countless pediatric lives over the many decades of his career."
- Samuel L. Brady, PhD, Associate Professor of Radiology, Cincinnati Children's Hospital

Few medical imaging physicists have had the impact that Keith Strauss, BA, MSc, FAAPM, FACR has had in making the world a safer place for pediatric patients undergoing radiologic imaging. Yet, Keith's humble nature and generosity belie a persistent leadership style that has resulted in numerous, tangible contributions in pediatric radiology care. As Kimberly Applegate MD says of Keith, "Make no mistake, Keith is a bulldog in disguise. ... he is someone who keeps at it despite others telling him it can't be done." Keith has had a decades long vision of the need for quality and safety in pediatric imaging and he will not quit until this vision has been achieved. Perhaps these qualities come from his upbringing and his staunch Christian faith. Keith was born on a farm in Nappanee, Indiana about 25 miles from South Bend. As a farmer, his father worked hard, was strict, yet fun-loving and loved playing pranks outside the home. His mother was also strict but loved singing which brought a warmth to their home. Keith says, "My dad taught me how to work. I was given a lot of responsibility at a young age. When things need to be done, you roll up your sleeves and do it." John Boone PhD, a colleague of Keith's, tells the story that "once when his father was away, a cow went into labor and Keith had to deliver the calf. He was just eight years old and after several attempts he realized that he wasn't big enough to pull the calf out of the birth canal. Being resourceful, he got a tractor and rigged up a rope to the calf's legs. He was successful in delivering the calf with that tractor. Thus, his use of technology for the care of pediatric mammals started at an early age!"

In 1977, Keith received a Master of Science degree in Radiologic Physics at the University of Chicago and for 8 years worked at Michael Reese Hospital performing some of the first acceptance testing of equipment for the new hospital. At that time, he was one of only 5 full-time diagnostic radiologic medical physicists in the country. His quality and safety work at Michael Reese caught the attention of John Kirkpatrick, MD, the famed pediatric radiologist at Boston Children's, who Keith later considered a mentor. John recruited Keith to be the Director of Radiation Physics and Engineering at Boston in 1984. John later told Keith " You know over my career, I have had an opportunity to work with a lot of people, but I have never worked with anyone who was as pleasant a surprise or more successful in his field than you!" What a compliment from one of the giants in the field of pediatric radiology!

In 2012, Keith was recruited to Cincinnati Children's Hospital where he is Associate Professor of Radiology and Section Head of Clinical Medical Physics. Keith has a vast academic legacy. He has given almost 200 lectures and written over 175 papers, book chapters, editorials and abstracts. As Sam Brady, PhD states, "In the field of pediatric imaging, Keith's publications are some of the most cited and referenced scientific works to date. Many of Keith's efforts have fundamentally changed how we image pediatric patients." Keith changed the field by working with "companies to build better interfaces, fundamental equipment controls, default imaging protocols, and, most importantly, a culture of considering pediatrics for each piece of equipment. Not only has Keith worked with the companies that build imaging equipment, he has worked with the national and international agencies tasked with writing the regulations, standards for accreditation, and specifications for imaging equipment; agencies such as the ACR, FDA, CRCPD, NCRP, ICRP, IEC, IAEA and MITA. This effort to both work with the manufacturers from the ground up and the regulators from the top down has done more to improve pediatric image quality than any other medical physicist."

Over a 43 year career, Keith's most significant work as viewed by Dr. Sarah McKenney, Lead Medical Physicist at Stanford University (and a mentee of Keith's) is, "I think Keith's greatest unsung accomplishment is ensuring high integrity physics within Image Gently.

This improved the technical quality of care during imaging for pediatric patients both in the US and worldwide." Keith's contribution to Image Gently cannot be overstated. He spent hours proofreading scientific papers, web materials and parent educational information. He has been involved as a key leader in each campaign, advising pediatric radiologists (especially me!). He has spoken to countless parents about radiation dose, alleviating their fear. He substantially contributed to the process that addressed Tom Slovis' dream in 2001: a call for a better CT dose index for children than CTDIvol. This required the publication of Size Specific Dose Estimate (SSDE) for the trunk in 2011, publication of SSDE for the head in 2019, and the completion of an International Electro Technical Commission Standard in 2019 for CT vendors to follow when calculating and displaying SSDE on their units. Hopefully, some scanners may have this capability at the RSNA in 2020! And finally, he demonstrated the impact that diagnostic medical physics can have in creating better image quality at properly managed radiation doses in four major teaching hospitals. Keith worked with the American Association of Physicists in Medicine to establish a Pediatric Imaging Subcommittee (PISC) that has a charge to specifically develop and disseminate the science behind proper pediatric imaging techniques. As John Boone says, "A quintessential educator, Keith has mentored several medical physicists who have taken positions at pediatric hospitals – not only in the way of advice, but by getting these young scientists engaged in pediatric imaging activities in the AAPM and beyond."

Along this amazing journey… Keith has had some help! He met his wife Bobbie in college. She supported him in graduate school with a teaching job. Of that special time in their life, Bobbie says that if she didn't go to the library with Keith, she would never have seen him! Bobbie says, "I used to think Keith was perfect; he's not - but he is perfect for me. I've been blessed to be married to Keith for 45 years. He's a loving, loyal, encouraging man of integrity." They have a close-knit and loving family consisting of a son, Andrew, in finance, a daughter Erin, a pediatric nurse, their spouses and five grandchildren. As Keith reflects on his career he states, "Here is the simple truth. My faith in Jesus Christ, Bobbie's positive influence, my education, and life's daily lessons taught by family and all who I meet impact how I try to live and how I attempt to solve challenges. I have been tremendously blessed by my Lord who has created career opportunities for me to improve pediatric patient care. I've simply tried not to squander them."

Keith, we are most fortunate that your life's work has contributed to our beloved field of pediatric radiology and we assure you, that your opportunities have not been squandered.

Marilyn Goske, MD

SPR 2020 JACK O. HALLER – THOMAS L. SLOVIS AWARD

This award is given in memory of Jack O. Haller and Thomas L. Slovis who both excelled as educators, and mentors. Their abilities and enthusiasm stimulated many young medical students and residents to pursue pediatric radiology. This award is given to an individual who has demonstrated evidence of outstanding ability to educate trainees (medical students, residents and fellows) and who has shown sustained substantial excellence in mentorship skills.

Oscar Navarro, MD

After completing his radiology residency in Chile in 1994, Oscar Navarro worked a few years as a staff radiologist. He then completed a pediatric radiology fellowship at The Hospital for Sick Children in Toronto in 2000. Since 2001, he has been working at The Hospital for Sick Children.

In 2011, he became the program director of the Pediatric Radiology residency program and director of the fellowship programs at SickKids. Since then, he has excelled in reorganizing and restructuring the residency and fellowship programs in Pediatric Radiology.

Oscar's dedication for teaching has benefited trainees of all background for all these past years. His structured and practical approach in teaching is renowned for making every learning opportunity by his side highly valuable.

Since 2004, he has been one of the very few individuals voted year after year as an "exceptional teacher" by both residents and fellows at the University of Toronto.

Oscar's expertise in his field and in teaching are also recognized at the national and international levels, being an invited speaker in the past years notably at the SPR, ESPR, SLARP, AOSPR and BSPR meetings.

To this day, he has authored over 70 peer-reviewed publications and participated in 8 book chapters.

Despite his strong experience and high level of expertise, Oscar remains humble and curious, always eager to learn. His enthusiasm and passion for Pediatric Radiology are highly contagious.

His mentorship has clearly been influential for many trainees that had the chance to learn by his side. Over the years, he has motivated numerous young radiologists to reach towards clinical and academic excellence in Pediatric Radiology. His mentorship extends well beyond the end of fellowships, and his regular postings on Twitter about current and past trainees is only one of the many ways that he has shown himself to be a continuously supportive and proud mentor and educator.

Oscar embodies, in my opinion and in the opinion of many others, the perfect mentor and teacher in Pediatric Radiology, and is truly deserving the Jack O. Haller - Thomas L. Slovis Award. By his own words, teaching has been one of the highlights of his academic career. There is no doubt that Oscar will continue serving as a true role model in all aspects of his professional career, and that he will continue to actively participate in teaching and successfully shaping the future of our specialty.

Caroline Lacroix, MD, FRCPC

HEIDI PATRIQUIN AWARD

In recognition of Dr. Patriquin's commitment to international education, this fellowship is designed to subsidize the expenses of a Pediatric Radiologist who practices outside of North America.

Manisha Jana, MB, BS
All India Institute of Medical Sciences, New Delhi, India

HEIDI PATRIQUIN AWARD

Sally Saad, MB, BS
Cairo University Teaching Hospitals, Egypt

SCIENTIFIC PAPERS - CONVERTED TO POSTERS

Authors are listed in the order provided. An author listed in bold identifies the presenting author.

Paper #: 001

Assessment of Distal Ureteral and Ureterovesical Junction Visualization on Contrast Enhanced Voiding Urosonography

Ellen C. Benya[1], *ebenya@luriechildrens.org*; Francis Prendergast[1], Dennis B. Liu[2], Mary Wyers[1]; [1]Medical Imaging, Ann & Robert Lurie Children's Hospital, Chicago, IL, [2]Division of Urology, Ann and Robert Lurie Children's Hospital, Chicago, IL

Purpose or Case Report: Contrast enhanced voiding urosonography (CEVUS) uses intravesically administered microbubble contrast to detect vesicoureteral reflux (VUR) and urethral anomalies with ultrasound. Multiple studies have suggested CEVUS can replace voiding cystourethrogram (VCUG) as a radiation free alternative. Analysis of ureterovesical junction (UVJ) and ureters on VCUG documenting UVJ position, ureteral duplication, periureteral diverticula and ureteroceles is important as anatomic variations may affect management and surgical approach. *Our purpose was to assess UVJ region visualization in children with VUR detected on CEVUS.*
Methods & Materials: CEVUS studies performed between 6/18 and 3/19 with reported VUR were retrospectively reviewed by 2 pediatric radiologists to confirm presence of VUR and to qualitatively assess UVJ region for each renal moiety using a 3 point scale for clear, limited or absent visualization of the distal ureter, ureterovesical junction, ureteral duplication, periureteral diverticula and ureteroceles.
Results: 34 studies with VUR on CEVUS were identified. 67 renal moieties were evaluated including a solitary kidney in 1 child. VUR was detected in 52 moieties by Reader 1 and in 53 by Reader 2. Single moiety with discrepancy between Readers regarding VUR was excluded from statistical analysis.Distal ureteral visualization was described as absent in 22 and limited in 16 refluxing renal moieties by Reader 1 and as absent in 18 and limited in 7 by Reader 2. Weighted Kappa of 0.47 reveals moderate agreement between Readers for distal ureteral visualization.Visualization of UVJ was described as absent in 33 and limited in 14 refluxing renal moieties by Reader 1 and as absent in 20 and limited in 21 by Reader 2. Weighted Kappa of 0.29 reveals low agreement between Readers for UVJ visualization.Visualization of ureteral duplication was described as absent in 39 and limited in 4 refluxing renal moieties by Reader 1 and as absent in 42 and limited in 2 by Reader 2. Weighted Kappa of 0.88 reveals high agreement between Readers for ureteral duplication.No diverticula were detected by either Reader and one ureterocele was detected by both readers.
Conclusions: We demonstrate limited distal ureteral and UVJ visualization in refluxing renal moieties on CEVUS. Awareness of this limitation is important as there may be implications when evaluating patients for surgical management of VUR.

Paper #: 002

Contrast Enhancement Characteristics of Gadolinium-Based-Contrast-Agents (GBCA) in Functional MR Urography (fMRU) in Children

Aashim Bhatia[2], *aashimbhatia@gmail.com*; Dmitry Khrichenko[1], Hansel J. Otero[1]; [1]CHOP, Philadelphia, PA, [2]Children's Hospital of Pittsburgh, Pittsburgh, PA

Purpose or Case Report: This study will normalize contrast enhancement curves for three GBCAs in fMRU and use it to assess for differences in renal enhancement characteristics of different GBCAs used in pediatric fMRU.
Methods & Materials: This is a retrospective IRB-approved, HIPAA-compliant study. From all fMRU studies performed at two pediatric institutions between 2007 and 2017, we selected those renal units with normal morphologic features and normal function parameters. Then, the kidneys were grouped according to the contrast agent used at our institutions during the study period (i.e.: gadopentetic acid - Magnevist®; gadoterate meglumine - Dotarem®; and gadobutrol - Gadavist®). Basic demographic information (e.g.; age, sex) was extracted from their electronic medical records.
Results: Out of a total of 2014 renal units, 447 morphologically and functionally normal kidneys were included in the final sample. The median ages for each group was 7.7 years for gadoterate meglumine, 8.9 years for gadobutrol, and 7.3 years for gadopentetic acid. Of the 447 kidneys, 329 (73.6%) were imaged with gadopentetic acid, 65 (14.5%) with gadobutrol and 53 (11.9%) were imaged with gadoterate meglumine.The 2 min enhancement ratio to baseline of the kidneys, with baseline considered the 1 sec time point, with gadoterate meglumine is 19.6, with gadobutrol is 19.9, and with gadopentetic acid is 17.3.The percentage change in decreased enhancement within the kidneys after 6 minutes compared to 2 minutes for gadoterate meglumine is 16.1%, 9.2% for gadobutrol, and 18.9% for gadopentetic acid.Gadoterate meglumine and gadobutrol had similar enhancement ratios to baseline, and gadoterate meglumine had a faster washout compared to gadobutrol.Time to peak (TTP) was determined, 156 sec for gadoterate meglumine, 168 sec for gadobutrol , and 152 sec for gadopentetic acid.In the aorta, gadoterate meglumine demonstrated the highest ratio between the minimum and maximum normalized enhancement compared to the other two GBCAs.
Conclusions: We found that the use of a macrocyclic non-ionic agent results in a delayed time to peak and slower washout than both the linear and macrocyclic ionic agents; while the ionic agents behaved similarly in terms of enhancement and transit time. Because basic parameters of fMRU including calyceal and renal transit time as well as the duration of image acquisition for analysis were first determined with an ionic linear agent, the switch to a non-ionic GBCA warrants a re-evaluation of normal ranges for such parameters.

Paper #: 003

Tubal Torsion: A Challenging Diagnosis

Arta Stanescu, *stanescu@uw.edu*; Jeffrey P. Otjen, Marguerite Parisi; Radiology, Seattle Children's Hospital, Seattle, WA

Purpose or Case Report: Fallopian tube torsion is a rare cause of acute abdominal pain in pediatric patients. Pelvic ultrasound is the first imaging modality utilized to evaluate for pelvic pathology, typically to rule out ovarian torsion. Ultrasound findings of fallopian tube torsion can be challenging, leading to delayed surgical intervention, particularly when ovaries have a normal gray scale appearance and spectral Doppler waveforms. We reviewed the ultrasound features of fallopian tube torsion in a series of surgically proven cases.
Methods & Materials: In this IRB approved retrospective study, patients who underwent pelvic ultrasound because of abdominal or pelvic pain between 2005 and 2015 were identified. Ten patients aged between 10 and 16 were found to have surgical evidence of tubal torsion. Clinical data and imaging features were analyzed.
Results: All patients presented with one or more episodes of abdominal pain, the interval between initial presentation and surgery ranging between 1 day and 2 months. All 10 patients underwent transabdominal ultrasound examinations while 3 patients also had CT exams. Diagnosis of fallopian tube torsion and/or hydrosalpinx was suggested prospectively in 4 patients based on the presence of a tubular fluid filled adnexal structure on ultrasound. In the remainder 6 patients, the presence of large cystic midline structures arising from the adnexa was described. In these cases, concern for possible intermittent ovarian torsion or adnexal mass was raised despite the normal appearance of the ovaries. In two of these cases, a dilated fallopian tube was also present in retrospect. Necrotic fallopian tube changes leading to salpingectomy were found at surgery in 8 out of 10 cases. In 6 out of 10 cases associated paratubal cysts were noted, and in one case ovarian torsion was also present.
Conclusions: Delayed diagnosis in fallopian tube torsion can lead to salpingectomy with important implications on the future reproductive potential. In our retrospective review of ultrasound findings, the diagnosis was suggested prospectively only when hydrosalpinx was identified. A large cystic adnexal or midline pelvic mass with normal ovaries in a patient with pelvic pain should also raise concern for fallopian tube torsion. Increased awareness of these findings can lead to improved, timely diagnosis and prompt surgical intervention.

Paper #: 004

Quantitative Liver MRI in Children and Young Adults with Compressed SENSE

Alexander Boyarko[1], **Jonathan R. Dillman[2]**, *jonathan.dillman@cchmc.org*; Amol Pednekar[2], Jean A. Tkach[2], Andrew T. Trout[2]; [1]University of Cincinnati College of Medicine , Cincinnati, OH, [2]Cincinnati Children's Hospital Medical Center, Department of Radiology, Cincinnati, OH

Purpose or Case Report: Compressed SENSE (CS) facilitates significantly shorter MRI acquisition times. There is a paucity of data comparing quantitative MRI with regularly under-sampling schemes like SENSE to pseudorandom under-sampling schemes like CS. The purpose was to compare measurements of liver proton density fat fraction (PDFF), T2*, and stiffness between SENSE and CS techniques with identical MR acquisition parameters.
Methods & Materials: Clinical liver MRI examinations performed between March 2019 and September 2019 that included quantitative MRI with both SENSE and CS were retrospectively identified. The CS acceleration factors were selected to allow a 50% breath-hold duration compared to our routine clinical SENSE acquisitions. Patient demographics were recorded, along with liver PDFF (%), T2* (ms), and stiffness (kPa). Weighted (by region of interest area) mean was computed for each parameter at four anatomic levels for both SENSE and CS acquisitions. Spearman's rank-order correlation (r) was used to evaluate the association between conventional and CS measurements, and Bland-Altman plots were used to determine means bias and 95% limits of agreement (LOA).
Results: Thirty-three examinations met inclusion criteria. Mean patient age was 14.1 ± 4.6 years; eleven exams (33%) were in female patients. Liver PDFF showed very strong positive correlation (r=0.99) between sequences, with a mean bias of 0.26% (95% LOA: -0.91, 1.43%). Liver T2* showed weak positive correlation (r=0.37), with a mean bias of -3.2 ms (95% LOA: -12.44, 6.11 ms) that decreased with longer T2*, and it included two extreme outliers due to motion artifacts. Liver stiffness showed very strong positive correlation (r=0.97) with a mean bias of 0.1 kPa (95% LOA: -0.36, 0.56 kPa) that increased with increasing liver stiffness.
Conclusions: In our population, there was very strong correlation between SENSE and CS-based MRI measurements of liver PDFF and stiffness, with minimal bias. However, there was relatively poor correlation between T2* measurements, with a moderate bias between SENSE and CS under-sampling schemes.

Paper #: 005

Contrast-Enhanced Ultrasound of Liver Lesions in Children: A Comparative Study to CT/MRI

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Purpose or Case Report: Contrast-Enhanced ultrasound (CEUS) is being increasingly used in children as it offers the advantage over CT/MRI of real time imaging, low cost, lack of radiation, easy access, and no need for anesthesia. In our study, we evaluate CEUS for characterization of liver lesions in children and compared the enhancement patterns and diagnosis based on CEUS to MRI/CT in the pediatric population with liver lesions.
Methods & Materials: We retrospectively reviewed patients with liver lesions that had both CEUS and CT/MRI at our institution between 2017 and 2019. All patients underwent CEUS using 1-2 injections of Lumason at 0.03ml/kg. For each lesion, we reviewed the technique used, the enhancement pattern, presence of washout, and suspected diagnosis by CEUS and MR/CT at the time of the study. Clinical outcome or pathology results were noted when available.
Results: 16/20 patients (< 1 – 18 years old, 11 females and 9 males) had both CEUS and MR/CT. CEUS was performed before the MR/CT in 3 patients and after MR/CT in 13 patients. CEUS was performed using a Siemens Sequoia (8) and GE (8) ultrasound machines. 5 lesions showed no enhancement (2 fatty infiltrations, 2 scarring, 1 hemorrhage), 1 lesion showed early enhancement with rapid washout (neuroblastoma), 1 showed delayed washout (FNH) and 9 lesions showed enhancement without washout (4 FNH's, 2 hemangiomas, 3

abscess/infection). CEUS was concordant with CT/MRI in 13 cases and discordant in 3 cases. In these 3, CEUS correctly diagnosed neuroblastoma metastasis, fatty infiltration, and an atypical hemangioma while MR or CT were inconclusive. No contrast reactions were noted.
Conclusions: CEUS is a safe, fast procedure that can be performed in children without the need of anesthesia and without exposure to ionizing radiation. Although our study is limited by a relatively small sample of patients, our data demonstrate excellent concordance with CT/MRI for the enhancement patterns and lesion characterization of liver lesions.

Paper #: 006

Ultrasound of Liver Elastography in Children: Does Depth Matter?

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Purpose or Case Report: Our aim is to determine the normal elastography liver stiffness values in children and if sampling depth is a factor.
Methods & Materials: The study population included 127 children (68 male, 59 female) age 8 to 18 (mean 12.8 years, SD 3 years) who had liver ultrasound with elastography. Patients with abnormal liver ultrasound were separated from those with normal studies. The liver was normal in 69 children and abnormal in 58 children. All examinations were performed for clinical indications. Elastography was performed using acoustic radiation force impulse ultrasound and point shear-wave elastography technique. Measurements were performed at two depths: 2 cm and 4 cm. Ten measurements were performed at each depth. The median stiffness (k Pa) of those measurements at each depth was analyzed by utilizing a repeated measures analysis of covariance. Average median stiffness for different groups was compared using model-based t tests with the Bonferroni correction for multiple comparisons.
Results: A linear association between median stiffness and age, adjusting for whether or not liver findings are abnormal, depth, and the interaction between liver findings and depth, was identified (p=0.0095). The estimated corresponding slope is about 0.16 k Pa per 1 year of age (95% confidence interval (CI): (0.04, 0.28)).Average median stiffness in k Pa adjusted for age in normal group increased from 3.72 at 2 cm to 4.15 at 4 cm and for the abnormal group from 4.61 to 5.84. There is a statistically significant difference between the average median stiffness at 2 cm and 4 cm for patients with normal liver findings adjusting for age (p=0.0119; 95% CI: (-0.78, -0.08), Bonferroni-adjusted) and for patients with abnormal liver findings adjusting for age ($p < 0.0001$; 95% CI: (-1.66, -0.79), Bonferroni-adjusted).Regarding the difference between the average median stiffness at 2 cm and 4 cm for patients with normal liver findings and the corresponding difference for patients with abnormal liver findings, there is sufficient statistical evidence to suggest that there is a difference between those two differences, adjusting for age (p=0.0016; 95% CI: (0.31, 1.28)).
Conclusions: A small increase in k Pa with age was detected. Measurements at 4 cm depth are greater than 2 cm depth. The increase in median stiffness in abnormal livers is significantly greater than in normal livers suggesting a method for increasing sensitivity in detecting abnormal liver stiffness.

Paper #: 007

Comparison of Manual and Automatic Liver MRE Processing for Shear Stiffness Estimation in the Pediatric Population

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Purpose or Case Report: To compare liver shear stiffness estimates obtained by Automatic Liver Elasticity Calculation (ALEC) processing of two-dimensional (2D) gradient-recalled echo (GRE) magnetic resonance elastography (MRE) data to stiffness values obtained from standard-of-care manual processing.
Methods & Materials: 62 patients with autoimmune liver diseases (sclerosing cholangitis or autoimmune hepatitis) underwent 2D GRE MRE at 60 Hz on a 1.5T scanner (Ingenia; Philips Healthcare) for this IRB-approved study. For manual processing, elastograms were generated in Intellispace Portal v10.1 (Philips Healthcare) with two readers (R1, R2) independently placing regions-of-interest (ROIs) to calculate mean liver stiffness (weighted for ROI size). ALEC (Mayo Clinic; Rochester, MN) generated elastograms with automatically segmented ROIs directly from MRE magnitude and phase images. Intellispace portal and ALEC both used a Multimodal Direct Inversion (MMDI) algorithm for computation of stiffness maps. Results were compared using Pearson's correlation (r), intra-class correlation coefficients (ICC), and Bland-Altman analyses.
Results: Study participants were in the age range of 7-20 years (mean age: 15.5 years; 33 males). ICC for inter-reader (R1 vs. R2) agreement for manual processing was excellent (ICC=0.989, 95%CI: 0.981-0.993) with mean bias of -0.05 kPa (95% Limits of Agreement (LoA): 0.47 to -0.57 kPa). Correlation between manual and ALEC processing was excellent (R1: r=0.987; R2: r=0.983) with mean bias of -0.33 kPa (R1 95% LoA: 0.36 to -1 kPa) and -0.28 kPa (R2 95% LoA: 0.42 to -0.97 kPa). ALEC measurements were perfectly reproducible (r=1; mean bias=0 kPa, 95% LoA: 0 kPa). Manual processing took 5:48 ± 1:07 minutes *per subject*. All the data was processed automatically with ALEC in the background using batch file that took 3:30 minutes to set up. Mean computation time for each case was 2:53 mins on a Microsoft Windows 10 system with Intel® Core ™ i5-7500, 4 Core CPU and 16 GB RAM.
Conclusions: Liver stiffness values computed using ALEC showed excellent agreement with manual analysis and were perfectly reproducible. ALEC processing of MRE should eliminate inter-observer variability, facilitate workflows, and reduce post processing time.

Paper #: 008

Normal Liver Stiffness by MR Elastography in Children

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Purpose or Case Report: MR elastography (MRE) is increasingly being used to non-invasively assess diffuse liver disease in children. However, there are limited normal liver stiffness data for MRE in children. The purpose of this study was to determine normal liver stiffness measured by MRE for children and assess for associations with demographic factors, MRI field strength and MRI vendor.
Methods & Materials: This was a prospective multi-institutional study conducted under IRB approval with written informed consent. 98 children with no known history of liver disease and with body mass index (BMI) ≤85th percentile were recruited to undergo MRE, evenly distributed across GE, Philips and Siemens scanners at 1.5T and 3T. Participants were evenly recruited into 2 age groups (7-11.9y or 12-17.9y). Participants completed a questionnaire confirming absence of liver disease, had liver function tests drawn, and were weighed and measured (height, girth). MRE was performed using the manufacturer's product sequence, and chemical shift-encoded MRI was performed to determine liver proton density fat fraction (PDFF) and T2*. Stiffness data were excluded for participants with any abnormal laboratory value, PDFF >5%, or T2* <20 ms at 1.5T. Descriptive statistics were used to summarize population characteristics. Students t-test, Pearson correlation, and the Kruskal Wallis test were used for comparison of groups.
Results: 76 (77.6%) participants with a mean age of 12.5±2.9 years met all inclusion criteria. 42 (55.3%) were female. Mean BMI was 18.7±2.4 (range: 14.6-24.3), and mean BMI percentile was 50.9±22.5% (range: 13.6-85%). 40 (52.6%) participants were scanned at 1.5T and 36 (47.4%) at 3T. 25 (32.9%) participants were scanned on GE magnets, 27 (35.5%) on Siemens, and 24 (31.6%) on Philips. Mean liver stiffness for the population was 2.2±0.4 kPa (range: 1.3-3.4 kPa). Mean PDFF was 2.2±0.9%, and mean T2* was 34.5±8.3 ms. There were no statistically significant differences in liver stiffness based on sex (p=0.74), MRI field strength (p=0.15), or MRI manufacturer (p=0.12), and there were no statistically significant correlations between liver stiffness and age (r=0.58, p=0.62) or BMI (r=-0.071, p=0.54).
Conclusions: Normal liver stiffness by MRE for children 7-17.9y is approximately 2.2kPa (±2 SD: 1.4-3 kPa) and is not dependent on demographic or technical factors.

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Paper #: 009

IVC and Lung US for Volume Assessment in Pediatric Hemodialysis Patients: Initial Experience

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Purpose or Case Report: Assessment of fluid overload in hemodialysis patients is usually based on a patient's ideal weight which presents a challenge, especially in children due to normal growth and development. Noninvasive, validated sonographic fluid balance measurements could potentially guide fluid removal in children undergoing hemodialysis. We examine changes in IVC diameter and lung b-lines in children pre- and post- dialysis.
Methods & Materials: This prospective, HIPAA-complaint study measured the IVC diameters, collapsibility index as well as the presence and number of lung b-lines in 18 lung zones (i.e.; upper, mid and lower zones at midclavicular, anterior axillary and posterior axillary lines); on lung ultrasound in a cohort of children before and 1- hour after hemodialysis between January and September 2019. Images were reviewed by 2 pediatric radiologists blinded to clinically history and fluid status. Non-weighted descriptive analysis is presented.
Results: Six subjects (4 boys and 2 girls) median age 13.6 years (range: 3.4-17.7) completed 23 pre and post dialysis visits (41 ultrasound studies). The average maximum diameter of the IVC (Dmax) pre-dialysis was 1.56±0.6 cm and 1.51±0.6cm, for reader 1 and 2, vs. 1.29±0.5 cm and 1.31±0.6 cm post-dialysis, respectively. The average minimum diameter of the IVC (Dmin) pre-dialysis was 1.24±0.6 cm and 1.21±0.6 cm, for reader 1 and 2 vs. 1±0.5 cm and 1.09±0.6 cm post-dialysis, respectively. The IVC collapsibility index (IVCci) was 23.6±14.9 and 18.0±14.3 pre-dialysis- and 23.74±12.46 and 17.1±15.0 post-dialysis.Average number of b-lines changed from pre- to post-dialysis as follows:Right lung: 1.72±2.0 and 2.20±2.0 for reader 1 and 2, to 1.26±2.3 and 1.94±2.9, respectively.Left lung: 2.26±3.5 and 2.63±4.4 for reader 1 and 2, to 1.30±3.2 and 1.70±3.2, respectively.
Conclusions: Ultrasound shows differences in IVC and b-line measurements after dialysis. However, there is significant interreader variability and overlap between pre- and post-dialysis values, hindering its potential use to guide clinical decisions in individual patients. Additional research with larger samples is needed to further define the potential role of ultrasound in the assessment of volume status in children on hemodialysis.

Paper #: 010

Free-Breathing 3D Golden-Angle Radial Sparse Parallel Dynamic Contrast-Enhanced MRI (GRASP) for Diagnosis of Terminal Ileitis in Pediatric Small Bowel Crohn Disease (CD): A Supplement or Alternative to Conventional MR Enterography (C-MRE)?

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Purpose or Case Report: This study compares the performance of a single free-breathing GRASP sequence to a full C-MRE protocol in pediatric small bowel CD. The high k-trans of affected bowel in CD may allow high spatiotemporal GRASP dynamic contrast-enhanced technique to provide comprehensive diagnostic value in CD, especially in patients with limited breath-hold capacity.
Methods & Materials: 24 patients with known or suspected CD and available endoscopic biopsy results were evaluated over a 25-month period (September 2017 to September 2019) using a standard C-MRE protocol with the addition of GRASP imaging. Two radiologists, blinded to clinical data and C-MRE results, reviewed the GRASP studies on a 3D workstation and scored

standard reporting elements of CD. Discrepant reporting elements were resolved by consensus. The consensus read was compared to C-MRE results and biopsy. Cohen's Kappa coefficients were calculated for the following: 1) Agreement between the consensus GRASP and clinical C-MRE, 2) inter-rater reliability for GRASP, 3) agreement between GRASP and biopsy, and 4) agreement between clinical C-MRE and biopsy. Subjective image quality, radial artifact, and motion artifact were scored on a Likert scale with 5 as the best rating.
Results: GRASP had moderate agreement for terminal ileal involvement when compared to C-MRE (k 0.58), and inter-reader agreement for GRASP was moderate (k 0.6). When compared to biopsy within 30 days, GRASP agreement with biopsy results was fair (k 0.31), and clinical C-MRE agreement with biopsy was moderate (k 0.56). 5 GRASP discrepancies from clinical read for ileal involvement included 3 false positives and 2 false negatives, with 1 false negative GRASP being concordant with biopsy, and the remaining biopsy results favoring the C-MRE. Mean image quality scores for 2 readers were 3.71/5 for overall image quality, 3.73/5 for radial artifact, and 3.75/5 for motion artifact.
Conclusions: The lower diagnostic accuracy of GRASP when compared to C-MRE for pediatric CD favors use as a supplement rather than an alternative to the full C-MRE protocol, but GRASP may become an essential part of the workup in patients with limited breath-hold capacity given its favorable image quality ratings and free-breathing technique.

Paper #: 011

Ferumoxytol-enhanced 4D Flow MRI: Comparison of Image Quality with Extracellular Gadolinium-based Contrast and Non-contrast Studies in Children with Congenital Heart Disease

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Purpose or Case Report: Three dimensional magnetic resonance angiography (3DMRA) and two-dimensional phase contrast are commonly used for assessment of anatomy and flow in congenital heart disease. Time-resolved, three-dimensional phase contrast MRI (4D flow) provides complete volumetric coverage of the chest with flow assessment in any plane. How the addition of ferumoxytol (Fe), a blood pool contrast, changes 4D flow magnitude image quality relative to extracellular gadolinium-based contrast agents (GB) and non-contrast (NC) exams is unknown. We compare image quality measurements in Fe, GB and NC 4D flow with ECG-gated, respiratory-navigated 3DMRA.
Methods & Materials: 32 patients with Fe 4D flow were age-matched to 33 patients with GB and 13 patients with NC 4D flow. 4D flow image quality was assessed by (1) aortic signal-to-noise ratio (SNR) (2) aortic contrast-to-noise ratio (CNR) (3) qualitative rating by 2 blinded readers. Ascending aorta (Ao), branch pulmonary arteries (PA), right superior vena cava (RSVC), pulmonary veins (PV), endocardial border (EB), and coronary artery origins (CAO) were rated 0=Not included 1=Nondiagnostic 2=Diagnostic. Ascending and descending aorta dimensions (AD, DD) on 4D flow magnitude images were compared to 3DMRA. Agreement between readers was assessed by taking the difference between raters' scores and performing Wilcoxon rank sum test.
Results: Aortic SNR and CNR was significantly higher in Fe 4D flow (SNR: FE 56±26, GB 35±13, NC 24±12; CNR: FE 19±14, GB -7±15, NC -15±12, p<.001). AD and DD correlated well with 3DMRA for Fe and GBCA but not NC (AD R^2: FE .98, GB .94, NC .54; DD R^2: FE .96, GB .95, NC .6). All structures were rated diagnostic more often for Fe than GBCA and NC (p<.001). Ao was rated diagnostic on 32(100%) FE, 12(36%) GB, and 3(23%) NC. EB and PV were seen on most Fe studies (63% and 81% respectively); non-diagnostic on all NC and all but 1 GB showing PV. CAO were rarely diagnostic (FE 5(16%), GB 1(3%), no NC). For structures most often seen (Ao, PA, right SVC), interrater agreement was higher in Fe than GB and NC (p<.05).
Conclusions: MRA image quality varies between contrast types. NC 4D flow magnitude images are nondiagnostic for measurements. Qualitatively, Fe image quality is superior to GB and NC, including for detection of the endocardial border and small structures such as pulmonary veins. If 4D flow is to replace 2D-PC and 3D MRA as a single acquisition for vascular and flow assessment, Fe is essential to creating diagnostic magnitude images.

Paper #: 012

MR Lymphangiogram Findings in Young Infants with Chylothorax: Do Imaging Findings Correlate with Outcomes?

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Purpose or Case Report: Review imaging findings on static and dynamic contrast enhanced magnetic resonance lymphangiogram (DCMRL) in young infants who presented with chylothorax and correlate these imaging findings with clinical outcomes.
Methods & Materials: A retrospective review was performed of all MR lymphangiograms (MRL) performed in infants (≤ 3 months of age) with chylothorax. Abnormal findings were identified on T2-weighted MRL and DCMRL via two-reader consensus. Review of the electronic medical record was performed to identify relevant clinical parameters.
Results: A total of 32 MRLs (15 male) were reviewed (average age 6 weeks, range 4 days-12 weeks). Inguinal node lymphatic contrast injection was performed in all cases. Intrahepatic lymphatic contrast injection was additionally performed in 10 cases. T2-weighted imaging findings included pleural effusion (100%), ascites (84%), and body wall edema (63%). Abnormal DCMRL perfusion involved: lung (53%), hilar (72%), pleural (19%), intercostal (88%), and dermal perfusion (dermal backflow 41%; subcutaneous channels 6% on inguinal injection only). The thoracic duct (TD) was visualized in 72% and partially in 13% of cases. Initial management included percutaneous (56%) and surgical (13%) intervention or conservative management (31%). 72% of children had chest tubes in place at the time of MRL. Median chest tube time was 16 days post-MRL (range 1–502 days). Chest tube presence predicted surgical or percutaneous intervention (p= 0.04), rather than conservative management. Median length of time from MRL to discharge home, transfer to another facility, or mortality was 51 days (range 1 day-2.5 years). Of the 24 children requiring respiratory support at the time of imaging, 58% weaned to room air during post MRL management. Of imaging findings, body wall edema and dermal perfusion were the biggest predictors of mortality, with a total mortality rate of

19%. Additional perfusion abnormalities and visualization of the thoracic duct did not correlate with mortality or length of hospital stay.
Conclusions: Young infants with chylothorax demonstrated abnormal perfusion of the lungs in 53%, the hila in 72%, and of the intercostal lymphatics in 88% of MRLs. Although management varied between percutaneous, surgical, or conservative care, body wall edema and dermal perfusion were the biggest predictors of mortality in these patients demonstrating the importance of imaging during initial work up.

Paper #: 013

Prevalence and Morphology of Left Anterior Descending (LAD) Myocardial Bridges (MBs) Detected in Children by Coronary CTA (CCTA)

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Purpose or Case Report: To evaluate by CCTA the prevalence and morphology of pediatric LAD MBs (coronary segments that contact or tunnel within myocardium), which are common and usually incidental in adults but only sporadically reported in children.
Methods & Materials: All consecutive CCTAs performed at our institution using a Siemens Flash CT from 10/2016 through 9/2019 on patients <age 19 without known cardiac disease referred for symptoms or equivocal echocardiography were retrospectively reviewed. For each case with normal coronaries or an isolated aberrant right coronary artery (RCA), 2 pediatric cardiovascular radiologists in consensus graded the presence of LAD MBs using the Kim (2009) system (0- absent, 1- partial myocardial contact, 2/3- full encasement without/with visible overlying myocardium) and measured their location of origin and length with Aquarius iNtuition software as well as myocardial depth and %systolic compression for grade 3 MBs. MB prevalence rates in normal and anomalous RCA groups were compared with the Fisher exact test. Multivariate regression adjusting for age, gender, height, weight, reconstruction phase, and co-existing aberrant RCA was also used to assess factors associated with MB presence and morphology.
Results: 144 CCTAs were reviewed, 96 (66.7%) in females, with mean +/- SD age of 11.2 +/- 5.0 yr, 44 (30.6%) with an aberrant RCA. MBs were detected in 111 (77.1%); 15 (10.4%) had 2 MBs. Of the 126 MBs, 67 (53.2%) were grade 1, 48 (38.1%) grade 2, and the rest grade 3. Most (108, 85.7%) began in the mid LAD, with mean distance from the LAD origin, length, and mass index (MMI=length*grade) of 33.2 +/- 18.5 mm, 20.5 +/- 15.0 mm, and 34.2 +/- 3.4, respectively. Among the 11 grade 3 MBs, mean myocardial depth, LAD diameters at end-systole and diastole, and %compression were 1.8 +/- 0.9 mm, 1.9 +/- 0.3 mm, 2.8 +/- 0.6 mm, and 32.6 +/- 15.6%, respectively. MB prevalence rates were not statistically different (p=0.28) in anomalous RCA (31/44, 70.5%) and normal groups (80/100, 80.0%). In multivariate models, greater weight was associated with slightly increased odds of higher grade bridges (OR=1.05, p=0.034); there were no statistically significant predictors of MB presence, length, or MMI.
Conclusions: LAD MBs <grade 3 are detectable in most children at CCTA with otherwise normal coronaries or an aberrant RCA. Physiologic testing is likely prudent prior to ascribing pathologic significance to a MB or presumptively repairing one at the time of elective anomalous RCA surgery.

Paper #: 014

Free-Breathing Highly Accelerated 2D Cine Cardiac MRI Using Deep Convolutional Neural Network (DCNN) Reconstruction: Clinical Validation

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Purpose or Case Report: To assess the image quality and clinical performance of a novel accelerated, free-breathing 2D cine cardiac MR sequence with DCNN reconstruction in comparison to conventional breath-held 2D cine balanced steady-state free precession (bSSFP).
Methods & Materials: 17 consecutive children (mean age: 14.2 yr, range: 9.7-22.0 yr, 10 male) were prospectively recruited for both short-axis cine acquisition strategies in one non-sedated 1.5T (Signa Artist, GE Healthcare) exam for cardiomyopathy or congenital heart disease. The respiratory-triggered 12-fold accelerated sequence was undersampled to acquire one slice over 1 RR interval. The reconstruction network inputs are zero-filled images generated using coil sensitivity maps that are extracted from a calibration region. Images are then reconstructed with a network that implements iterations of separable 3D convolutions and data consistency steps, completed within 1 minute. For each case, 2 blinded pediatric CV radiologists independently scored image quality of the DCNN and bSSFP recons on a 5-point scale (1-worst, 5-best) and manually segmented the LV/RV endocardial contours. Scan times (approximated as time between acquisition start and next sequence start) and image quality scores were compared using the Wilcoxon rank-sum test. Intra- and interobserver agreement in ventricular volumes/function for each recon type were assessed with the intraclass correlation coefficient (ICC).
Results: Accelerated scans were significantly faster than conventional bSSFP (mean time: 2.3 +/- 1.5 min vs. 11.3 +/- 2.9 min, p<0.001) with only minimally decreased mean image quality scores (3.6 +/- 0.6 vs. 4.1 +/- 0.5, p=0.001); scores for all recons were >=3, indicating at least diagnostic quality. For both raters, there was excellent agreement between volume/function measurements derived from conventional and DCNN images; ICCs for LVEDV, LVESV, LVSV, LVEF, RVEDV, RVESV, RVSV, and RVEF were 0.959-0.960, 0.953-0.967, 0.925-0.952, 0.839-0.977, 0.965-0.970, 0.945-0.958, 0.945-0.979, 0.894-0.958, respectively. There was also excellent interobserver measurement agreement in these parameters both for DCNN and conventional images, with ICCs ranging from 0.879-0.990 and 0.887-0.992, respectively.
Conclusions: The accelerated, free-breathing DCNN technique was much faster than bSSFP with comparable image quality and measurement agreement for key LV/RV parameters. This approach may thus allow substantially shorter cardiac MRI with a primary goal of ventricular volume and function analysis.

Paper #: 015

Mesenteric Dynamic Contrast MR Lymphangiography: Initial Experience and Comparison with Intranodal and Intrahepatic MR Lymphangiography

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Purpose or Case Report: To report on our initial experience with the use of mesenteric dynamic contrast MR lymphangiography (DCMRL) for evaluation of the lymphatics in patients with concern for mesenteric lymphatic flow disorders and compare these findings to intranodal (IN) DCMRL and intrahepatic (IH) DCMRL.
Methods & Materials: A retrospective review of the imaging and clinical findings in children undergoing mesenteric DCMRL was performed. The technique involves injection of a gadolinium contrast agent into the mesenteric lymphatic ducts followed by dynamic time-resolved imaging of the abdomen and chest. Comparison was made to IN-DCMRL and IH-DCMRL which was performed concurrently. Imaging was reviewed by two readers in consensus for lymphatic perfusion of the duodenum and leaks into the duodenal lumen and peritoneum on mesenteric DCMRL, IN-DCMRL, and IH-DCMRL. Visualization of the thoracic duct (TD) was also evaluated.
Results: 15 consecutive patients (10 male, mean age 6.9 years, range 2 months-17 years) with mesenteric DCMRL who presented for evaluation of either protein losing enteropathy (PLE) and/or ascites were evaluated. Mesenteric DCMRL was technically successful in 14/15 patients (93%). The TD was not visualized in 4 patients, 3 of which did not have a patent TD. All patients had also IN-DCMRL and IH-DCMRL. There was no difference in TD visualization between the modalities (p=0.711). When comparing IN-DCMRL to IM-DCMRL, there was improved visualization of peritoneal leaks (p=0.003), duodenal perfusion (p=0.003), duodenal leak (p=0.014). There was no statistical difference on these findings when comparing mesenteric DCMRL to IH-DCRML. Mesenteric DCMRL demonstrated a peritoneal leak in 7 patients whereas IH-DCMRL demonstrated leak in 3 patients. Duodenal intraluminal leaks were seen by IH-DCMRL in 9 patients versus 5 with IM-DCMRL. No peritoneal or duodenal intraluminal leaks were seen with IN-DCMRL. In one patient with congenital PLE the three modalities showed different disconnected flow patterns with duodenal leak only seen by mesenteric DCMRL. There were no short-term complications from the procedures.
Conclusions: Mesenteric DCMRL is feasible and potentially safe. Mesenteric DCMRL might be the imaging modality of choice for patients with mesenteric flow abnormalities such as certain forms of ascites and PLE. Further studies should be conducted to determine when and how to utilize this new lymphatic imaging modality.

Paper #: 016

Computed Tomography Findings of Thoracic Ectopia Cordis in the Setting of Cantrell Syndrome

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Purpose or Case Report: To characterize the range of cardiac and extracardiac CT findings in children with thoracic ectopia cordis in the setting of Cantrell syndrome.
Methods & Materials: Six patients with ectopia cordis who underwent CT angiography during a 6-year period were retrospectively analyzed.
Results: All six patients revealed multiple thoraco-abdominal midline abnormalities associated, which suggested the diagnosis of Cantrell syndrome. Three patients were categorized as a definitive diagnosis with all five Cantrell syndrome criteria present (intracardiac defect, sternal cleft, pericardial defect, diaphragmatic defect, and omphalocele), while the remainder three, showed varying degrees of the Cantrell Pentalogy. All patients showed a complete sternal defect, reported previously as an unusual finding in Cantrell Syndrome. Unlike to the findings reported on previous studies, we found that 5 of our patients showed atrial septal defect and parallel appearance of the great arteries. Finally, 5 of our patients showed anatomic variants not previously reported in the literature, such as elongated atrial appendages and a single connection of pulmonary veins in the same axial plane. 4 patients died in the first weeks of life, all of them from complex associated cardiac defects
Conclusions: Pentalogy of Cantrell is a very rare syndrome encompassing varying degrees of midline defects and congenital cardiac anomalies that can be associated with ectopia cordis. Our six patients diagnosed with ectopia cordis had varying degrees of the Cantrell pentalogy and presented anatomic variants which are generally not reported in literature.

Paper #: 017

Cardiac Magnetic Resonance Imaging Assessment of Interventricular Septal Geometry in Neonates with Bronchopulmonary Dysplasia Associated Pulmonary Hypertension

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Purpose or Case Report: BPD is associated with pulmonary hypertension (PH) and patients with BPD-associated PH (BPD-PH) have increased morbidity and mortality. Noninvasive assessment of BPD-PH has traditionally relied on echocardiograms. However, recent advances have allowed the use of MRI in the assessment of respiratory and cardiac disease in infants with BPD. In adults and older pediatric patients, increased left ventricular eccentricity index (MR-EI) and decreased MRI septal curvature correlate with increased mean

pulmonary artery pressure and pulmonary vascular resistance. The current study sought to determine the relationship of MR-EI and septal curvature in neonates with BPD and BPD-PH with short term respiratory outcomes and need for pulmonary vasodilator therapies.
Methods & Materials: 35 moderate or severe BPD and 11 mild BPD or control infants were imaged without contrast between 38 and 47 weeks post-menstrual age on a neonatal-sized, NICU-sited 1.5T MRI scanner. MR indices including MR-EI and septal curvature were determined and compared to BPD severity and clinical outcomes including hospital length of stay (LOS), duration of respiratory support, respiratory support level at discharge and pulmonary vasodilator therapy.
Results: **Results:** MR-EI was directly associated and septal curvature was inversely associated with BPD severity. In a univariate analysis, MR-EI and septal curvature (p-values reported) were associated with increased hospital LOS ($P=0.004$), duration of respiratory support ($P<0.0001$), respiratory support at hospital discharge ($P<0.0001$) and need for pulmonary vasodilator therapy ($P<0.0001$). In multivariable analysis, MR-EI, BPD severity, and birth weight were associated with hospital LOS ($r = 0.49$) and duration of respiratory support ($r = 0.55$), septal curvature and BPD severity were associated with respiratory support at hospital discharge ($r = 0.47$), and septal curvature was associated with need for pulmonary vasodilator therapy ($r = 0.66$, $p = 0.0014$).
Conclusions: MRI-derived indices including MR-EI and septal curvature correlate significantly with clinical outcomes including hospital LOS, duration of respiratory support, respiratory support level at hospital discharge, and pulmonary vasodilator therapy in neonates with BPD and BPD-PH.

Paper #: 018

Dynamic Contrast Enhanced MR Lymphangiography in Children

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Purpose or Case Report: Dynamic Contrast Enhanced MR Lymphangiography (DCMRL) allows evaluation of the central conducting lymphatics in patients with central lymphatic flow dysfunction. Direct injection of gadolinium contrast into inguinal lymph nodes followed by serial imaging allows visualization of lymphatic channels and lymphodynamics. This study reviews the DCMRLs performed at our institution over a 2 year period including indications, findings and impact on clinical management.
Methods & Materials: 8 children, 2 to 17 years (mean 6 years), underwent DCMRL on a Siemans Prisma 3T scanner. Following cannulation of bilateral inguinal lymph nodes under ultrasound guidance, T2 3D SPACE and pre-contrast 3D T1 VIBE were followed by serial VIBE imaging during administration of 0.1 mmol/kg Gadavist. Imaging was performed until opacification of the thoracic duct was seen and until no new additional areas of contrast leak or reflux were noted. Images were reviewed for opacification and anatomy of central lymphatics (cisterna chyli and thoracic duct), contrast reflux, and lymphatic leak as well as lymphatic channel engorgement on T2. Charts were reviewed for imaging impact on clinical decision making.
Results: Indications were chylothorax (4) -- current (2) and remote (2), protein losing enteropathy (1), expansile rib lesions in a Fontan patient (1), abdominal pain and mesenteric and retroperitoneal "mass" (1), renal lymphangiectasia (1) and chylopericardium (1). Contrast opacified the central lymphatics and demonstrated their anatomy in 8/8 patients. Reflux into abnormal lymphatic beds was seen including pulmonary (4), supraclavicular (3), intercostal (3), retroperitoneal (3), mesenteric (2), and pericardial (1). Site of chyle leak in 2 patients with chylothorax and 1 patient with chylopericardium were identified. One patient underwent successful percutaneous TD embolization with cessation of chylopericardium. Two patients' chylothoraces resolved with conservative management, and one patient avoided biopsy when rib lesions were found to be located at sites of chyle reflux. One patient with central conducting lymphatic anomaly was initiated on medical therapy with sirolimus. Two patients' imaging served as baseline, one prior to Fontan and one with renal lymphangiectasia and hypertension prior to undergoing tonsillectomy.
Conclusions: DCMRL offers direct visualization of the central lymphatics in children with potential to visualize a variety of lymphatic dysfunctions and can positively impact medical decision making.

Paper #: 019

Developing A Low Dose Dynamic Airway Protocol for Simulating Clinical CT Studies Utilizing A 3D Printed Infant Dynamic Airway Phantom

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Purpose or Case Report: Dynamic 4D CT (D4DCT) can replace bronchography in the assessment of tracheobronchomalacia (TBM) but setting up a new D4DCT service for infants with TBM poses unique challenges due to their venerability. Simulation prior to implementation is essential as D4DCT involves continuous volumetric CT scanning through the breathing cycle, potentially delivering high radiation doses. Radiation dose, gantry rotation and scan dynamics can be customized.Our purpose is to describe the development and implementation of CT dynamic airway protocol using a 3D printed *Infant Dynamic Airway Phantom* (phantom) for simulation of D4DCT in tachnypnoea and collapsible airways, thereby validating image quality and estimating radiation dose prior to clinical implementation.
Methods & Materials: Materialise Mimics™ was used with chest CT data of one infant to segment the air contained in the airway, which was wrapped in a 2mm offset to create a lumen model. The proximal airway was cut open for connecting to an ET-tube. The phantom was printed on a Stratasys Connex 500 in Tango+.Siemens FLASH CT was used for test imaging at rapid respiratory rates and various combinations of CT settings (kVp, mAs, cycle time, rotation time, and total number of rotations). The phantom was surrounded with 5" PMMA acrylic glass for attenuation and was connected via ET tube with an inflated cuff to a wall oxygen outlet for constant air flow. Infant respiratory rates and airway collapsibility were simulated by rhythmically occluding the tubing to a metronome set at 40bpm, causing expansion and collapsibility of the flexible phantom during inspiration and expiration respectively.
Results: A fixed technique setting at 80kVp, 6mAs, 0.28sec rotation time, 0.43sec cycle time, and a total number of 6 scan cycles provided satisfactory dynamic airway CT images capturing just over one breathing cycle. Settings are at the

minimum tube output equivalent to a total of 0.74 mGy/6 scan cycles in CTDI, predicted as a total clinical radiation dose of 0.2 mSv for a 4cm length of airway D4DCT.
Conclusions: The Phantom, combined with a set-up simulating a rapid respiratory rate and TBM, allowed us to design and validate a clinical CT protocol for D4DCT of an infant airway. It also allowed estimation and optimization of radiation dose prior to patient scanning. Clinical applications have further supported the predictions of image quality and dose by the phantom study.

Paper #: 020

Assessment of Germinal Matrix Hemorrhage on Cranial Ultrasound with Deep Learning Algorithms

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Purpose or Case Report: To assess whether a convolutional neural network (CNN) can be trained via transfer learning to accurately diagnose germinal matrix hemorrhage-intraventricular hemorrhage (GMH-IVH) on cranial ultrasound (CUS) by comparing its performance to that of a board-certified radiologist. Secondary endpoints will include the ability of CNN to grade GMH-IVH severity, identify GMH-IVH on MRI, and assess low-grade GMH-IVH on CUS that cannot reliably be seen by a radiologist.
Methods & Materials: In this IRB approved retrospective study, we reviewed records from our children hospital's radiology database. Consecutive patients, 6 months in age or younger, from January 2009 to September 2019, were screened for cranial ultrasounds performed at our institution with or without subsequent brain MRI. Patients with inadequate or incomplete ultrasound examinations due to a poor acoustic window from a closing anterior fontanelle were excluded.Types of data collected were as follows: patient characteristics, such as age, gender, diagnosis, and indication for imaging referral; and imaging data, including right and left GMH-IVH grade on ultrasound based on the 1978 classification proposed by Burstein, Papile et al. and presence of GMH-IVH on MRI.A total of 200 CUS were retrospectively utilized for the training and testing of a CNN binary classifier. Key sagittal images at the level of the caudothalamic groove were obtained from 100 patients with GMH-IVH and from 100 patients without hemorrhage. 20 cases were randomly allocated from the total for validation and an additional 20 for testing. We utilized transfer learning (VGG16) and data augmentation in our algorithm due to the low sample size. The model was then assessed using the test dataset with area under the Receiver Operating Characteristic curve and accuracy.
Results: Preliminary analysis using this small cohort suggests an accuracy in the 70-80% range with similar values for the area under the ROC curve.
Conclusions: A CNN trained on a small set of images with data augmentation is able to detect GMH-IVH on CUS with relatively good accuracy at superhuman speeds. We predict that further analysis with segmentation using a larger cohort will improve accuracy. This proof of concept may apply to other CUS diagnoses with the potential to create a neural network for grading GMH-IVH.

Paper #: 021

Assessment of Classic Metaphyseal Lesions on Bone Surveys for Non-Accidental Trauma with Deep Learning Algorithms

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Purpose or Case Report: To assess whether a convolutional neural network (CNN) can be trained via transfer learning to accurately diagnose metaphyseal corner fractures on long bone radiographs by comparing its performance to that of a board-certified pediatric radiologist. Secondary endpoints will include the ability of the CNN to detect the type of long bone presented on the radiograph as well as identify the chronicity of the fracture.
Methods & Materials: In this IRB approved retrospective study, we reviewed records from our children hospital's radiology database. Consecutive patients, 12 months in age or younger, from January 2009 to September 2019 were screened for bone surveys in the evaluation of suspected non-accidental trauma performed at our institution. Patients with inadequate or incomplete radiographic examinations due to poor patient positioning or overlying artifact were excluded.A total of 132 frontal radiographs of the femur were retrospectively utilized for the training and testing of a CNN binary classifier. Radiographs were obtained from 61 patients who were found to have femoral metaphyseal corner fractures and from 71 patients with normal femoral metaphyses and no metaphyseal corner fractures. Twenty cases were randomly allocated from the total for validation and an additional 20 for testing. We utilized transfer learning (VGG16) and data augmentation in our algorithm due to the low sample size. The model was assessed using the test dataset with area under the Receiver Operating Characteristic curve and accuracy.
Results: Using a small training dataset of 82 images, we achieved an accuracy of 95% with both validation (n = 20) and test (n = 20) datasets. Our model achieved an area under the Receiver Operating Characteristic curve of 0.94.
Conclusions: A CNN trained on a small set of images with data augmentation is able to detect metaphyseal corner fractures on long bone radiographs with relatively high accuracy. We predict that further analysis with segmentation using a larger dataset will further improve accuracy.

Paper #: 022

Virtual Reality Simulations of Pediatric MRI Exams Increase Anticipatory Knowledge and Reduce Nervousness in a Pediatric Cohort

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Purpose or Case Report: Virtual reality (VR) has been used successfully as a psychological preparation tool in the pediatric patient population for elective surgery, oncological procedures and pain management. MRI exams require patients to remain motionless in a small, confined space for extended periods of time creating nervousness and an inability to hold still. VR offers a new way to prepare pediatric patients for MRI through simulations to reduce nervousness and decrease motion, resulting in more successful imaging outcomes. This study is

designed to assess if VR simulations of an MRI exam can increase anticipatory knowledge and reduce nervousness in a pediatric cohort.
Methods & Materials: 30 pediatric patients were enrolled at an academic outpatient imaging facility (16 males, 14 females; mean age 11.7 years, range 7 years to 18 years). The VR application provided patients with an immersive simulation of an MRI assisted by a child life specialist. Patients were given the same survey pre and post VR simulation. They were asked to rate their degree of nervousness for the exam on a 10-point likert scale and if they knew what their MRI exam would be like. Patients were also asked pre and post VR simulation to rate whether their head hurt, eyes hurt, had an upset stomach, or felt dizzy to assess for "simulator sickness." A post MRI survey was also given and patients rated whether the VR simulation made them feel less nervous, helped them practice lying still, and whether they would recommend the VR simulation. Changes in likert survey responses pre and post VR simulation were assessed with non-parametric paired Wilcox signed rank tests (p-value < 0.05).
Results: VR not only increased patients' knowledge about what to expect for their MRI exam ($p < 0.0001$) but also subjectively reduced their nervousness for the exam ($p < 0.0002$). Patients reported not feeling a difference before or after VR as to whether their head hurt ($p = 0.7$), eyes hurt ($p = 0.4$), stomach hurt ($p = 0.1$), or they felt dizzy ($p = 0.5$). Patients felt that the VR simulation reduced their nervousness (average 8.6 out of 10), allowed them to practice lying still (average 6.8 out of 10), and would recommend the VR simulation to other pediatric patients (average 9.1 out of 10).
Conclusions: Based on patient survey responses, VR simulations reduce patient nervousness and increase anticipatory knowledge for pediatric MRI exams. Follow up studies are being performed to look at the effect of VR simulations on imaging outcomes.

Paper #: 023

Merge Cube Integration in Clinical Practice for Patients with Maxillofacial Anomalies

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Purpose or Case Report: Many studies have shown that patient education with interactive, multimedia design can enhance information retention. Merge Cube is a commercially available interactive object that allows one to use a phone or iPad to display and manipulate 3D images via an app. The purpose of this study is to determine if reviewing personalized 3D computerized tomography (CT) images via Merge Cube improves patients' education and understanding versus reviewing the images on a monitor.
Methods & Materials: We conducted a prospective randomized control study including patients from the plastic surgery clinic who had undergone maxillofacial CT for cleft lip and palate or orthognathic surgery. Patients were randomized into one of two groups: control patients had routine image explanation by their surgeon using 3D images on a monitor; and experimental patients had image explanation by their surgeon using a Merge Cube. Subjects in both cohorts completed an anonymous survey of their experience and satisfaction utilizing a 5 point Likert scale. Mann Whitney U tests were performed to compare the responses between the groups.
Results: A total of 27 subjects, control (n=12, 44%) and Merge Cube (n=15, 56%), participated in the study. The Merge Cube group said that they felt that the CT imaging was more clearly explained to them versus the control group (mean = 1.07 vs 1.33, p=0.25). Most importantly, the Merge Cube felt more involved in the decision making process versus the control group (mean = 1.27 vs 1.58, p=0.27) and felt that the surgeon explained the treatment options better (mean = 1.2 vs 1.42, p=0.35).
Conclusions: Although there was not a statistically significant difference between the two cohorts, the Merge Cube group consistently felt like they understood their condition better and felt more involved in their care. Hopefully a larger sample size will allow these results to reach statistical significance. Merge Cube has some potential to serve as an interactive tool to help improve overall patient care.

Paper #: 024

An Object Detection Machine Learning Model to Identify Rickets on Pediatric Wrist Radiographs

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Purpose or Case Report: Machine learning that can identify and localize objects in an image using a labeled bounding box is called object detection. The purpose of this study is to demonstrate object detection in identifying rickets on pediatric wrist radiographs.
Methods & Materials: The institutional review board approved this retrospective study. The radiology information system was searched for radiographic examinations of the wrist performed for the evaluation of rickets from 2007-2018 in children less than 7 years old. Inclusion criteria were an exam type of "Rickets Survey" or "Joint Survey 1 View" with reports containing the words "rickets" or "rachitic." Exclusion criteria were reports containing the words "renal," "kidney," or "transplant." Two pediatric radiologists reviewed the images and classified them as either rickets or normal. Twenty-six images were excluded because of: healing rickets (10), excessive artifact (8), discrepant radiologist interpretation (6), abnormal positioning (1), and duplicate image (1). The remaining images were annotated according to their classification by drawing a labeled bounding box around the distal radial and ulnar metaphases. The training dataset was created from those images acquired between 2007-2017. This included 264 normal wrists on 142 images and 104 wrists with rickets on 61 images (most images had bilateral wrists). This training dataset was used to create the object detection model using the Turi Create framework and YOLOv2 model with a Darknet base network on an iMacPro. The testing dataset consisted of those images acquired between 2017-2018. This included 37 normal wrists on 20 images and 20 wrists with rickets on 10 images. The model was tested on the testing dataset and model sensitivity and specificity calculated.
Results: Of the 20 wrists with rickets in the testing set, 16 were correctly identified as rickets, 2 incorrectly identified as normal, and 2 were not labeled. Of the 37 normal wrists in the testing set, 33 were correctly identified as normal, 2 incorrectly identified as rickets, and 2 were not labeled. This yielded a sensitivity and specificity of 80% and 95% for wrists with rickets and 89% and 90% for normal wrists. Overall model accuracy was 86%.

Conclusions: Object detection can be used to identify rickets on wrist radiographs. Further development with a larger training dataset is needed to improve model sensitivity and specificity, and robust testing is needed for model validation.

Paper #: 025

A Machine Learning Model to Detect Ingested Button Batteries and Coins on Pediatric Foreign Body Series Radiographs

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Purpose or Case Report: Timely diagnosis of foreign body ingestion in children is important, particularly in the case of an ingested button battery. A button battery which lodges in the esophagus can quickly cause severe esophageal and mediastinal injury. It is also important to distinguish an ingested button battery from a coin; a button battery may be misdiagnosed a coin because of its similar radiographic appearance. The purpose of this study is to develop a machine learning model to identify button batteries and coins on pediatric foreign body series radiographs.
Methods & Materials: The institutional review board approved this retrospective study. The training dataset was created from 228 images selected from foreign body series radiographs acquired between 2007-2017. It included 114 images with ingested button batteries, 57 images with ingested coins, and 57 normal images. For simplicity, only frontal radiographs were used. The type of foreign body was either endoscopically proven or confirmed by the consensus of three pediatric radiologists. The button batteries and coins were labeled with bounding box annotations. This training dataset was used to create the model using the object detector toolkit of the Turi Create framework and YOLOv2 model with a Darknet base network on an iMacPro. The testing dataset consisted of all foreign body series radiographs acquired between 2017-2018, a total of 1678 images (37 button batteries, 347 coins, 211 other foreign bodies, 1083 normal), however one image contained a superimposed button battery and coin and this was excluded. Coins and button batteries in the testing dataset were either endoscopically proven or confirmed by the interpreting radiologist in the setting of an appropriate history. The model was tested on the testing dataset and model sensitivity and specificity calculated.
Results: The sensitivity and specificity of the machine learning model for button battery detection was 81% and 92%, and for coin detection was 83% and 96%. Only 1% of normal images were false positive for a coin or button battery, but 58% of images with other foreign bodies (not a coin or button battery) were false positive for a coin or button battery. The overall accuracy of the model was 88%.
Conclusions: Machine learning can be used to identify and differentiate button batteries and coins on pediatric foreign body series radiographs. Further development with a larger training dataset is needed to improve model accuracy.

Paper #: 026

A Machine Learning Model to Detect Anatomical Regions of Interest on Pediatric Foreign Body Series Radiographs

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Purpose or Case Report: Foreign body ingestion is common in children. Timely diagnosis of the nature and location of the foreign body is important. A button battery which lodges in the esophagus can quickly cause severe esophageal and mediastinal injury. Machine learning that can detect anatomical regions of interest is an important step in computerized foreign body localization and may result in prioritization of radiographs with mediastinal foreign bodies. The purpose of this study is to develop a machine learning model to identify anatomical regions of interest on pediatric foreign body series radiographs.
Methods & Materials: The institutional review board approved this retrospective study. The training dataset was created from 357 images selected from foreign body series radiographs acquired between 2007-2017. The images consisted of a variety of frontal views of the neck, chest, abdomen, and pelvis. These images were labeled with bounding box annotations for the following anatomical regions: neck (262), mediastinum (317), abdomen (352), and pelvis (302). This training dataset was used to create the model using the object detector toolkit of the Turi Create framework and YOLOv2 model with a Darknet base network on an iMacPro. The testing dataset consisted of all foreign body series frontal radiographs acquired between 2017-2018, a total of 1679 images. The model was tested on the testing dataset and model sensitivity and specificity for each anatomic region was calculated. Only completely imaged anatomic regions were considered in the analysis; partially imaged anatomic regions were not considered (e.g., the abdomen on a chest radiograph or the mediastinum on an abdominal radiograph).
Results: Sensitivities for identifying anatomical regions of the neck, mediastinum, abdomen, and pelvis were 93.9%, 97.8%, 88.1%, and 90.3%, respectively. Specificities for identifying anatomical regions of the neck, mediastinum, abdomen, and pelvis were 99.8%, 99.8%, 100.0%, and 99.7%, respectively. Overall model accuracy was 94.1%.
Conclusions: Machine learning can be used to identify anatomical regions of interest on pediatric foreign body series radiographs. This model could be combined with a foreign body detection model to prioritize those exams with mediastinal foreign bodies for radiologist interpretation.

Paper #: 027

Distribution of Pediatric Imaging Acuity after Deploying Comprehensive Radiology Report Categorization System

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Purpose or Case Report: In an effort to improve communication of important radiology findings, we designed and deployed a unique comprehensive radiology report categorization (RADCAT) system that organizes results by acuity and need for radiology follow-up. The goal of our study is to outline and compare the distribution of RADCAT pediatric

imaging reports from three different clinical settings.
Methods & Materials: Our 87-bed pediatric teaching hospital is part of a multihospital academic tertiary care referral center. The RADCAT system was designed to categorize results of all diagnostic imaging studies at our health center and includes 5 categories: RADCAT1 – "Normal result", RADCAT2 – "Routine result", RADCAT3 – "Result with recommendation for non-urgent follow-up", RADCAT4 – "Priority result", and RADCAT5 – "Critical result". The grading system was implemented at our pediatric hospital in October 2017, after which every report generated within our dictation system required a RADCAT grade as a discrete data element prior to being finalized by the radiologist. Using standard search functions, we reviewed 2 years of data (October 1, 2017 – September 30, 2019) from the electronic health record to evaluate the distributions of report grading for pediatric patients in the emergency department (ED), inpatient, and outpatient settings.
Results: During the 2-year period review, 109,706 total RADCAT grades were assigned to pediatric imaging studies (21.3% RADCAT1, 48.7% RADCAT2, 3.9% RADCAT3, 25.7% RADCAT4, and 0.4% RADCAT5). There were several observations made when comparing the distributions of RADCAT categories from the ED, inpatient, and outpatient settings. Overall, ED and outpatient imaging study distributions were similar. Pediatric ED and outpatient imaging studies were six-times more likely to be graded with RADCAT1 and two-times more likely to be graded with RADCAT2 than inpatient imaging studies. Pediatric inpatient imaging studies had a higher proportion of RADCAT4 and RADCAT 5 results than ED or outpatient studies.
Conclusions: The RADCAT system has been successfully deployed throughout our pediatric hospital and provides a means for large-scale data analytics for continuous practice quality improvement and research. Based on review of 2 years of RADCAT distribution data, ED and outpatient imaging study distributions are similar with greater proportions of lower acuity studies in comparison to that of inpatient imaging studies.

Paper #: 028

Identification of Child Abuse Cases based on Electronic Health Records Containing Radiology Reports Using Convolutional Neural Networks

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Purpose or Case Report: Child abuse is the principal cause of traumatic injury and death in children 0-36 months old. Radiologic findings are a critically important piece of evidence necessary for assessment by a Child Protection Team to assess possible abuse. Current algorithmic strategies for the detection of abuse are sensitive, but compromise specificity. The purpose of this study was to determine the performance of deep learning to diagnose child abuse using Natural Language Processing of the unstructured free-text from Electronic Health Records (EHR), including essential information from Radiology Reports.
Methods & Materials: This retrospective study was approved by our IRB. The Child Protection Team of our Regional Referral Center processed 1123 patients between January 2015 and May 2019, roughly half were diagnosed as victims of abuse. We utilized these patients' EHR including Radiology Reports. Provider notes from the first encounter until the one prior to involvement of the Child Abuse Pediatrics Team (CAP-Team) were processed, enabling an assessment of abuse before CAP-Team involvement. We designed and optimized three natural language processing methods: Rules-based (88 rules), Bag-of-Words, and Word Embeddings, using Convolutional Neural Network approaches, and training with 10-fold cross validation.
Results: The best performing CNN approach was Bag-of-Words, achieving average accuracy of 89.9±2.6%, followed by Rules-based with accuracy 76.6±3.7%. Word Embeddings using two separate corpora had the lowest accuracy of 65.8±2.8% and 66.4± 3.8%. The average ROC-AUC was 93.1±2.2% for the bag of words, and 81.4±5.2% for rules-based. Word embeddings' results were not successful due to the lack of representative embedding. Saliency maps showed that radiologically determined words (negative, normal, fracture, musculoskeletal, head, swelling) were among those highly relevant to the classification.
Conclusions: We successfully applied deep learning networks trained on unstructured free-text; our methodology exhibited high accuracy and ROC-AUC for abuse classification. The Bag of Words algorithm is particularly successful, while word embeddings approaches fail due to a lack of representative embeddings. Radiological findings strongly influence the classification. By restricting the study to pre-CAP-Team involvement, these results are suggestive of a decision support aid that non-child-abuse-specialists may use to determine whether to involve a CAP-Team for the evaluation and management of a specific patient.

Paper #: 029

Imaging Appearance of Vaping-associated Pulmonary Injury

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Purpose or Case Report: Vaping associated pulmonary injury (VAPI) has recently received national attention as an epidemic resulting in cases of significant morbidity and mortality from electronic cigarette use. The purpose is to present the clinical and imaging findings in adolescents with pulmonary symptoms from suspected VAPI.
Methods & Materials: Imaging of all adolescents (<19 years old) with acute pulmonary symptoms and history of vaping were assessed. Imaging findings on chest radiographs and CT scans were reviewed by two radiologists in consensus. Clinical presentation and laboratory data was derived from the electronic medical records including pulmonary function tests (PFTs), bronchoscopy, and pathology if available.
Results: A total of 10 patients were identified (8 male, mean age 16.6 years, 15 to 18 years). Most common presentation was progressive, subacute respiratory distress with accompanying abdominal pain. All but one of the patients tested positive for THC on urine drug screen. Most (70%) had an elevated white blood cell count and serum inflammatory markers. Chest radiograph features were most notable for interstitial pattern of opacities (100%) and basilar predominance of abnormalities (80%). CT features were most notable for extensive ground glass opacities (89%), interstitial opacities (78%), subpleural sparing (67%) and apical to basilar gradient (78%). No cases demonstrated imaging evidence of lipoid pneumonia. One

patient negative for THC had inconsistent imaging findings demonstrating multifocal peripheral nodular opacities, large basilar consolidations, and small bilateral pleural effusions. Seven patients underwent PFTs which most frequently demonstrated mildly impaired diffusion (43%). One patient underwent flexible bronchoscopy and bronchoalveolar lavage with pathology demonstrating neutrophilia and lipid droplets in macrophages. Average length of hospital stay was 6 days. All patients received supportive treatment with supplemental oxygen and corticosteroids. Four required ICU admission.
Conclusions: Adolescents with suspected VAPI most commonly present with subacute respiratory distress with abdominal pain. Imaging findings of ground glass opacities, subpleural sparing, and an apical to basilar gradient were seen most consistent with organizing pneumonia or hypersensitivity pneumonitis. Recognition of the common spectrum of imaging findings may have significant patient management implications, especially if the diagnosis is not suspected clinically.

Paper #: 030

Tracheobronchomalacia on Dynamic Airway CT: Interreader Reliability

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Purpose or Case Report: Dynamic Airway CT (DACT) has risen in popularity in recent years, however, studies of Tracheobronchomalacia (TBM) are hindered by inconsistent definitions which variously rely on airway area, airway diameter, and qualitative measures. We explore the interrater reliability of these measures.
Methods & Materials: Retrospective review of our PACS was undertaken for cases of DACT cases demonstrating TBM. Our dynamic airway CT protocol included 6 sequential CT series imaging over 1-2 breath cycles. Studies were independently reviewed by 3 pediatric radiologists. Specific malacic segments for analysis were agreed upon in advance. The following features were assessed in end-inspiration and end-expiration:(1) max AP diameter, (2) max cross-sectional area and (3) length of malacic segment. Subjective categorical assessment of TBM was recorded. A subset of 2 raters used Aquarius iNtuition to measure the volume of collapse at end inspiration and expiration from the junction of the malacic segment with the normal airway. Intraclass correlation coefficient (ICC) was used for numeric variables and Fleiss's kappa (κ) was used for categorical variables.
Results: 8 patients with DACT demonstrated TBM. Mean age at presentation was 23 months (range 0 - 157). 4 lesions (50 %) were associated with extrinsic compression.Substantial agreement was seen with subjective scoring of TBM severity ($\kappa=0.69$, $p<0.001$). Agreement across all 3 raters was seen with 6/8 patients (75%). Poor reliability was seen with length of TBM segment (ICC=0.40, p=0.04).Moderate reliability of max AP diameter in inspiration and expiration was seen (ICC=0.634, ICC=0.541). Good reliability was seen with max cross-sectional area measurement in inspiration and expiration (ICC = 0.822, $p=<0.001$, ICC = 0.86, $p<0.001$). However, there was poor agreement for the percentage airway area collapse with ICC 0.13, p=0.274. Airway volume demonstrated good reliability on max inspiration (ICC = 0.862, $p<0.001$) and poor reliability on max expiration (ICC = -0.16, $p<0.001$). Poor reliability was seen when considering the percentage of volume collapse (ICC = 0.31, p=0.124).
Conclusions: Our data suggests that pediatric DACT may suffer from a lack of reproducible quantitative measures of TBM. In fact, percentage of diameter and cross-sectional area collapse demonstrated poor-moderate agreement. A 3D approach did not improve this. Interestingly, the only domain of robust agreement regarding TBM was the subjective rating, where 75% of cases generated complete agreement.

Paper #: 031

Chest Imaging Findings of ANCA-Associated Vasculitides (AAV) in Children

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Purpose or Case Report: The anti-neutrophil cytoplasmic antibody (ANCA)-associated vasculitides (AAV) are a group of autoimmune diseases characterized by vascular inflammation requiring immunosuppressive treatment. Involvement is most common of the kidneys and lungs, although there is a paucity of literature reporting the chest imaging findings in children. Our goal is to describe the salient chest imaging findings of pediatric AAV to promote recognition by radiologists.
Methods & Materials: A retrospective review of the electronic medical records of all patients with the diagnosis of AAV from 2008-2019 at our institution was performed and details regarding clinical presentation, management and outcome were extracted. The pulmonary and extrapulmonary findings on all chest computed tomography (CT) scans were recorded by a board-certified pediatric radiologist.
Results: AAV was diagnosed in 49 pediatric patients (female/male: 38/11). Mean age at presentation was 11.85+/- 4.94 and mean age at diagnosis was 12.55 +/- 4.7 years. Thirty-six (73.5%) patients presented with thoracic manifestations including cough (n=25), pulmonary hemorrhage (n=23), infection (n=11), shortness of breath (n=12), chest pain (n=8) and respiratory failure (n=8). Sixty-eight CT scans (66 helical/volumetric, 2 axial noncontiguous) of 30 patients were available for review. The most prevalent pulmonary findings on the 68 CT scans were pulmonary nodules in 28 (41%) with the nodules being poorly-defined in 89%, consolidation in 26 (38%) and ground-glass opacities in 26 (38%). Other findings included pulmonary cysts in 9 (13%), septal thickening in 9 (13%), fibrosis in 3 (4%), crazy-paving in 1 (1%) and bronchiectasis in 1 (1%). On the 66 helical/volumetric CT scans, the most common extrapulmonary finding was hilar/mediastinal lymphadenopathy in 18 (27%), followed by pleural effusion in 7 (11%), pleural thickening in 7 (11%), and pericardial effusion in 5 (8%). All patients were treated with intravenous corticosteroids and other immunosuppressants and immunomodulators resulting in clinical recovery, corroborated by improvement in the CT findings in all 16 patients with follow-up CT imaging.
Conclusions: Thoracic involvement is common in pediatric AAV. Typical manifestations on chest CT include poorly defined pulmonary nodules, pulmonary air space opacities and lymphadenopathy. Follow-up CT demonstrates improvement in the chest imaging findings in response to therapy.

Paper #: 032

Validating a Deep Learning Model that Detects Non-Diagnostic Pediatric Lateral Airway/Soft Tissue Neck Radiographic Exams for Clinical Use

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Purpose or Case Report: At our institution, airway radiographs are routinely checked by the radiologist to ensure diagnostic image quality prior to the technologist completing the examination. These checks interrupt the workflow for both the technologist and radiologist. In this study, we develop and validate a deep learning algorithm to detect non-diagnostic lateral airway radiographs.
Methods & Materials: Lateral airway radiographs scanned in the emergency room patients scanned between 01/01/2000 and 07/01/2019 were retrospectively queried from the PACS. Two radiologists reviewed and classified each radiograph as diagnostic or nondiagnostic. Disagreements were adjudicated by a third radiologist. This classification served as ground truth to train different deep learning models. The radiographs were assigned to training and test datasets using an 80/20 random data split. Data augmentation techniques like image rotation, shearing and translation were used during training. In order to evaluate the performance of the resultant algorithms, 3 technologists and 3 different radiologists classified the images in the test dataset as diagnostic or nondiagnostic. Inter-observer agreement between the technologists and between the radiologists was calculated and their consensus ratings were compared to the ground truth obtained from the original reviewers.
Results: The training set consisted of 615 radiographs (366 diagnostic/249 nondiagnostic) while the test set consisted of 239 radiographs (165 diagnostic/74 nondiagnostic). The best deep learning model (ResNet) achieved sensitivity, specificity, and AUC (area under the curve) of 0.90 (0.01), 0.82 (0.03) and 0.86 (0.02), respectively on the test set. The technologists achieved sensitivity, specificity, and AUC of 0.70 (0.10), 0.77 (0.10) and 0.74 (0.01) and the radiologists achieved sensitivity, specificity and AUC of 0.94 (0.03), 0.64 (0.09), 0.80 (0.03) versus ground truth. Inter-observer agreement for the technologists was fair (kappa=0.36), while that for the radiologists was moderate (kappa=0.59). Kappa value for agreement between the best deep learning model, consensus rating of three technologists, and consensus rating of three radiologists to the ground truth were 0.69, 0.49 and 0.66, respectively.
Conclusions: We report the development and validation of deep learning models that detect non-diagnostic pediatric DR airway/soft tissue neck X-ray exams and have shown that the algorithms perform significantly better than the technologists and as good as the radiologists.

Paper #: 033

Imaging Features of Adolescent EVALI (E-Cigarette or Vaping-Associated Lung Injury)

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Purpose or Case Report: Electronic cigarette (e-cigarette) or vaping product associated lung injury (EVALI) has become epidemic across the United States. To assist in prompt diagnosis, we describe the imaging features of adolescent EVALI.
Methods & Materials: A retrospective review of the electronic medical records of all patients treated for EVALI by the Texas Children's Pulmonology service was performed to extract details of the product, clinical presentation, pulmonary function testing (PFT), treatment and outcome. An experienced pediatric chest radiologist categorized the chest radiographs (CXR) as normal or abnormal, and systematically noted the findings in the lungs, pleural spaces and mediastinum on computed tomography (CT) exams.
Results: The 9 patients (7M:2F) ranged in age from 14 to 18 years. Vaping products included nicotine, flavoring agents and cannabinoid oils. Eight patients reported co-existing use of marijuana, cigarettes or cocaine. Vaping ranged from "almost daily" to "20-30 puffs daily" for 3 weeks to 4 years. Presenting signs/symptoms included cough, chest tightness, dyspnea, fever, abdominal pain, vomiting, malaise, and weight loss. CXR was abnormal in 8/9 at presentation. CT findings included diffuse ground-glass opacities (8/8), interlobular septal thickening (7/8), consolidation (6/8), mediastinal/hilar lymphadenopathy (6/8) and crazy-paving (6/8). Airspace opacities demonstrated subpleural sparing in 7/8. Two had pleural effusion and one had pulmonary nodules. The predominant pattern resembled diffuse alveolar damage, pulmonary hemorrhage, alveolar proteinosis, lipoid pneumonia or organizing pneumonia. EVALI was suggested in 2/9 radiology reports. Bronchoalveolar lavage done in one showed neutrophils, hemosiderin-laden macrophages, and lymphocytes. Eight received PFTs, which showed obstructive pattern in 4 and restrictive pattern in 3. No lung biopsies were performed. No respiratory tract infections were identified. Seven were treated with steroids and one required intubation. Follow-up CXR improved in 4/6 patients over a period of up to 1 month. None underwent follow-up CT.
Conclusions: Chest CT findings characteristic of EVALI in adolescents include diffuse airspace opacities with subpleural sparing, interlobular septal thickening, crazy-paving and lymphadenopathy. A normal CXR is uncommon but does not exclude the diagnosis, and CXR can demonstrate response to steroids. With the rising popularity of vaping, radiologists should be aware of the imaging features of EVALI to expedite diagnosis.

Paper #: 034

Development of Diagnostic Imaging Criteria for Clinical Trials in Pediatric Patients with Pulmonary Fibrosis

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Purpose or Case Report: Children's interstitial lung diseases

(chILD) comprise a large spectrum of rare diffuse lung disorders, with a subset of patients developing chronic fibrosing lung disease. While imaging criteria for lung fibrosis are established for adults and correlate with prognosis and outcome, there are limited data on imaging for diagnosis, prognosis, and outcomes in children with fibrotic lung disease. To fill this gap, a group of ILD specialists aimed to define the imaging features for diagnosis of lung fibrosis for a forthcoming randomized trial of nintedanib versus placebo in pediatric patients with fibrosing ILD (1199-0337; NCT04093024).
Methods & Materials: Imaging criteria for diagnosis of adult pulmonary fibrosis were reviewed by an international panel of radiologists and pulmonologists with experience in ILD and clinical trial application. High-resolution computed tomography (HRCT) scans from chILD cases with suspected fibrosis were reviewed and the adult imaging criteria adapted based on the characteristics observed. The resulting imaging criteria for lung fibrosis in chILD were agreed by expert consensus. In a case study, data driven texture analysis software (Humphries, Radiol 2017) was used to quantify the imaging criteria and changes over time on four longitudinal chest CT scans in a child with a genetic mutation of *SFTPC*.
Results: Study eligibility will be determined based on documented evidence of fibrotic lung disease by centrally confirmed HRCT. To qualify, patients need two longitudinal CT scans with at least two of: reticular abnormality, traction bronchiectasis, honeycombing, architectural distortion, or cystic abnormality. For patients with previous findings of fibrosis on lung biopsy, a single chest CT with either reticular abnormality, honeycombing, traction bronchiectasis, or architectural distortion will be sufficient. Ground glass opacity can be present but does not qualify as one of the fibrotic criteria. Findings from the case-study based on these imaging criteria appeared to show increased fibrosis over time.
Conclusions: Criteria for diagnosis of chronic fibrosing ILD in pediatric patients have been defined for evaluation in clinical trials. Case-study evaluation of changes over time suggests these criteria may also be useful to evaluate treatment response. Qualitative and quantitative methods will be used to assess fibrotic changes on chest CT in a sub-study of the planned clinical trial of nintedanib in children with lung fibrosis.

Paper #: 035

Work of Breathing in Neonates with and without tracheomalacia using Dynamic High-Resolution MRI Combined with Computational Fluid Dynamics

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Purpose or Case Report: Tracheomalacia (TM) is a common morbidity associated with prematurity and manifests as dynamic collapse of the trachea lumen due to cyclic changes of intrathoracic pressure during breathing. Premature infants often have elevated work of breathing (WOB) related to their distal, small airway and lung abnormalities. The large airway contribution to WOB can be determined using computational fluid dynamics (CFD), which is a well-known technique to calculate the resistance and WOB in the human airway. However, previous studies are based on static airway geometry without motion. Using the novel technique of ultrashort echo time (UTE) magnetic resonance imaging (MRI), the tidal volume and airway motion can be used to create a dynamic model for use in CFD. Our aim is to calculate the estimated WOB in a dynamic trachea with neonatal TM compared with a stable, static trachea.
Methods & Materials: Ten neonatal intensive care unit (NICU) patients diagnosed by bronchoscopy (5 with TM, 5 without TM) were imaged using UTE MRI (resolution 0.7x0.7x0.7 mm) in a neonatal-sized 1.5T scanner sited within the NICU. 7 patients were breathing room air at the time of MRI (postmenstrual age at MRI ~41 weeks), and 3 patients were on high flow nasal cannula. Images were retrospectively respiratory-gated based on the motion-modulated k-space center to generate 8 distinct images throughout the breathing cycle, from which tidal lung volumes were measured and airway surfaces generated via segmentation. The airflow rates were determined also using the k-space center Airway motion was defined via registration of each airway surface. STAR-CCM+ (Siemens) 11.06 software was used to simulate the airflow throughout the breathing cycle. The contribution of the airway (nasopharynx to carina) to WOB was calculated for each patient using patient specific CFD simulations. CFD simulations were run without airway motion using a static geometry (largest airway geometry detected during the breathing cycle) to compare the increase in the breathing effort due to motion.
Results: On average, TM caused 364% increased WOB compared to the static CFD model. Whereas, subjects without TM increased WOB only 36% due to less dynamic changes in the trachea.
Conclusions: This study demonstrates that WOB related to the large airway movement can be evaluated using patient-specific CFD based on retrospectively gated UTE MRI. Neonates with TM expend nearly 5 times more energy for breathing than if their airway was static.

Paper #: 036

Pediatric Mediastinal Masses: Prebiopsy Evaluation and Outcomes, A 10-year Retrospective Study

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Purpose or Case Report: Evaluate patient demographics, current imaging patterns, extent of disease, and tumor types in pediatric patients with mediastinal masses to assist with developing an imaging algorithm to streamline patient care.
Methods & Materials: Single institutional retrospective chart review of children with mediastinal masses between 2008 and 2018. Charts reviewed for pre-procedure symptoms, imaging characteristics, vascular and airway compression, pathologic results, and complications.
Results: 40 cases (33 initial, 7 residual/recurrent disease) of mediastinal masses in 37 patients were included for review. The median patient age at diagnosis was 15.03 years (IQR 11.67-17.27). In the initial diagnosis group, chest radiograph (n=29, 88%), and CT (n=31, 94%) were the predominant modalities used for prebiopsy evaluation. In the setting of recurrent disease, chest radiography x-ray (6), CT (5) and PET (4) were used to a identify residual/recurrent lesion. Physical signs or symptoms of mediastinal (vascular or airway) compression were present in 12 patients. On imaging, major airway compression was present in 22/33 patients with initial diagnosis and 1/7

patients with recurrent disease. Symptoms corresponded to a 67% PPV for vascular compression and an 83% PPV for airway compression. Major vascular compression was more common in primary disease (21/33) compared to recurrent/residual (2/7). Median interval between mass identification and biopsy was 1 day for the initial diagnosis group, and 4 days for the recurrent/residual disease group. Hodgkin's (18/40, 45%) and Non-Hodgkin's (12/40, 30%) lymphoma were the most common diagnoses. Other pathology included; Ewing sarcoma, aneurysmal bone cyst, Germ Cell Tumor, and neuroblastic tumor. In 4 cases a definitive result was not obtained from image guided biopsy. Bradycardic arrest occurred during a single procedure in a patient with central airway and SVC compression, that responded to CPR and change in patient position to alleviate airway/svc compression.
Conclusions: There is variation in imaging evaluation of initial and recurrent mediastinal masses in preparation for biopsy. Mediastinal compression is frequently present in both initial and recurrent disease, however, are inconsistently predicted by clinical symptoms. We propose an imaging algorithm that factors in radiation exposure, type of disease, patient age, signs and symptoms of vascular or airway compression to provide consistency and guidance for the pediatric and general radiologis

Paper #: 037

Pediatric Diagnostic Reference Ranges for Dual-energy Dual-source Contrast-enhanced Chest CT

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Purpose or Case Report: To develop diagnostic reference ranges (DRRs) for pediatric contrast-enhanced dual-energy CT (DECT) examinations as a function of patient size and radiation output of the CT scanner with comparison to conventional single energy CT (SECT).
Methods & Materials: This is an institutional review board-approved, retrospective study which included pediatric patients (age 8.0 ± 6.6 years, range newborn to 21 years) undergoing contrast-enhanced chest CT with either SECT or DECT on a dual-source CT system (Somatom Flash, Siemens), from September 2014 until September 2018. Volume CT dose index (CTDIvol) and patient effective diameter were extracted using dose tracking software (Radimetrics): SECT (N=264) and DECT (N=291). All exams used automatic exposure control and iterative reconstruction. SECT used automated kilovoltage selection (range 80 to 120 kV), and DECT used 80/140Sn kV. Patient data were grouped into one of five effective diameter ranges to allow development of DDRs as a function of patient size. The median, 25th and 75th quartile of the two CT dose indexes were determined for the corresponding effective diameters. Quantitative image metrics assessed included contrast, noise and contrast-to-noise ratio. Subjective image quality (scale 1, excellent, to 4, non-diagnostic) of 10 DECT and SECT scans from each circumference group was assessed Statistical unpaired comparisons were made between groups.
Results: For the five effective diameters (< 15cm, 15-19cm, 20-24cm, 25-30 cm and > 30cm), the median CTDIvol [25th-75th quartile] for DECT were 1.2 [0.9-1.3], 1.7 [1.4-2.0], 3.0 [2.4-3.6], 5.0 [4.3-6.0], 7.7 [6.0-12.8] mGy; and for SECT 1.0 [0.7-1.4], 1.2 [1.0-1.7], 3.5[2.4-5.0], 6.3[4.9-7.3], 9.4[8.1-12.1] mGy; respectively. The CTDIvol values were statistically similar between SECT and DECT across all groups, except in the 20-24cm group where the CTDIvol for DECT was lower ($P <$ 0.01). Quantitative and qualitative image quality was similar for both groups.
Conclusions: Dual energy CT can be used clinically in pediatric chest CT with radiation exposures and image quality similar to those of SECT. The DRRs (median, 25th and 75th quartiles) reported in this study as a function of patient size and radiation output can serve as reference standards to help manage pediatric patient radiation doses and image quality in DECT

Paper #: 038

Accuracy and Precision in Pediatric Chest Radiograph Interpretation: A Comparison of Pediatric Radiologists with Different Levels of Experience.

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Purpose or Case Report: Small airways disease (SAD) is a common pathology seen in pediatric patients. In suspected cases of SAD/RSV/bronchiolitis, chest radiographs are often ordered to diagnose disease and to rule out other conditions, such as bacterial pneumonia. While SAD and pneumonia have unique radiographic features, the threshold to diagnose such findings may depend on radiologist experience and training background. The purpose of this study is to investigate intra-radiologist precision and accuracy in diagnosing normal, SAD, and bacterial pneumonia on pediatric chest radiography.
Methods & Materials: An IRB-approved retrospective review was performed of all stat pediatric chest radiographs performed in patients aged 6 months to 6 years over a one-year period. Three fellowship-trained pediatric radiologists at different stages of their careers (early-, mid-, and late-career) assigned a diagnosis of normal, SAD or pneumonia to each of 100 randomly selected qualifying cases. Two to four weeks later, this process was repeated with the 100 cases presented in a different order. Intra-radiologist agreement was then assessed.
Results: Overall intra-radiologist agreement held an average kappa value of 0.64, indicating "good" agreement. Intra-radiologist agreement was 78% for the early-career pediatric radiologist (kappa value of 0.65), 79% for the mid-career pediatric radiologist (kappa value of 0.66), and 76% for the late-career pediatric radiologist (kappa value of 0.61). For all cases, accuracy was 71.5%, 68% and 69% for the early-career, mid-career, and late-career pediatric radiologist, respectively. In the first round, all three pediatric radiologists agreed on the diagnosis of "normal" 71% of the time, "SAD" 66% of the time, and "Pneumonia" 95% of the time.
Conclusions: Our findings demonstrate that there is no statistically significant difference in the precision or accuracy with which pediatric radiologists of different levels of training interpret pediatric chest radiographs. Nevertheless, both overall precision and accuracy were lower than anticipated, which appears to be primarily due to inconsistency in diagnosing SAD. Ongoing studies comparing radiologists of different subspecialties and comparing staff and resident radiologists are currently in process and will allow for more complete characterization of this study's conclusions.

Paper #: 039

Short and Intermediate Term Impact of the Fontan Operation On Liver Stiffness

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Purpose or Case Report: The Fontan operation, used to palliate single ventricle congenital heart disease, increases venous pressure in the liver and is associated with Fontan associated liver disease (FALD), for which liver fibrosis is the final common pathway. Elastography (ultrasound [US] or MRI) can be used to non-invasively measure liver stiffness associated with liver fibrosis. However, these measures are confounded in Fontan patients due to venous congestion. The purpose of this study was to prospectively document the stiffening effect of passive hepatic congestion following the Fontan operation and track changes in liver stiffness over the post-operative period.
Methods & Materials: This was a prospective study conducted under IRB approval with written informed consent. Patients scheduled for the Fontan operation underwent baseline liver US with 2D shear wave elastography (SWE) prior to surgery. Patients then underwent follow-up SWE at 24-96h post-Fontan, hospital discharge (6-8 days post-Fontan), 6-months, and 1-year. For each SWE examination, 10 shear wave speed measurements were obtained in the right hepatic lobe. Descriptive statistics were used to summarize population characteristics. Patient shear wave speed (SWS) data were expressed as medians (mSWS).
Results: 23 patients (78% male) were imaged 24-96h postoperative, 20 were imaged at discharge, 15 were imaged at 6-months, and 7 were imaged at 1-year. Mean age at baseline US was 3.8±0.9 years. The most common cardiac lesions were: hypoplastic left heart syndrome (n=11) and tricuspid atresia (n=8). All but two patients underwent extracardiac conduit Fontan. Population median mSWS was 1.28 m/s at baseline, increased to 2.27 m/s postoperative, and remained relatively stable thereafter (1.92 m/s at discharge, 2.17 m/s at 6-months, and 2.02 m/s at 1-year). Median mSWS change from baseline was 1.02 m/s postoperative, 0.73 m/s at discharge, 0.77 m/s at 6 months, and 0.8 m/s at 1 year (all statistically significant, $p<0.0001$). Changes in mSWS from discharge to 6 and 12 month post-Fontan ultrasound were not statistically significant. There was no significant difference in mSWS at baseline based on cardiac lesion and no significant difference in change in mSWS between baseline and follow up based on surgery type.
Conclusions: Fontan palliation of single ventricle congenital heart disease results in immediate and sustained postoperative increases in liver stiffness measured by US 2D SWE that persist for at least one year.

Paper #: 040

4D flow MRI of the Whole Heart in 4 Minutes with Compressed-SENSE: Feasibility for Quantification of Pathological Flow in Pediatric Congenital Heart Disease

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Purpose or Case Report: 4D flow MRI with full coverage of the heart and proximal vessels is a powerful tool to understand hemodynamic pathology arising from congenital heart disease (CHD) and subsequent surgery; however, scan times often exceed 10 minutes thereby limiting widespread adoption in pediatrics. Decreasing scan time using compressed-SENSE (CS), a combination of conventional parallel imaging (SENSE) and randomized spatial undersampling, shows promise over SENSE alone. However, both the feasibility and its effect on accurate flow quantification in pediatrics has not been evaluated. This study investigated the feasibility of CS for pediatric 4D flow MRI to quantify flow indices used in risk stratification of CHD such as coarctation or pulmonary regurgitation, in comparison with SENSE.
Methods & Materials: 15 patients (15.0±7.3y) with CHD were enrolled. All patients' images were acquired on a Philips Ingenia 3T with CS=6 and separately with SENSE= 2 (phase encode) x 2 (slice), with online reconstruction. Images were processed to remove noise and velocity aliasing. To quantify blood flow, 4 anatomical landmarks were defined for the aorta and 3 were defined for the pulmonary arteries. Peak velocity, systolic flow rate, and net flow rate were computed at each landmark. In addition, based on this data, Qp/Qs was derived. For patients with pulmonary regurgitation or aortic coarctation, regurgitant fraction and maximum peak velocity at the coarctation were quantified. A two-tailed, paired t-test was used for statistical analysis.
Results: Of 15 patients, 3 patients had hemi-Fontan circulation or uncorrectable severe aliasing in their images and pulmonary measurements were not included. 2 patients had coarctation and 3 patients had pulmonary regurgitation. CS achieved a reduction in scan time of 30.2% over the SENSE approach (3:47±1:07mins vs. 5:25±1:32mins, respectively). No statistical differences were found for peak velocity, peak flow rate, and net flow ($p > 0.08$ for all measurements). Qp/Qs showed no statistical differences ($p=0.14$) with mean values of 1.12±0.24 (CS) and 1.05±0.24 (SENSE). Coarctation velocities were equivalent with a mean difference of 5.6% (subject 1: 1.56m/s vs. 1.48m/s; subject 2: 2.60m/s vs. 2.46m/s; CS vs. SENSE). Regurgitant fraction had a mean difference of 1.9% (23.3±4.6% vs. 21.4±8.1% CS vs. SENSE).
Conclusions: CS 4D flow can measure whole heart pediatric hemodynamics in less than 4 minutes, suggesting CS can be implemented for pediatric patients in a clinically relevant time window.

Paper #: 041

Use of Compressed Sensing to Reduce Scan Time and Breath-holding for Cine bSSFP in Pediatric Cardiac MRI

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Purpose or Case Report: **Introduction**: Conventional pediatric MRI acquisitions of a short axis (SA) stack for ventricular volumes typically requires one breath-hold per slice, resulting in multiple coordinated breath-holds under anesthesia to acquire the entire stack. Here, we aim to validate a compressed sensing approach to reduce breath-holding during SA balanced steady state free precession (bSSFP) cine imaging. Equivalency is tested via qualitative image scoring and global volumes

compared to conventional bSSFP cine imaging.
Methods & Materials: **Method:** 22 patients undergoing clinically indicated cardiac MRI were enrolled in this IRB-approved study (age: 16±8y [range: 3-36]; 12 females; HR: 71±15bpm [range: 50-117]). All imaging was performed on a commercial 3T scanner (Ingenia, Philips Healthcare) using retrospective ECG-gated cine bSSFP. Cine SA images covering both ventricles were acquired with conventional parallel imaging (SENSE = 1.5-2) and a vendor-optimized parallel imaging/compressed sensing approach (compressed SENSE [CS] = 2.5 < 40 kg ≤ 3.5). Identical image acquisition parameters were used (TR/TE/FA: 3 ms/1.5 ms/40-45°; in-plane voxel resolution: 0.9-1.4 mm; 10-14 slices; slice thickness: 6-10 mm; temporal resolution: 30±5 ms [17-40 ms]). Image quality was scored for blood-myocardial contrast (BMC), edge definition (ED), and presence of artifact (PA) by an experienced radiologist. Quantitative comparisons included LV and RV end systolic volume (ESV), end diastolic volume (EDV), ejection fraction (EF) (Circle CVI42, Calgary).
Results: **Results**: No differences were found with image scores for BMC, ED, and PA (p = 0.67, 0.27, 0.14). No differences were found between LV EDV, ESV, and EF for the two sequences (p = 0.92, 0.77, 0.33) or RV EDV, ESV, and EF (p = 0.18, 0.13, 0.58). Scan duration (not including rest between breath-holds) was 8±2 s/slice for conventional imaging (1min36s±24s total) vs. 4±2 s/slice for CS (54 s±18 s total). With CS, 2-4 slices were acquired per breath-hold, further speeding up acquisition 2-4 times (including rest between breath-holds).
Conclusions: **Conclusion:** Equivalent image quality and cardiac volumes were found between acceleration approaches. The time savings per slice acquisition with CS allowed for a 75% reduction in number of breath-holds (12 vs. 3) without differences in qualitative or quantitative measurements as compared to the conventional technique. These time savings will reduce the number of breath holds and result in and shorter and simpler anesthesia protocols.

Paper #: 042

Tomographic Characteristics of the Left Pulmonary Artery Sling: Report of Eleven Cases and Review of Literature

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Purpose or Case Report: To describe CTA findings of children with left pulmonary artery sling (LPA) using the classification proposed by Wells, et al and report associated anomalies and surgical outcomes.
Methods & Materials: In a multicentric study from 2013 to 2019, we retrospectively identified 11 patients with a left pulmonary artery sling referred for CT angiography. Demographics, clinical data and outcomes were collected from their medical records. CTA findings were collected by two pediatric radiologists. In all cases, 3D volume-rendered reconstructions plotting the airway and central vessels were obtained.
Results: of the 11 patients (median age: 6 months, range: 1-44 months; 6 girls:5 boys), 9 (81.8%) were symptomatic, with shortness of breath and/or stridor at presentation.There were seven patients with type 1 (type 1A: n=5, type 1B: n=2) and 4 patients with type 2 (type 2A: n=3, type 2B: n=1). Seven patients had associated cardiovascular anomalies, including ventricular and atrial septal defects (n=3, each), persistent ductus arteriosus and persistent left superior vena cava (n =2, each), and also one case each of partial anomalous pulmonary venous return, pulmonary stenosis, total anomalous pulmonary venous return and foramen oval permeable respectively. The proximal branches of the right pulmonary artery (RPA) had its origin 10 of the 11 cases on the RPA, only one patient showed an anomalous origin of the right middle pulmonary artery from a common orifice between the RPA and LPA. The LPA reanastomosis was performed in 8 patients, including two patients with accompanying tracheoplasties. 2 patients of this series died before surgical correction.
Conclusions: Left pulmonary artery sling is an uncommon vascular ring and CT angiography is an accurate method for demonstrating it and its associated cardiovascular anomalies for an optimal presurgical evaluation of LPAS.

Paper #: 043

Hemodynamic Assessment of Anomalous Aortic Origin of a Coronary Artery (AAOCA) in Children Using Patient-Specific Flow Models

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Purpose or Case Report: AAOCA is the second leading cause of sudden cardiac death in the young which typically occurs with exertion. With in-vitro patient-specific modeling the study aims to assess the differences in fractional flow reserve(FFR)with hyperemia(high-flow)in a patient with AAOCA with a confirmed ischemic event and compare it to a patient with normal coronaries
Methods & Materials: Patient-specific flow models were created after segmenting CT data and 3D printed using Agilus a flexible material whose compliance was matched to native aortic tissue from 2 subjects:1)11 year old male with anomalous right coronary artery(RCA)with a 12.3mm intramural course, slit-like ostium and confirmed ischemia on stress testing; 2)16 year old male with normal coronary artery anatomy. The two models were placed in a left heart duplicator under exercise conditions of 90bpm, cardiac output of 5L/min and mean aortic pressure of 100mmHg. RCA flow at baseline was set to account for 30% of 4-5% of the cardiac output. Pressure waveforms were recorded using a Millar catheter starting in the aorta, through ostium and intramural segment into RCA mediastinal segment. FFR was computed as the ratio of distal to aortic pressure. A simulated stress test was performed, increasing the aortic pressure from 100 to 240mmHg to observe effects of pressure-driven anatomical deformation on coronary flow
Results: In normal RCA, FFR measurements from the aortic position to the mediastinal segment showed no sign of ischemia(FFR>0.8). In the anomalous RCA, FFR measurements under exercise conditions showed a significant drop in FFR in the middle of the intramural course to<0.6, indicating conditions for ischemia. FFR recovered distal to the intramural segment,

but remained<0.8. Exposing the models to the simulated stress illustrated an unhindered increase in coronary flow in response to aortic pressure with the normal model compared with the ischemic AAOCA model, with the latter showing a slope on the flow-pressure curve that was 2.2 times lower than that obtained with the normal coronary
Conclusions: Ischemia in AAOCA patients may manifest through dynamic biomechanically driven flow resistance related to the morphological substrate like ostial stenosis and intramural course. In AAOCA with clinically documented ischemia, FFR significantly decreases at the ostium and intramural course, and resistance to flow with increasing aortic pressure increases(absent in normal coronaries). These findings may highlight the mechanisms leading to sudden death in AAOCA

Paper #: 044

Patient specific 3D-printed Modeling for Risk-stratification in Anomalous Aortic Origin of a Coronary Artery (AAOCA): Material Selection, Model Creation and Validation

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Purpose or Case Report: Morphological features including intramural course, high ostial location, and slit-like ostium are considered risk factors for sudden death in patients with AAOCA. Assessment of coronary blood flow at rest and hyperemia may contribute to understanding the cause of death, and to risk stratification and management. A patient-specific biomechanical 3D printed model incorporating morphological features derived from CTA was developed to quantify coronary blood flow in AAOCA.
Methods & Materials: IRB approval was obtained. Retrospectively ECG-gated CTA data from an AAOCA subject was used to segment the aortic valve, proximal aorta, and proximal right and left coronary arteries. 3D virtual models were created and exported as .STL format into CAD modeling software to create vessel walls and connections to inflow and outflow pipes. To determine material composition and properties, dog bone samples were designed per ASTM standards, printed with Agilus 30 on a CONNEX 350, and coated with Parylene (PY), polyurethane (PU) or silicone (SI) to create desirable optical and mechanical properties, and compared to fresh pediatric human aorta specimen stored in alcohol on an Instron machine to derive stress/strain curves and dynamic modulus and stiffness values. Aortocoronary pulsatile flow phantoms were designed and 3D printed with Agilus 30, Visijet S500, and silicon molding. The 3D printed model was filled with iodinated contrast, connected to a pulse duplicator, scanned using volumetric CT. Data was subjected to blinded standardized assessment for AAOCA by an expert reader, and compared to original patient dataset.
Results: Properties of Agilus 30 coated with polyurethane and silicon at 2mm thickness were found to closely mimic properties of native aorta, with tensile strength ranging between 2.4 and 3.1 MPa. A 0.8 mm intimal wall thickness (WT) for the intramural segment, 1mm WT for the mediastinal coronary, and 2mm WT for the aorta were assigned. There was complete agreement between the CT assessment of the 3D printed model and patient CTA for location of the ostia, branching pattern, ostial stenosis, presence of intramural course and length of intramurality. Dynamic cross-sectional measurements of proximal coronaries in the intramural and mediastinal segments were identical to patient CTA.
Conclusions: It is possible to transfer key morphological variables in AAOCA from CTA to a 3D printed model that can be used for biomechanical testing and flow analysis.

Paper #: 045

Motion Corrected Free-Breathing (FB) Late Gadolinium Enhancement (LGE) in Duchenne Muscular Dystrophy (DMD): A Suitable Alternative to Traditional LGE Sequence.

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Purpose or Case Report: DMD is X-linked cardiac and skeletal myopathy caused by dystrophin protein deficiency with early death by cardiomyopathy. Cardiac magnetic resonance imaging (CMR) with myocardial fibrosis by late gadolinium enhancement (LGE) precedes decline in ejection fraction (LVEF) and may alter management in DMD. Muscle weakness limits ability to perform consistent breath-hold (BH) in traditional LGE sequences. Free-breathing (FB) LGE with motion correction (MOCO) allows improved visualization. We hypothesize that FB LGE with MOCO provides equivalent diagnostic quality with similar scan time to traditional LGE sequence.
Methods & Materials: IRB approved retrospective analysis of 28 patients with DMD undergoing clinical CMR from April to October 2019. All subjects scanned on 3T Seimens Skyra with 1) traditional BH, phase sensitive inversion recovery, spoiled gradient echo (BH-SGRE) and 2) FB-MOCO, PSIR, single shot, balanced SSFP sequences in short-axis plane (FB-MOCO), 10-15 minutes after 0.1 mL/kg Gadavist injection for LGE. BH-SGRE slices were acquired over 10-12 heart beats (~50 ms/beat), while FB-MOCO slices were acquired in one heartbeat (~260 ms). Both sequences had spatial resolution of 1.1x1.1x8 mm3. 139 slices were compared for image quality in blinded fashion by two independent readers using Likert scale scoring system of 1-5 (1=non-diagnostic, 5=excellent). Presence of artifacts and DME was similarly assessed.
Results: Mean±SD age of sample was 13.2±2.8 years, BSA 1.4±0.4 m2, heart rate of 90±15 bpm, and LVEF of 55±5 %. Mean±SD scan duration was 1.4±0.4 min for BH-SGRE and 1.6±0.6 min for FB-MOCO. Image quality score was comparable with median [IQR] BH-SGRE: 3.5 [3.4 - 3.6] vs. FB-MOCO: 3.6 [3.5 -3.8]. Both techniques identified fibrosis equally in 13/28 patients (BH-SGRE:88 segments vs FB-MOCO:91 segments of LGE). Blurring of myocardium seen in 37% of BH-SGRE and 11% of FB- MOCO. Pericardial artifacts related to magnetic inhomogeneity seen in 4% of BH-SGRE and 36% of FB- MOCO. Ghosting artifacts seen in 7% of BH-SGRE and 2% of FB- MOCO.
Conclusions: The FB-MOCO sequence provides similar diagnostic quality and acquisition duration compared to BH-SGRE LGE in patients with DMD. There were no significant diagnostic discrepancies between techniques. There is decreased motion blur/ghosting artifact, but increased magnetic inhomogeneity artifact in the FB-MOCO technique. This technique may be suitable in patients with difficulty breath holding and requiring LGE assessment.

Paper #: 046

Radiologic Evidence of Portal Hypertension can Identify Patients at Risk for Fontan Failure

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Purpose or Case Report: Portal hypertension is a manifestation of Fontan-related venous congestion and hepatic fibrosis. We studied the prevalence of radiologic evidence of portal hypertension (RP) and its association with Fontan hemodynamics and adverse outcomes. We also tested the validity of the VAST score, used in a prior study, in our population.
Methods & Materials: Fontan patients who underwent cross-sectional abdominal imaging between 2012 and 2019 were retrospectively reviewed. RP was defined as the presence of ≥2 of the following: varices (V), ascites (A), or splenomegaly (S). The VAST score was calculated as 1 point for each of V, A, S, or T (thrombocytopenia). High Fontan pressure was defined as Fontan pressure >13 mm Hg on catheterization. Fontan failure (FF) was defined as diuretic escalation, ventricular assist device placement, heart transplant, or death. Associations were assessed using univariate and multivariate logistic regression.
Results: We included 124 patients with mean age and time since Fontan of 24±9 and 17±7 years, respectively. The overall distribution of V, A, S, and T was 18 (14%), 26 (21%), 36 (30%, n=119), and 36 (29%), respectively. 25 (20%) patients met the definition of RP, and 35 (28%) patients had a VAST score ≥2. FF was noted in 27 (22%) patients at the time of abdominal imaging or during follow-up.On univariate analysis, patients with RP were more likely to have high Fontan pressure (79% vs 30%, p<0.0001) measured at a median interval of 1.0 (IQR 0.2-2.8) year from abdominal imaging. They were also more likely to experience FF (OR 4.1, 95% CI 1.6-10.6, p=0.003). FF was associated with VAST score ≥2 (OR 3.9, 95% CI 1.6-9.6, p=0.002) but not with thrombocytopenia alone (OR 1.3, 95% CI 0.5-3.2, p=0.58). Patients with FF were older (28±13 vs 23±8 years, p=0.02) and were more likely to have high Fontan pressure (67% vs 30%, p=0.002) and moderate or severe ventricular dysfunction (VD) on imaging (28% vs 7%, p=0.004).On multivariate analysis, RP was independently associated with FF when adjusted for VD and age (OR 4.1, 95% CI 1.5-11.6, p=0.007), but not when adjusted for high Fontan pressure (OR 1.4, 95% CI 0.4-5.4 p=0.602). Similarly, VAST score ≥2 remained significant after adjusting for VD and age (OR 3.6, 95% CI 1.4-9.6, p=0.01) but not for high Fontan pressure (OR 1.7, 95% CI 0.5-5.8, p=0.36).
Conclusions: Radiologic evidence of portal hypertension may herald higher Fontan pressures and increased risk of FF. Thrombocytopenia did not independently predict adverse outcomes in our study.

Paper #: 047

Detection of Anomalous Aortic Origin of a Coronary Artery (AAOCA) by Echocardiogram: When Does Cardiac Computed Tomographic Angiography Add Value?

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Purpose or Case Report: Anomalous Aortic Origin of Coronary Artery (AAOCA) is the 2nd most common cause of sudden cardiac death in the young. Coronary artery origins are evaluated as part of transthoracic echocardiography (TTE) and diagnostic precision may be limited by technical limitations, operator dependence, and patient cooperation. MRI and gated Cardiac Computed Tomographic Angiography (CCTA) are often utilized in patients where an anomaly is suspected on TTE. There is limited literature comparing TTE and CCTA in children with suspected AAOCA. The purpose of this study is to determine the distribution of various coronary anomalies comparing TTE and CCTA data, and define the added value advanced imaging brings in clinical decision-making.
Methods & Materials: Following IRB approval, retrospective review of data was obtained, over a 3 year period, in patients aged 0-18 years who underwent TTE and CCTA for suspected AAOCA . Exclusion criteria included non-diagnostic TTE or CCTA. Patient demographics, CCTA and TTE findings, and interventions performed were recorded.
Results: 100 consecutive patients were included (60 % male), mean age 11 years (7days-18 yrs). All patients had a TTE interpreted by a pediatric cardiologist prior to CCTA with the mean time interval between studies of 80 days (0-257 days). In 93 patients, CCTA detected 94 anomalous coronaries (90 anomalous right coronary artery(RCA), 3 anomalous left coronary and 1 anomalous circumflex arteries). Definitive coronary abnormality was reported on TTE in 77 patients; 76 (99%) of which were confirmed by CCTA, 1 patient was found to have a normal variant. Surgery was performed in 10 patients (13%) in this group. Suspected anomalous origin was reported in 16 patients on TTE, 13 of which were abnormal on CCTA. Surgery was performed in 1 patient in this group (7.7%). Coronary origin was not seen on TTE in 6; of these, 3 had AAOCA on CCTA and 3 had hypoplastic RCA with left dominant system. Only 1 patient who had a normal TTE was found to have AAOCA on CCTA.
Conclusions: CCTA adds value in diagnosing AAOCA when coronary origins are not well assessed or suspected anomalous origin is suggested on TTE. However, when a confident definitive diagnosis of AAOCA is reported on TTE, CCTA did not yield a change in diagnosis. Thus, the significant contribution of CCTA in patients with AAOCA relates to highly detailed findings on the precise origin/spatial relation, ostial morphology, and course of the anomalous coronary artery.

Paper #: 048

Role of Gated Cardiac Computed Tomographic Angiography in the Evaluation of Surgical Complications After Stage I Norwood Procedure and its Implications on Management: A Comparative Study with 2D-echocardiography

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Purpose or Case Report: Norwood procedure is a 3-stage surgical palliation for patients with functionally single ventricle anatomy, most commonly hypoplastic left heart syndrome. Complications after stage I operation are not uncommon and include Blalock Taussig Thomas (BTT) /Sano shunt abnormalities, Damus-Kaye-Stansel (DKS) anastomotic narrowing, and neo-aortic arch /branch vessel stenosis. Transthoracic echocardiography (TTE) is traditionally the mainstay for evaluation. The purpose of our study is to compare Gated Cardiac Computed Tomographic Angiography (CCTA) with TTE when evaluating post-operative complications after stage I Norwood procedure and implications of CCTA findings on management.
Methods & Materials: We performed a retrospective chart review of all patients who underwent urgent CCTA for suspected complications related to stage I Norwood procedure over a 4-year period. Elective Pre-Glenn CCTA's were excluded. Patient demographics, CCTA findings, TTE findings, as well as interventions performed were recorded.
Results: 34 patients were included. Male to female ratio was 1:1. The mean age at CCTA was 63 days (range 4-210 days). All patients had a prior TTE with the mean time interval between TTE and CCTA of 2 days (range 0-9 days). CCTA detected 57 abnormalities in 30 patients, with 23 directly related to post-surgical complications including shunt related complications (10/23, 43%), DKS anastomotic narrowing (2/23, 9%), and neo-aortic arch/branch vessel abnormalities (11/23, 48%). The 23 complications were managed as follows: surgery (9, 39%), catheter-based intervention (7, 30%), medical/no change in management (7, 30%). TTE missed 10/23 (43%) findings detected by CCTA of which 50% had direct surgical/interventional implications, either managed with surgery (3/10, 30%) or catheter-based intervention (2/10, 20%).
Conclusions: CCTA plays an important role in detecting surgical complications after stage I Norwood procedure, and identifies additional findings compared to TTE that have direct surgical/interventional implications. CCTA should be part of imaging algorithm in imaging these patients.

Paper #: 049

A Comparison Between a Prototype 3D UTE and PETRA Pulse Sequence for Pediatric MSK Imaging.

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Purpose or Case Report: Ultra-Short Echo Time (UTE) imaging, characterized by acquisition schemes with Echo Times (TE) of < 1 msec, have enabled new applications of pediatric musculoskeletal (MSK) MRI including cortical bone, tendons and ligaments. The protons in the bone collagen matrix have an effective T2* on the order of 20 – 80 μsec. The UTE sequence consists of a 40 μs long non-selective RF pulse followed by transmit/receive switch time and a 100% asymmetric data, i.e. free induction decay, acquisition from the center to the surface of a sphere. In order to achieve the shortest possible TE, data acquisition starts already during ramp-up time of the readout gradient. The aim of our study was to assess the feasibility and compare two UTE sequences, a prototype 3D UTE with radial koosh-ball acquisition and clinically available pointwise encoding time reduction with radial acquisition (PETRA), in pediatric patients referred for clinical MSK studies.
Methods & Materials: This prospective study included patients referred for clinical MR imaging, and underwent UTE imaging using both 3D with radial koosh-ball acquisition (TE = 0.04ms) and PETRA (TE=0.07ms). Scans were done on 3T Skyra (Siemens, USA). Qualitative assessments were performed between conventional sequences and UTE sequences.
Results: A variety of pediatric MSK studies with pathology were compared, located at various anatomic locations, including knees, shoulders, elbows and ankles. There were no differences (p=0.08) in the sequence acquisition time between prototype 3D UTE (mean time, 6 mins.) and PETRA (mean time, 5 mins.) with read-out voxel size ranging 0.5-0.7mm. When compared to routine conventional (TE>1msec) pulse sequences, UTE imaging provided a more direct depiction of the regional osseous anatomy and morphology. Small cortical avulsion fractures are often only conspicuous on UTE imaging when compared to conventional sequences. When compared to PETRA, 3D UTE was less susceptible to signal loss outside of the immediate isocenter of the designated field of view. We will share images showing the importance of using UTE for clinical bone imaging.
Conclusions: UTE is becoming an important diagnostic tool for assessing cortical bone. Our results show UTE images obtained using 3D with radial koosh-ball acquisition are superior as compared to PETRA in terms of image quality.

Paper #: 050

Advanced Cartilage Imaging in Children During Skeletal Maturation: Complementary Approach with MR T2 and T1rho Mapping

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Purpose or Case Report: Cartilage imaging in adults has been a rich area of research in which MR T2 and T1rho mapping provide complementary information regarding the extracellular matrix, including collagen fibers and glycosaminoglycans, respectively. However, in the pediatric population, there remains a need to obtain normative data for these variables during skeletal maturation. The purpose of this study is to provide complementary information regarding cartilage during skeletal maturation with T2 and T1rho maps.
Methods & Materials: Twenty two asymptomatic subjects (5 to 23 yrs, mean 14.6 +/- 5.3 yrs, 10 female,12 male) underwent knee MRI including axial and sagittal T2 and T1 rho mapping with 3T scanner. Mean T2 and T1rho of the patella and distal femur (anterior, central, and posterior) were measured. Physeal patency (open, closing/closed) was recorded. Mean values were correlated with age (Pearson correlation) and compared based

on physeal patency (t-test) and location (1-way ANOVA). In addition, spatial variation (mean values as a function of normalized distance from the osteochondral to articular surface) was evaluated for patellar and distal femoral cartilage.
Results: There was a statistically significant decrease in mean T2 and T1rho as a function of age (r= -0.60 and -0.59 respectively, p<0.05). The open physis group had longer T2 (anterior: 52.4 vs. 46.5, posterior: 50.6 vs. 41.9 msec) and T1rho (anterior: 51.9 vs. 42.6, posterior: 53.0 vs. 46.7) than the closing/closed physis group at the anterior and posterior femur (p<0.05). The open physis group had longer values than the closing/closed group at the patella on T2 (45.1 vs. 38.6, p<0.05), but no difference on T1rho. The central femur showed longer T2 (53.7 msec) and T1 rho values (49.2 msec) than anterior and posterior with statistical significance on T2 (p<0.05). Spatial variation of T2 and T1rho showed similar patterns in the patellar and femoral cartilage, initially decreasing just beyond the osteochondral junction and then gradually increasing toward the articular surface.
Conclusions: Contrary to adult senescent changes, which result in increased T2 and T1rho due to degeneration, skeletal maturation results in a sequential decrease in both T2 and T1rho in cartilage. There is regional variation in cartilage with the longest value in the weight bearing portion. Despite T2 and T1 rho reflecting different properties of the microstructure of cartilage, spatial variation follows similar patterns for both maps.

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Paper #: 051

MRI Criteria for Ramp Lesions of the Knee in Children with Torn Anterior Cruciate Ligament (ACL)

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Purpose or Case Report: Mensicocapsular injury (ramp lesion) occurs in 9-17% of ACL tears. These injuries are a risk factor for instability and failure following ACL reconstruction. The far peripheral location has contributed to under-diagnosis during routine anterior-approach arthroscopy. While there has been increasing interest in the identification and treatment of these lesions in adults, there is a paucity of published data on children and the proposed MRI features lack specificity. Therefore, the purpose of this study was to investigate the performance of MRI criteria for identifying ramp lesions in children.
Methods & Materials: This IRB-approved, HIPPA-compliant retrospective study included patients with primary ACL tears, who underwent pre-operative MRI, performed between Feb 1, 2017 and July 30, 2019, and diagnostic arthroscopy with attention to the medial meniscocapsular junction (MCJ). Each MRI examination was blindly retrospectively re-reviewed to determine the presence or absence of a suprapatellar joint effusion, medial joint findings (meniscus tear, peripheral meniscal irregularity, MCJ ligament tear, junctional T2-weighted signal, tibial plateau marrow edema), and lateral joint findings (meniscus tear, tibial plateau marrow edema). Chi-square, Fisher's exact, and Mann-Whitney U tests were used to compare MRI findings between those with and without arthroscopically-confirmed ramp lesions.
Results: Seventy-one subjects (40 had ramp lesions at arthroscopy: 24 boys and 16 girls, 16.4 $\pm$ 2.1 years; 31 did not have ramp lesions at arthroscopy: 12 boys and 19 girls, 15.1 $\pm$ 2.1 years) were identified from the 312 patients whom underwent primary ACL reconstruction. Subjects who had ramp lesions were significantly older at arthroscopy (p=0.018) than those who did not have ramp lesions, but there were no differences in the distribution of sex (p=0.075), days between injury and MRI (p=0.067), or days between MRI and surgery (p=0.133) between the two groups. Knees with ramp lesions were more likely to have a suprapatellar effusion (p=0.047), medial meniscus tear (p=0.023), MCJ ligament tear (p=0.003), and junctional T2-weighted fluid-high signal (p<0.001). No association was found between ramp lesions and meniscal irregularity (p=0.070), size of the torn meniscal fragment (p=0.061), lateral meniscus tear (0.704), or tibial edema (p=0.929).
Conclusions: MRI findings predictive of a ramp lesion include a suprapatellar effusion, medial meniscus tear, MCJ ligament tear, and junctional T2-weighted fluid-high signal.

Paper #: 052

Developmental Dysplasia of the Hip: Can Enhancement MRI Predict Avascular Necrosis

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Purpose or Case Report: Developmental dysplasia of the hip (DDH) is the leading cause of hip disease in infants. AVN is a potential complication of treatment for DDH, which is traditionally diagnosed on follow-up pelvic radiographs. But classic radiographic findings of AVN may be radiographically-occult for months to years after surgery. To investigate the performance of gadolinium-enhanced magnetic resonance imaging (MRI) for predicting avascular necrosis (AVN) of the femoral head following surgical hip reduction for developmental dysplasia of the hip (DDH) using qualitative and quantitative methods.
Methods & Materials: This IRB-approved, HIPAA compliant retrospective study included 47 children (7 boys and 40 girls; mean age 9.3 ± 4.6 months), who underwent contrast-enhanced MRI examinations immediately following unilateral surgical hip reduction between April 1, 2009 and June 30, 2018. AVN was determined on follow-up pelvic radiographs (mean 48.1 ± 23.0 months) using both Salter's and Kalmachi and MacEwen Criteria. Two radiologists and 1 orthopaedic surgeon, blinded to clinical outcomes, independently classified the postoperative MRI enhancement pattern into normal, globally-decreased, focally-decreased, or near-absent. Regions of interests (ROIs) were used to quantify changes in T1-weighted signal intensities between treated and untreated sides and percent enhancement between AVN and non-AVN hips. Non-parametric tests and Fisher exact test were used to compare values between hips that did and did not develop AVN. Bonferroni correction were used for multiple comparisons.
Results: Ten (21%) femoral heads developed AVN. No significant differences between AVN and non-AVN groups were detected in sex (p=61), laterality (p=0.46), surgical technique (p=0.08), trial of harness treatment (p=0.72), or abduction angle (p=0.44). No significant differences were found between AVN and non-AVN hips in any of the enhancement grades (Grades 1-4) and at either early (p = 0.76) or late (p = 0.66) enhancement times. Signal intensities between treated and

untreated sides were not significantly different (non-AVN group, p=0.09-1.0, AVN group, p=0.54-1.0) and percent enhancement between AVN and non-AVN hips were also not significantly different (early enhancement, p=0.41-0.88; late enhancement, p=0.53-0.74).
Conclusions: Qualitative enhancement patterns and quantitative enhancement values on post-operative MRI examinations were not significantly different between hips that did and did not subsequently develop AVN.

Paper #: 053

Vertebral Porosity and Disc Hydration: Feasibility Study using Quantitative UTE MRI

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Purpose or Case Report: Anatomic changes during bone growth and skeletal maturation are under-studied and incompletely understood, partially attributed to the sparing use of ionizing radiation in children. Recently, a clinically-feasible UTE (ultra-short echo time) MRI technique has emerged, enabling the direct visualization of bone. Although validated in adults, its spatial resolution and reproducibility have not been fully investigated in children. Therefore, the purpose of this study is 1) to determine the feasibility of UTE MRI to quantify changes in vertebral porosity and disc hydration along the thoracolumbar spine and 2) to investigate inter-rater reproducibility.
Methods & Materials: This is a HIPPA-compliant MRI examination performed for sequence optimization and for feasibility determination. Dual-echo UTE images were acquired on a 3-Tesla MRI scanner (Skyra, Siemens), using a clinically available spine multi-channel surface coil. Quantitative analysis was performed using the calculated porosity index (TE_{long} / TE_{short}) within manually selected regions of interests (ROIs). ROIs were drawn around six consecutive vertebral bodies and six intervertebral disc levels by 2 research assistants, independently and under the supervision of a board-certified, fellowship-trained pediatric musculoskeletal radiologist. Chi-square test was used to compare porosity index between different vertebral levels and hydration index between different disc levels. Intra-class correlation was used to determine reproducibility.
Results: High-resolution UTE MRI required approximately 6-10 minutes to produce 3D bone images with a readout voxel size ranging from 0.47mm to 0.81mm. The thoracolumbar spine from a volunteer (19 year-old female) was imaged in both axial and sagittal planes. Using the sagittal images (voxel size: 0.63mm), 19 ROIs were drawn around each of the 6 vertebral and disc levels to produce a total sample size of 114 vertebral body ROIs and 114 disc ROIs. Vertebral porosity ($p<0.0001$) and disc hydration ($p=0.004$) increased in the craniocaudal direction. Intra-class correlation coefficients were excellent for all 6 vertebral levels (range: 0.970-0.998).
Conclusions: High-resolution UTE MRI can reliably quantify changes in vertebral porosity and disc hydration between levels, which reflect location-dependent changes in tissue composition and microstructure. Further investigation is warranted to determine age- and gender-dependent changes in health and disease.

Paper #: 054

Humeral Lesser Tuberosity Avulsion Fractures – MRI Characteristics in Pediatric Population

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Purpose or Case Report: Humeral lesser tuberosity avulsion fractures (LTAF) are rare injuries in children. Limited information is available describing MRI characteristics. We aim to describe demographics, mechanism of injury, and MRI findings of LTAF.
Methods & Materials: We conducted a retrospective search of the last 10 years. All children with shoulder MRI and LTAF were included. If available, radiographs were evaluated. Age, gender, mechanism of injury, and treatment were recorded. MRI evaluated size of the avulsion fragment, displacement in the axial plane, percentage of the subscapularis tendon involved, dislocation of the long head of the biceps tendon, and additional injuries.
Results: We found 11 children, all male, median age 13.8 yrs (range 12.5-16.1 yrs). Most common mechanism of injury was sports-related blunt trauma or overhead throwing (9 children; 82%), particularly football and wrestling. All patients were skeletally immature, 9(82%) demonstrated isolated LTAF at the footprint of the subscapularis tendon. Only 1 patient had associated osteochondral injury to the humeral head and a labral tear. The long head of the biceps tendon was normal in 10 cases (91%) with only 1 child demonstrating medial dislocation.Median size of the avulsed fragment was 16mm (range 5-23mm), with a median AP displacement of 3mm(range 0-7mm). Age did not correlate with size of avulsed fragment (p=0.79). All subscapularis tendons were intact with redundancy and edema in cases of retraction. Total avulsion of the subscapularis footprint was seen in 5(45%), partial avulsion involving >50% of the footprint in 4(36%) and partial avulsion involving <50% of the footprint in 2(19%).Of those cases with available radiographs (9/11), two thirds (6/9) were initially reported as normal with retrospective evaluation showing an avulsion fragment in two cases (2/6). One of the initial radiographs raised concern for bone tumor. The best view for identification of an avulsion fragment was the axillary view.Treatment was variable with 6 patients (55%) undergoing internal fixation.
Conclusions: Lesser tuberosity avulsion fractures are rare and can be radiographically occult. MRI was able to identify mostly isolated injuries to the subscapularis tendon insertion with variable size of the avulsed fragment and degree of tendon involvement. The long head of the biceps tendon is usually normal in signal and location. Although rare, radiologist should be aware of this entity for correct diagnosis and prevention of unnecessary biopsy or contrast administration.

Paper #: 055

Estimating Time Since Injury of Healing Upper and Lower Extremity Fractures in Young Children

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Purpose or Case Report: Healing fractures are a common

radiographic finding in cases of child physical abuse. Accurate time since injury estimation of healing fractures may provide an opportunity for identification and characterization of physical abuse, especially in young children unable to verbalize. This study examines patterns of long bone fracture healing in a modern sample of young children.
Methods & Materials: A retrospective study of unintentional long bone fractures of the upper and lower extremities in children less than two years old was conducted at a large pediatric tertiary care center. Features of fracture healing (subperiosteal new bone formation [SPNBF] and callus formation) were evaluated and recorded as present or absent on radiographs at initial and follow-up visits. Casted studies were excluded if the fracture was obscured on all views. Abuse-related fractures and those with unknown date of injury were excluded. Individuals with co-morbidities or disorders affecting bone, and fractures requiring internal fixation were also excluded.
Results: There were 189 fractures in 175 patients (males: 77, 44%; females 98, 56%). One hundred twenty seven (67%) were upper limb fractures (humerus:37, radius:34, ulna:31, clavicle:25) and 62 (32%) were lower limb fractures (femur:26, tibia:24, fibula:12) and 533 exams were evaluated. Over half of upper and lower limb fractures exhibited SPNBF two weeks post-injury. SPNBF was observed 7 to 87 days post-injury in upper limb fractures (mean: 27 days, n=164 radiographs) and 8 to 95 days post-injury in lower limb fractures (mean: 29 days, n=75 radiographs). The majority of fractures exhibited callus formation by the third week post-injury. All levels of callus matrix (soft, intermediate, hard, remodeling) were observed earlier in upper limb fractures. Soft callus was first observed earliest in humerus and ulna fractures (10 days) and latest in tibia fractures (31 days). Hard callus was first observed earliest in humerus fractures (17 days) and latest in tibia and fibula fractures (28 days).
Conclusions: Patterns of healing are evident, with differences noted based on healing feature and fracture location. Though the largest sample to date, the results of this study may not be generalizable to all ages or fracture locations and differences in time of healing based on variables such as patient age and fracture location should be further explored.

Paper #: 056

Bone Densitometry in the Realm of Childhood Cancer and Hematologic Diseases

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Purpose or Case Report: Increased rates of survival of patients diagnosed with childhood cancer presents an opportunity to assess long-term effects of treatments. Bone health has been identified as one of the processes impacted by cancer treatment. Bone densitometry is a tool used for patients currently undergoing treatment for childhood cancer and hematologic diseases such as sickle cell disease and those having completed therapy. This discussion will focus on the methods used to measure bone health and some of the challenges involved in doing so.
Methods & Materials: Patients were scanned at prescribed intervals and/or time points using Quantitative Computed Tomography (QCT) lumbar spine and Dual Energy X-ray Absorptiometry (DXA) with results interpreted by radiologists and entered into the patients' chart for clinician review. This presentation will include the basic physiology of bone remodeling and illustrate how QCT and DXA are utilized to measure bone health. Differences between the two modalities and challenges encountered in completing these studies will be discussed using data from previously published papers as well as drawing on personal experience with bone densitometry.
Results: It has been shown through these evaluations that bone health can be adversely affected by treatments for catastrophic diseases during a time when bone mineral accretion typically occurs in the healthy population. Patients most severely affected include those treated at a younger age, those receiving glucocorticoid treatment, endocrinopathies and craniospinal irradiation. Those at greatest risk include children treated for Acute Lymphoblastic Leukemia and brain tumors, Lifestyle factors such as suboptimal nutrition and limited weight-bearing exercise can compound the effects of therapy.
Conclusions: Bone densitometry is a valuable tool in the overall care of childhood cancer patients and those with hematologic diseases. Serial scanning at prescribed intervals aids in monitoring the status of bone health as patients age. Patients should be counseled on lifestyle choices including diet and exercise that may help to maintain or improve their bone health. Optimization of bone health is needed during adolescence and early adulthood in order to protect bone mineral density into adulthood.

Paper #: 057

Imaging Biomarkers of the Physis: Cartilage Volume on MR Imaging vs. Tract Volume and Length on Diffusion Tensor Imaging

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Purpose or Case Report: To compare how 3D MRI measurements of physeal cartilage volume, and DTI measurements (tract volume and length) correlate with growth parameters and detect differences in growth between patients treated with cis-retinoic acid and controls.
Methods & Materials: We calculated and compared physeal cartilage volumes from 3D MR images and physeal/metaphyseal DTI tract volumes and lengths from tractographic images in 20 neuroblastoma survivors treated with cis-retinoic acid and 20 age- and sex-matched controls. We correlated metrics with height percentile and annualized growth rate, correcting results for sex and age.
Results: DTI tract volumes had the highest correlation with height percentile ($r= 0.74$) followed by tract length ($r=0.53$) and 3D-Volume ($r=0.40$) (all $p<0.02$). Only tract volumes and lengths correlated with annualized growth velocity. Patients showed significantly smaller tract volumes (8.00cc vs. 13.71 cc, $p<0.01$) and shorter tract lengths (5.92 mm vs 6.99 mm, $p=0.03$) than controls, but no significant difference (4.51 cc vs 4.85 cc) on 3D MRI volumes. The 10 patients with lowest height percentiles had smaller tract volumes (5.07 cc vs. 10.93 cc, $p<0.01$), but not significantly different 3D MRI volumes. Tract volume was the best predictor of the effect of cis-retinoic acid with an accuracy of 75%.
Conclusions: DTI tract volume of the physis/metaphysis can predict abnormal growth better than physeal cartilage volumetric measurement and correlates best with height

percentile and growth velocity.

Paper #: 058

Pediatric Discoid Meniscus: Can MRI Features Predict Symptoms and Need for Surgery?

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Purpose or Case Report: Clear MRI criteria for discoid meniscus in the pediatric population is limited in the literature. This has resulted in a range of meniscal sizes and shapes being called discoid. While the diagnosis may be correct, features that could predict patient symptoms or increase the likelihood of meniscal surgery are unknown. The purpose of this study was to assess MRI features of intact discoid menisci and correlate with clinical outcomes in order to improve the prognostic utility of MRI.
Methods & Materials: In this IRB-approved retrospective study, we reviewed all knee MRIs performed at our institution between 2008 – 2019. Our inclusion criteria were knee MRIs with a radiologic diagnosis of discoid meniscus. Our exclusion criteria were torn discoid meniscus, prior meniscal surgery (saucerization), and confounding diseases (eg: JIA, septic arthritis, etc.). Radiologic features of the discoid meniscus were recorded (largest cranio-caudal (CC) dimension, largest transverse dimension, transverse dimension to tibial plateau ratio, and presence of intrasubstance degenerative signal). Patient characteristics were collected.
Results: 72/3277 (2.2%) patients had a discoid meniscus. 33/72 (45.8%) patients were identified that satisfied the inclusion and exclusion criteria. Patient age ranged from 2 to 17 years with a mean of 10.4 years. Average follow up was 30.4 months with a range of 1.3 to 144.3 months. The average CC dimension was 7.6mm (±2.9) on coronal imaging. Average transverse dimension was 18.9mm (±4.3). 17/33 (51.5%) had intra-substance degenerative signal. 22/33 (66.7%) of patients had chronic pain, 22/33 (66.7%) of patients had mechanical symptoms, and 8/33 (24.2%) of patients required surgery for either symptom relief or subsequent progression to tear. Intrasubstance degenerative signal was found significantly more in the patients requiring surgery (p=0.019). Cranio-caudal dimension neared statistical significance for predicting chronic pain and mechanical symptoms (p=0.10, p=0.13 respectively).
Conclusions: Preliminary results of our ongoing study demonstrate that intrasubstance degenerative signal in discoid menisci was found more often in patients requiring surgery. Of the size characteristics, greater craniocaudal sizes neared statistical significance to correlate with mechanical symptoms and chronic pain.

Paper #: 059

Automated Segmentation of Abdominal Muscle in CT Scans using Deep Learning

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Purpose or Case Report: In this study, we trained two convolutional neural networks to automatically identify the third vertebral level and segment the abdominal muscle in contrast enhanced abdominal CT images. In the future, these models will be used to determine reference ranges for skeletal muscle mass in children by age for the purpose of identifying patient characteristics associated with differences in skeletal muscle mass.
Methods & Materials: 370 CT images of abdomen with contrast were randomly selected from 10,000 scans, corresponding to roughly 10 for each gender from ages 0-18. The third vertebral level was identified in the sagittal image series and the abdominal muscle was manually segmented in the axial series corresponding to the identified level. A convolutional neural network with the U-Net architecture was used to train the segmentation model. A 5-fold cross validation set was generated by randomly splitting the axial images into datasets with 70% training, 10% training validation, and 20% test images. A second dataset with a similar split was generated from augmented data created by flipping, rotating, shifting, zooming, and shearing the original input axial images resulting in a set of 5,550 images. These two sets of images were then preprocessed by algorithmically removing the scan table, thresholding, resizing, and normalizing the images. The segmentation models were trained until there was no improvement in the validation loss function for 20 consecutive epochs. The models' performance was evaluated using the dice similarity coefficient (DSC). The performance of two different loss functions, a weighted dice score and binary cross entropy, were compared.
Results: The model trained with the non-augmented dataset achieved mean DSCs of 0.914 and 0.917 using the weighted dice score and binary cross entropy loss functions respectively. The model trained using the augmented dataset achieved means of 0.924 and 0.925.
Conclusions: The U-Net models trained on our datasets accurately segment the abdominal muscle on pediatric axial CT scans across the range of ages 0-18 years. Additional work is being performed to validate the performance of a U-Net model trained to identify the third vertebral level. Pending validation of this second model, an efficient pipeline for the segmentation of CT scans for the purpose of creating skeletal muscle nomograms has been developed.

Paper #: 060

Convolutional Neural Network for Diagnosis of Pediatric Developmental Dysplasia of the Hip on Conventional Radiography

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Purpose or Case Report: The purpose of this study was to develop a convolutional neural network (CNN)-based deep learning algorithm for the automated detection of developmental dysplasia of the hip (DDH) on conventional radiography and to assess its feasibility and diagnostic performance.
Methods & Materials: From 2,601 hip AP radiographs obtained in three different hospitals January 2011 and June

2018, 5,076 hip images were used to construct the dataset. Two invited radiologists were asked to label hip images as normal or DDH and all 5,076 patched images were divided into training (n = 4,050), validation (n = 513) and test sets (n = 513). Images underwent preprocessing, including cropping and histogram equalization, and were input into a convolutional neural network. To investigate diagnostic performance of the deep learning algorithm, we calculated the receiver operating characteristics (ROC) and precision recall (PRC) plots, accuracy, sensitivity, specificity, positive predictive (PPV) and negative predictive value (NPV) of the deep learning algorithm and they were compared with performances of two human readers with different levels of experience.
Results: The area under the ROC plot of deep learning algorithm and three radiologists were 0.988 and 0.988-0.919, respectively. The AUC of PRC plot of deep learning algorithm and three radiologists were 0.979 and 0.495-0.857, respectively. The accuracy, sensitivity, specificity, PPV and NPV of the proposed deep learning algorithm were 98.4, 94.0, 98.9, 90.4 and 99.4%. In McNemar's test, there was no significant difference between algorithm and experienced radiologist in diagnosis of DDH. On the other hand, the proposed model showed significant difference (P = 1.000) with higher sensitivity, specificity and PPV, compared to inexperienced radiologist. There were three false negative and five false positive cases in 513 test sets by using deep learning algorithm.
Conclusions: The proposed deep learning algorithm provided an accurate diagnosis of developmental dysplasia of the hip on hip AP conventional radiographs, which was comparable to an experienced radiologist.

Paper #: 061

Dynamic Radiologic Spectrum of Costochondral Junction Rib Fractures in Suspected Infant Abuse

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Purpose or Case Report: Radiologic diagnosis of rib fractures in suspected infant abuse is often challenging, and costochondral junction (CCJ) rib fractures can be particularly problematic. In an effort to enhance diagnostic accuracy and dating, we studied the dynamic radiologic spectrum of CCJ rib fractures on serial skeletal surveys (SSs).
Methods & Materials: Reports of SSs performed for suspected infant abuse (7/2005-6/2019) and images of those cases with CCJ rib fractures were reviewed. Inclusion criteria were: 1) anteroposterior (AP), right posterior oblique (RPO), and left posterior oblique (LPO) radiographs of CCJ rib fractures from *both* initial and ~two-week follow-up (FU) SSs, 2) additional fractures documented radiographically, 3) child protection team consults, and 4) state report filing for suspected abuse. CCJ rib fractures were excluded if they were only suspected on the initial SS but not confirmed on the FU SS, or identified on CT and/or MRI but not adequately documented radiographically. We identified 84 CCJ rib fractures from 26 infants (mean age=2.7 months; SD=2.1). Six radiographs (AP, RPO, LPO of initial and FU SSs) of each fracture were retrospectively assessed on PACS by a pediatric radiologist aware of the diagnosis. This reader indicated: 1) likely presence/absence of primary injury pattern, i.e. visible fracture line with a crescentic (bucket-handle), triangular (corner), or other fracture fragment pattern; 2) likely presence/absence of a secondary (healing) injury pattern: subperiosteal new bone formation (SPNBF), sclerosis, or growth disturbance (nodular enlargement, excessive cupping, flaring, and cartilage invagination) of the rib end. Results from the AP, RPO, and LPO radiographs of each survey were combined for analysis.
Results: On initial SSs, 64 of 84 fractures showed a primary injury pattern, and of those 64, 48 (75%) demonstrated a secondary injury pattern. On FU SSs, only 7 of 84 fractures showed a primary injury pattern, and all of these showed a secondary injury pattern. On combined initial and FU SSs, the most common primary injury pattern was a crescentic fracture fragment; the most common secondary injury pattern was a bony growth disturbance; and SPNBF was only noted on 26 of 84 fractures.
Conclusions: Three quarters of CCJ rib fractures identified on initial SSs show healing. An actual fracture line with a crescentic or triangular fracture fragment is less often encountered, and is usually associated with signs of healing. SPNBF is uncommon, despite other features of healing.

Paper #: 062

Osteochondral and Patellofemoral Ligament Injury after Acute Patellar Dislocation: Do Age or Skeletal Maturity Influence Injury Patterns?

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Purpose or Case Report: Prior to maturity, a secondary physis surrounding the patella defines an area of potential weakness. We seek to understand how age, sex, and physeal status affect the prevalence and degree of patellar osteochondral injury and medial patellofemoral ligament (MPFL) injury after acute patellar dislocation.
Methods & Materials: A retrospective review of the EMR and PACS from January 2016 to July 2019 identified 130 knees MRIs (from 126 patients, 4 with bilateral imaging) performed within 30 days of a first-time patellar dislocation. Patients with prior knee surgery and articular disorders were excluded. MRIs and associated reports were reviewed to evaluate the distal femoral physis (open, partially closed vs. closed), grade of patellar osteochondral injury (0-5, with grade 0 representing no visible injury and grade 5 representing exposed subchondral bone), presence of femoral osteochondral injury, presence and location of MPFL injury (patellar vs. femoral third), and presence of MPFL avulsion fracture. Statistical correlations with age, sex, and physeal status were measured with point-biserial correlation, 2-tailed z-test, and chi-square test.
Results: Study population130 evaluated knees aged 9-20 comprised 45% male and 55% female. The distal femoral physis was open in 42% (age 9-17), partially closed in 27% (age 13-17), and closed in 30% (age 16-20).Injury prevalence**Patellar osteochondral injury**: 45% (58/130) including 5% grade 4 and 16% grade 5.**MPFL injury**: 56% (73/130) including 38% at the patellar third, 22% at the femoral third and 5% at both.**Patellar MPFL avulsion fracture**: 15% (20/130).**Femoral osteochondral injury**: 15% (20/130) including 8% purely chondral injury and 8% osseous and chondral injury.Data analysis: Boys more often had grade 5 patellar osteochondral injury (24% vs. 10%, p=0.030) and MPFL injury (69% vs. 44%, p=0.007). Patients with open physes more often had MPFL injury than those with closed or partially closed physes (77% vs. 58%, p=0.030). Age had a positive biserial correlation with patellar osseous and chondral (grade 4 or 5) injury (p=0.029). Physeal status did not correlate with osteochondral injury grade. Age, sex, and physeal status did not correlate with the location

of MPFL injury, presence of patellar MPFL avulsion fracture, or presence of femoral osteochondral injury.
Conclusions: Our data demonstrate that male sex and increasing age, but not physeal status, is associated with higher grades of osteochondral injury. MPFL injury is associated with male sex and an open physis.

Paper #: 063

Pediatric Bassett's Ligament - Normal Variant or Ancillary Sign of Ankle Injury?

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Purpose or Case Report: Bassett's ligament is an accessory fascicle of the anterior tibiofibular ligament that is not well addressed in pediatric patients. In the adult literature, it is known that the ligament is not present in some patients, but may be thickened in the setting of talar dome osteoarthritis. The purpose of our study was to determine the prevalence of Bassett's ligament and measure its thickness in pediatric patients with MRI findings of lateral talar osteochondral lesions (OCLs), medial talar OCLs, and posterior ankle impingement and compare these measurements with patients with a normal ankle MRI.
Methods & Materials: Retrospective review of pediatric ankle MRI studies obtained through our electronic medical record was performed identifying 21 lateral talar dome OCLs (13.5±2.9 years; 33% female). Matched 1:1 controls of patients with medial talar OCLs (14.1±2.5; 62% female), posterior ankle impingement (12.5±2.4; 52% female), and those with normal ankle MRIs (13.8±2.5 years; 67% female) were obtained. All examinations were retrospectively reviewed by consensus by both a pediatric musculoskeletal radiologist and a pediatric radiology fellow for the presence of Bassett's ligament and its axial plane maximal thickness. Prevalence of the ligament and average thickness were calculated per subgroup and analyzed between subgroups for significant differences.
Results: Twenty-one MRI examinations were obtained in each subgroup, for a total of 84 MRI examinations. The prevalence of Bassett's ligament and its thickness in patients with lateral talar OCLs, medial talar OCLs, posterior impingement, and in normal ankle examinations was 71% (15/21) 1.88 ± 0.45 mm, 52% (11/21) 1.38 ± 0.22 mm, 52% (11/21) 1.33 ± 0.19 mm, and 71% (15/21) 1.52 ± 0.35 mm, respectively. Ligament thickness was significantly increased between the lateral talar OCL group when compared with the medial talar OCL, posterior impingement and normal groups with p-values of <0.01, <0.01, and 0.02, respectively. Comparison of ligament thickness between the control subgroups did not reach significance ($p<0.05$).
Conclusions: Bassett's ligament is a common and normal anatomic structure in the anterolateral compartment and is not a sign of ankle pathology. However, thickening of Bassett's ligament is seen with lateral talar dome OCLs and is not appreciated with other talar abnormalities or with a normal ankle MRI. Thickening of Bassett's ligament in the setting of a lateral talar dome OCL may be an indirect sign of anterolateral tibiotalar capsule injury.

Paper #: 064

Scaphoid Fractures in Skeletally Immature Pre-Teen Children

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Purpose or Case Report: Scaphoid fractures are well-recognized in adults where delayed diagnosis and treatment of displaced or rotated fragments can produce avascular necrosis and long-term morbidity. In children, scaphoid fractures are uncommon, particularly in the skeletally immature, with an estimated incidence of 11 per 100,000, and there is a relative paucity of published literature on its imaging characteristics and clinical prognosis. Therefore, the purpose of this study was to investigate imaging findings, fracture locations, and the clinical outcomes of scaphoid fractures in pre-teen children.
Methods & Materials: This IRB-approved, HIPAA-compliant retrospective study included 30 pre-teen children with scaphoid fractures who were identified using a report database search for "scaphoid fracture" between Dec 1, 2008 and June 30, 2019. The initial radiographic study for each subject was retrospectively reviewed and the visibility of the fracture on each available image (PA, lateral, oblique, scaphoid views), its location (distal third, middle third, or proximal third), its displacement, and any other fractures were recorded. Twenty-four children had follow-up radiography and four children had MRI studies. Demographic information and clinical outcomes were also recorded. Descriptive statistics were performed.
Results: Thirty children (16 boys, 14 girls; mean age, 9.5 $\pm$ 0.6 years, range 8-10 years). Four (13.3%) children underwent 4 views of the wrist, 23 (76.7%) underwent 3 views, and 3 (10%) underwent 2 views. Four (13.3%) fractures were inconspicuous on the initial radiography. Seven (23.3%) fractures were identified on all imaging views. Half of the fractures involved the middle third (waist) and the other half involved the distal third of the scaphoid. Fracture displacement occurred in 4 (13.3%) fractures (1-2mm) and none required surgical intervention. Only 1 (3.3%) fracture underwent surgical pinning for delayed union. Two (6.6%) children had concurrent distal radius fractures. Follow-up radiography showed signs of healing in all children.
Conclusions: Scaphoid fractures in skeletally immature, pre-teen children can be radiographically occult in the acute setting and are equally as likely to involve the distal and the middle third of the scaphoid. All of these fractures demonstrated favorable healing potential.

Paper #: 065

Skeletal Survey Discrepancies Between Adult Radiologist Preliminary Reports and Pediatric Radiologist Final Reports; Balancing Timeliness and Accuracy

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Purpose or Case Report: Imaging during the evaluation of suspected child abuse victims may be requested 24 hours a day, however, pediatric radiologists may not always be available to interpret these studies. Timely reporting is important for treatment and disposition in this vulnerable population. In addition, the accuracy of detection of subtle injuries is critical for patient safety. The current protocol at our institution consists of an immediate preliminary interpretation by an adult radiologist when a skeletal survey is obtained after hours, and final interpretation by one of three pediatric radiologists during normal business hours.
Methods & Materials: A retrospective cohort study was performed analyzing inpatient and emergency room skeletal surveys performed at a pediatric hospital for traumatic indications in 2017 and 2018, and related imaging and clinical data in the following month.
Results: Of 155 skeletal surveys, there were 15 (9.7%) cases with discrepancies related to misinterpretation of trauma, including additional fractures in 10, fractures diagnosed when there were none in 2, non-metaphyseal fracture diagnosed as metaphyseal in 1, subacute rib fractures described as healed in 1, and spine trauma questioned when there were congenital anomalies in 1. These discrepancies were classified as a clinically significant misinterpretation in 14 (9%) of the studies. In 7 (4.5%) cases, the change in interpretation resulted in a change in the child's disposition regarding non-accidental trauma or a change in management.
Conclusions: A protocol of an adult radiologist providing a preliminary report for skeletal surveys obtained after hours for suspected non-accidental trauma followed by a pediatric radiologist interpretation during normal business hours is an effective way to provide timely information, while also providing a safety net for the detection of additional significant injuries. The discrepancy rate at our institution is higher than that documented in the literature between pediatric radiologists, but lower than that described on skeletal surveys referred to a pediatric hospital for a second opinion. This serves as baseline data for future educational outreach to our adult radiology colleagues, for the purpose of quality improvement.

Paper #: 066

Solitary Long Bone Epiphyseal Lesions in Children: Radiologic-Pathologic Correlation and Epidemiology

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Purpose or Case Report: Solitary epiphyseal lesions are rare in children, and no large series describes the relative frequency of different etiologies. Understanding the incidence and nature of epiphyseal lesions is critical in informing radiologists encountering these lesions.
Methods & Materials: Retrospective review of radiology reports from 2000 - 2019 that mentioned the words biopsy or resection and one of the following: (1) epiphysis or (2) entities known to affect the epiphysis (e.g. chondroblastoma) was conducted. Cases were reviewed to ensure (1) the lesion was centered in the epiphysis, (2) tissue sampling was performed and (3) appropriate pathology reports and imaging were available. Conventional radiographs and/or advanced imaging (CT and MRI) were reviewed by 1 board eligible and 2 board certified pediatric radiologists. Clinical data was also reviewed.
Results: Out of a total of 422 studies, 49 met inclusion criteria. Median age was 13.1 years old (range 1.5 - 18.6). 14 patients (29%) patients were female. 40 patients (82 %) presented with pain with the remaining asymptomatic.Epiphyseal lesions identified include: chondroblastoma 22 (45%), non-specific nonmalignant pathology 11 (22%), osteomyelitis 9 (18 %), lymphoma 2 (4%) and 1 case of each of the following diagnoses, aneurysmal bone cyst, chondrosarcoma, enchondroma, hemangioendothelioma, and histiocytosis. 39 (80%) patients underwent surgical excision and 10 (20%) patients underwent image-guided biopsy. Image-guided biopsy resulted in a higher rate of non-specific pathologic diagnosis, 50% vs 15%, p=0.02.39 cases were initially imaged using radiography. Lesions that were correctly diagnosed (n=22) were larger than those that were not detected 3.4 vs 1.2 cc (p=0.23), had larger maximal dimension 2.2 vs 1.5 cm (p = 0.08), and were seen in older patients 13.9 vs 11.3 years old (p<0.01). Delay from initial radiographs to definitive advanced imaging was a median of 1.3 months (range: 0-24 months). Fever, elevated WBC, and inflammatory markers did not significantly differ between patients with and without osteomyelitis (p>0.40 for each).
Conclusions: Pediatric epiphyseal lesions are heterogeneous, but most are benign with chondroblastoma, osteomyelitis and other benign lesions accounting for over 85% of cases. Initial radiographic identification of these lesions can be challenging and imaging features are frequently nonspecific. Understanding the relative incidence of different pathologies may be helpful in informing the differential diagnosis.

Paper #: 067

Utility of Dynamic Transverse Imaging in Ultrasound Screening of Developmental Dysplasia of the Hip

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Purpose or Case Report: Several organizations have recommended ultrasound (US) screening for Developmental Dysplasia of the Hip (DDH) in infants with risk factors to facilitate early detection and treatment of the disease, and mitigate long-term morbidity. However, there is still debate on the value of screening US, particularly the dynamic stress component. The goal of our study was to evaluate the predictive value of selective screening hip US of infants with risk factors for detection of DDH requiring treatment, including the value of dynamic stress imaging.
Methods & Materials: We reviewed hip US studies performed at our institution for all infants with DDH risk factors between January 1, 2013 and June 30, 2014. Patients with positive physical findings of DDH were excluded. Alpha angle and femoral head coverage were measured on static coronal images. Hip stability was assessed with dynamic transverse imaging. Clinical data for patients referred to our institution's orthopaedic clinic were collected from electronic medical records to September 30, 2016.
Results: Six hundred and twenty-nine patients (62% female) with risk factors for DDH and normal physical examination underwent selective hip US screening. More females than males had abnormal hip US (p<0.001). Although breech presentation was the most common indication for screening, family history of DDH was the risk factor most strongly associated with abnormal hip US (7/44, 16%). Of those with abnormal findings

on hip US, 25/52 (48%) were not treated, including 21 patients with an alpha angle <60º in one or both hips. Stability on dynamic stress imaging was documented in 561 of 629 patients (90%). Of the 587 patients with normal findings on static coronal imaging, 5 (<1%) were reported to have instability on dynamic stress imaging, of which 2/5 received treatment.
Conclusions: Our cohort shows an incidence of DDH similar to other reported cohorts. US is effective in screening for DDH in asymptomatic infants with risk factors for DDH. Dynamic instability occurs in <1% of asymptomatic infants with normal findings on static coronal imaging and is not a predictor of treatment. Therefore, dynamic stress imaging can be eliminated when screening asymptomatic infants with normal coronal static imaging.

Paper #: 068

Comparison of Ultra High Frequency Ultrasound (40 MHz) Transducer to Conventional High Frequency (15 MHz) Transducer in Imaging and Needle Access of Inguinal Lymph Nodes for Lymphatic Intervention

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Purpose or Case Report: Inguinal lymph node identification using ultrasound is critical in performing intranodal lymphangiography. We routinely utilize a 15 MHz "hockey stick" linear high resolution ultrasound probe (Philips Epic 7) for identification as well as to gain needle access into the inguinal lymph node. However in children with severe body wall edema and in low weight premature babied identification of lymph nodes can be difficult and sometimes impossible. Higher frequency ultrasound transducers offer the potential for improved identification of lymph nodes in such cases. The aim of this study was to compare imaging finding of high resolution US probe to the traditional 15 mHz probe in patients undergoing lymph node access for lymphangiography.
Methods & Materials: This is a retrospective comparison of ultrasound images obtained with both 15 MHz linear probe as well as high frequency 40 MHz transducer (Visualsonics Vevo) in patients undergoind inguinal lymph node access for lymphatic imaging and intervention procedures between October 2018 and October 2019. Images were compared for resolution, ease of identification of node, lymph node characteristics and intra nodal needle position.
Results: A total of 15 patients (30 lymph nodes) were included in the study from. Age range included 4 days to 5 years. In all 15 patient, 30 lymph nodes were identified using the 40 MHz probe, however only 24 lymph nodes (80%) were identified using the 15 MHz transducer. Out of the 24 lymph nodes identified using the 15 MHz transducer, 4 lymph nodes (13%) had poorly defined architecture that blended with surrounding fat due to previous injection. These 4 nodes (13%) had a clearly identifiable architecture using the 40 MHz transducer.
Conclusions: The 40 MHz transducer has a superior resolution and can be used to easily identify inguinal lymph nodes even in neonates. Intra nodal needle position at least in some cases is better confirmed using the 40 MHz transducer. Finer details of lymph node including intranodal vessels and efferent lymph vessel are clearly seen with 40 MHz transducer and further studies are required to know the importance of visualizing these structures related to lymphatic access.

Paper #: 069

Lymphatic Interventions for Plastic Bronchitis and Outcomes in Patients with Congenital Heart Disease

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Purpose or Case Report: Percutaneous lymphatic interventions (PLI) target the pulmonary lymphatic abnormalities seen in patients with plastic bronchitis (PB). Existing data in patients with congenital heart disease(CHD)indicates poor transplant-free survival after the diagnosis of PB. We describe various techniques of PLI and characterize intermediate-term survival and complications after PLI.
Methods & Materials: We reviewed 70 patients with CHD and PB that underwent PLI at our institution between 8/2013 and 8/2019. We collected imaging, procedural, intermediate-term clinical outcome, and complication data.
Results: In the review of 70 patients, the median age was 8.8 years and 60 patients (86%) had Fontan physiology. Most patients had daily or weekly cast production prior to PLI for PB. Abnormal lymphatic perfusion was seen in both lungs in 62 patients (88%), and 50 patients (71%) underwent complete thoracic duct embolization, 16 (22%) patients had selective branch embolisation and 4 patients (6%) had direct percutaneous transthoracic branch embolisation. After index procedure, 11 patients (15.7%) required repeat PLI. Transplant-free survival was 89% at 19 months and 82% at 30 months. Median length of hospital stay for PLI was 6 days. Common complications included transient abdominal pain (77%), hypotension requiring IV fluids or pressor support (51%), and systemic inflammatory response syndrome (21%). Major complications were rare; 7 patients were reintubated, 4 had gastrointestinal bleeding with one requiring intervention, 3 had cardiac arrest, and 2 had embolic stroke. Two patients died prior to discharge (1acute cardiac arrest after an aspiration and 1multi-organ failure). Intermediate follow-up data were available on 63 patients (90%) from chart review or telephone survey. 81.0% of patients had no casting at follow-up. Casting frequency ($p<0.001$) and respiratory support ($p=0.002$) decreased post-intervention. Most reported improvement in their child's overall health, quality of life, and physical activity.
Conclusions: PLI is an effective treatment for PB in CHD patients. The majority of patients had cessation of casting and favorable outcomes which demonstrates PLI's feasibility and safety.

Paper #: 070

A Retrospective Analysis of Comparative Complication Rates of Pediatric Gastro-Jejunostomy Tubes

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Purpose or Case Report: Gastro-Jejunostomy (GJ) tubes are commonly placed and exchanged by interventional radiologists (IR) in pediatric patients requiring transpyloric feeds. GJ tubes

with slight variations are available from different manufacturers, most frequently used are Avanos Medical, Inc. (previously Halyard Medical Devices) and Applied Medical Technology (AMT). There is currently no published data available comparing complication rates between the different GJ tubes. The goal of this study is to compare complication rates at two different pediatric institutions and reasons for non-elective required exchange/replacement of GJ tubes manufactured by Avanos and AMT in pediatric patients.
Methods & Materials: A retrospective review on GJ tubes placed by IR at two tertiary pediatric hospitals between 1/12009 and 8/302019, on patients /aged one month to 22 years. Data on patient demographics, GJ tube specification, placement information, reason for replacement, and complication rates related to the procedure were collected and analyzed. Analysis utilizing Chi square test were performed.
Results: A total of 4,646 GJ tube placements were evaluated on 895 (Site 1 n=415, Site 2 n=435) subjects. One-third of the placements were manufactured by Avanos (n=1657, 36%) and a quarter utilized AMT (n=1188, 26%). Modified tubes and tubes from other manufacturers were excluded yielding a total number of 2,845 GJ tube placements. One-third of placements were routine elective exchanges (n=986, 35%), followed by non-elective exchanges/replacements (n=1859, 65%) for leaking (including around and through the tube) (n=268, 9%) and occlusion (n=217, 8%) for both manufacturers. There were equal numbers of complicating factors requiring non-elective replacement between Avanos (n=1075, 65%) and AMT (n=784, 66%). However, in evaluating the most common factors, there was a statistically significant higher rate of leaking (n=268) in Avanos (n=194, 12%) compared to AMT (n=74, 6%) (p=<0.001). Occlusion rates (n=217) were also statistically higher in Avanos (n=150, 9%) as compared to AMT (n=67, 6%) (p=<0.001). Balloon ruptures (n=115) were not statistically different between manufacturers, Avanos (n=54, 3%) and AMT (n=61, 5%) (p=0.012).
Conclusions: While routine elective change is a common reason for GJ tube exchange, two-thirds of patients have various factors requiring a non-elective exchange/replacement regardless of manufacturer with a statistically higher rate of leaking and occlusion in GJ tubes manufactured by Avanos versus AMT.

Paper #: 071

Biopsy Directed 2D MR Elastography of the Liver in Fontan Patients: Higher Stiffness not Necessarily More Fibrosis

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Purpose or Case Report: Fontan–associated liver disease (FALD) is associated with increased risk of liver cirrhosis and hepatocellular carcinoma. Liver biopsy is the current gold standard investigation for diagnosing liver fibrosis. Magnetic Resonance Elastography (MRE) is a non-invasive procedure assessing liver stiffness. To date, only limited published studies are available describing the correlation of MRE and biopsy in Fontan-associated pediatric patients. Further, longitudinal changes in MRE require an increase in hepatic stiffness of >22% to indicate true change in stiffness (95% CI). The purpose of this study is to determine the clinical implication of MRE in FALD.
Methods & Materials: Firstly, a retrospective review was performed of Fontan patients having an MRE study and percutaneous liver biopsy between 2015 and 2019 within a maximal time interval of 2 months. Targeted liver stiffness was measured via a freehand region of interest (ROI) in the area of biopsy as directed by reported liver segment and biopsy throw length. This and total liver stiffness was compared with a quantification of liver fibrosis measured by percentage Sirius red (%SR) staining of biopsy samples. Secondly, total liver stiffness was evaluated for patients with two or more MRE studies between 2016 and 2019 and compared. In the case of multiple MRE studies, the initial and most recent were compared. Clinical history, patient demographics, procedure reports, and pathology were reviewed.
Results: Eighteen Fontan patients were included from initial database triage, with a mean age of 15.2 years (SD=2.1, 14 males) and mean time interval since Fontan surgery being 12.6 years. There was no significant correlation between the %SR staining and total (r=-0.24, p=0.338) or targeted liver stiffness (r=-0.128, p=0.614). Seventeen patients were included from the second search, which showed a statistically significant increase in mean liver stiffness from 3.8 to 4.6 (21% increase) within an average period of 24±7 months (p=0.005).
Conclusions: Total and targeted MRE liver stiffness did not correlate with liver biopsy, the gold standard test. Although MRE stiffness is shown to increase longitudinally, the increase is insufficient to indicate true change in fibrosis. Thus, MRE has limited use in assessing liver fibrosis in Fontan patients. A possible underlying explanation is that congestion is a confounding factor in elastography assessment.

Paper #: 072

Image-guided Core Needle Biopsy of Mediastinal Lymphoma in Pediatric Patients: A Retrospective Review

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Purpose or Case Report: Lymphoma is the most common mediastinal mass in children. Obtaining tissue for diagnosis can be challenging due to reported low diagnostic yield and risk of cardiorespiratory collapse, especially in the setting of anesthesia. We report our experience with biopsy of mediastinal masses, report the diagnostic rate for lymphoma and biopsy/anesthetic complications related to the procedure.
Methods & Materials: A retrospective review of image-guided core needle biopsy biopsies of mediastinal masses performed over the past 10 years. All interventional radiology patients <18 years old with final pathology result of lymphoma were included in the analysis(N=24).
Results: 27 cases (24 patients) were included (13 male). The median age at diagnosis was 15.4 years (IQR 12.14-16.49) and median weight 56 kg (IQR 42-59 kg). There were 24 primary diagnoses and 3 recurrences. Lesion volume measurement was available for 25/27 cases with a median of 539 mL (IQR 360 - 877 mL). Tracheal deviation ranged from 0.6-3.3 cm from midline. Pre-biopsy airway narrowing was documented at the level of trachea (9), right bronchus (5), or left bronchus (12). Vascular compression was present in 16 patients (59.3%), of which superior vena cava compression was noted in 12(75%). 7 patients had pre-biopsy respiratory symptoms (cough, dyspnea, orthopnea, wheezing). The majority of procedures were performed in the operating room (19, 73.1%), with the remainder in the interventional radiology suite (5, 19.2%), CT

suite or intensive care unit. Ultrasound guidance was used alone or in combination in all cases. Adjunctive imaging guidance included CT (2, 7.4%) and fluoroscopy (1, 3.7%), and was only used in recurrent disease. Mean number of biopsy passes was 8 (IQR 6-12) with 25/27 using coaxial technique. The diagnostic rate was 96.2% (26/27). In a single case, subsequent surgical biopsy was required for diagnosis confirmation. A single patient with known airway and vascular compression developed intra-procedural hypoxia and bradycardic arrest that responded to change in position with spontaneous return of circulation.
Conclusions: When alternative sources of histologic material are unavailable in the setting of suspected mediastinal lymphoma, image-guided biopsy has a high diagnostic yield. Comprehensive evaluation of mediastinal mass size, airway and vascular compression may assist prior to biopsy, as we encountered cardiovascular collapse in a single patient receiving monitored anesthesia care.

Paper #: 073

Image-guided Percutaneous Bone Biopsy for Pediatric Osteomyelitis: Correlating MRI Findings, Tissue Pathology and Culture, and Effect on Clinical Management

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Purpose or Case Report: Bone biopsy for histopathology and tissue culture remains the gold standard for diagnosis of osteomyelitis. However, MRI often results in a radiologic diagnosis of osteomyelitis preceding biopsy. The purpose of this study is to examine the diagnostic yield of percutaneous bone biopsies and the effect of biopsy results on clinical management in children with suspected osteomyelitis and positive MRI findings.
Methods & Materials: An IRB-approved retrospective review was performed at a tertiary care children's hospital. A search of the electronic medical record and radiology PACS identified patients less than 18 years of age who underwent percutaneous bone biopsy in the interventional radiology department for a primary indication of osteomyelitis and had positive MRI findings for osteomyelitis prior to biopsy. Data was collected on patient demographics, MRI findings, biopsy procedural details, tissue culture and histopathology results, and clinical management before and after biopsy. Changes in management were categorized as antibiotic type/quantity, duration, or diagnosis.
Results: A total of 82 bone biopsies in 79 patients with clinical suspicion for osteomyelitis and positive MRIs prior to biopsy were performed over a 5-year period from October 2014 to September 2019. All biopsies were successful, sent for tissue culture, and without associated complications. 22/82 biopsies (27%) yielded positive tissue cultures. Of those with positive tissue cultures, 16/22 (72%) resulted in a change in clinical management. Of all biopsies, 18/82 (22%) resulted in a change in clinical management (15 antibiotic, 1 duration, 2 diagnosis). In the two cases which had changes in management but negative tissue cultures, one had narrowing of antibiotics based on the negative culture result and the other was initiated on empiric antibiotics based on the histologic diagnosis of osteomyelitis.
Conclusions: In the pediatric population, percutaneous bone biopsy is a safe procedure with a high success rate. However, there is a relatively low rate of positive tissue cultures even with MRI findings suspicious for osteomyelitis (though rates are similar to those reported in adults). Approximately 1 in 5 biopsies resulted in a change in clinical management, mostly changes in antibiotic selection. Bone biopsy may have a higher clinical impact in certain circumstances, such as poor response to standard therapy, patients at risk for atypical infections, or inconclusive clinical/imaging findings.

Paper #: 074

One Step Balloon Gastrostomy and Gastrojejunostomy Tube Insertions in Children Using a Modified Adult Technique

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Purpose or Case Report: To evaluate the safety, technical success and outcome of image-guided 'one-step' retrograde balloon gastrostomy tube insertions in children.
Methods & Materials: A retrospective single center review was conducted by querying our RIS/PACS system to retrieve all gastrostomy procedures between 2018 and 2019. Each case was individually reviewed to determine the technique, what type of device was inserted, any procedural complications, and other potentially relevant demographic data.The procedures were performed under general anesthesia or moderate to deep sedation, using a Halyard Mic-Key balloon gastrostomy kit with an additional securement device. Ultrasound and fluoroscopic guidance were used in all procedures. Gastrostomy tube insertion technique, technical success, safety, and outcome were analyzed. All patients were followed up until full feeds were reached. Patients were then seen in the gastrostomy clinic 2 weeks and 8 weeks after the procedure.
Results: There was a total of 46 procedures, comprising 39 one step button insertions (34 gastrostomies and 5 gastrojejunostomies) and 7 retrograde pigtail gastrostomy insertions. The pigtail gastrostomies were inserted as a fall back plan when the one step button gastrostomy insertions were deemed too risky. Technical success was achieved in 44/46 (96%) procedures (2 were aborted. 40/46 (87%) of gastrostomy insertions, were uneventful. Of the remaining 6, there were 2 dislodgments and 4 superficial site infections which occurred within the first six months of starting the interventional service and were attributed to post-procedure care challenges.
Conclusions: Image-guided 'one-step' retrograde balloon gastrostomy tube insertion is a valuable and safe technique for establishing gastric feeding in children.

Paper #: 075

Transcatheter Therapies in Pediatric Patients with Chronic Portal Vein Thrombosis of the Native Liver

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Purpose or Case Report: Portal vein thrombosis (PVT) is a major cause of pediatric portal hypertension and gastrointestinal (GI) bleeding. Recanalization with balloon angioplasty (BA) and stent placement have emerged as a minimally invasive

treatment option for PVT. We sought to review the success and complication rates of transcatheter PVT therapy in pediatric patients with native liver.
Methods & Materials: IRB approved retrospective single-center review of chronic (> 3 months) PVT in native liver managed by transcatheter therapies between 4/2014-10/2019 at a tertiary pediatric center. The demographics, procedure details, technical and clinical success, complications (graded as per SIR guidelines) and follow-up were reviewed.
Results: A total of 20 patients (pts) (55% male) had a median age and weight of 7 yrs (range 1.2-21.2) and 29.3 kg (9.2–88) respectively at first intervention. Probable cause of PVT was prior UVC placement (n=9), protein C and S deficiency (n=2) or idiopathic (n=9). 12 pts presented with GI bleeding; of those without prior GI bleed, 6 had confirmed varices on endoscopy. 16 pts had splenomegaly at baseline. Transsplenic (n=13), transhepatic portal (n= 2), or combined transsplenic and transhepatic portal (n=5) access was used. Recanalization was successful in 12 pts (60%) at initial intervention, consisting of BA (n=7), stenting (n=5), and thrombectomy (n=2) in addition to BA. Complications during initial intervention included 1 large volume hemoperitoneum (SIR C), moderate volume hemoperitoneum requiring transfusion (SIR C), and 2 instances of small volume hemoperitoneum (SIR A). Of the 12 successful cases, 6 underwent re-intervention with indications including procedural completion, recurrence of GI bleeding/thrombocytopenia, stent occlusion and persistent stenosis confirmed by ultrasound imaging. Overall, a total of 35 interventions were performed in this population of 20 pts with an additional SIR F (patient mortality) complication occurring upon reintervention.
Conclusions: Transcatheter therapy for pediatric chronic PVT in the native liver is an emerging minimally invasive treatment option. Additional research is needed to determine suitable candidates and refine interventional techniques to optimize successful treatment of pediatric chronic PVT.

Paper #: 076

Ultrasound-Guided Inguinal Hernia Repair

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Purpose or Case Report: There are a number of techniques used to repair inguinal hernias, both open a laparoscopic. Here we report a case series of a novel method, inguinal herniorrhaphy using ultrasound guidance.
Methods & Materials: With IRB approval, all cases of ultrasound guided inguinal hernia repair at our institution from November 2017-June 2019 were retrospectively reviewed. Data collected included demographics, operative time and complications. All patients were females. The steps of the procedure are as follows: A meniscus repair needle (Smith&Nephew) was passed with ultrasound guidance (L20-5 Linear transducer Zonare), suture was passed, percutaneously around the hernia sac in order to ligate it. A needle laparoscope was placed to confirm appropriate ligation of the hernia.
Results: 27 patients underwent for a total of 34 hernia repairs (6 bilaterals). Median age was 4.7years (IQR 2.6-6.6) and median weight was 16.0kg (IQR 12.8-21.3). Mean operative time was 42min (IQR 31-45). There were 6 patients (6/27) who had undiagnosed contralateral hernias that were identified at the time of surgery with ultrasound. There were 7 conversion to laparoscopy (21%), 4 for sliding hernias, one for Canal of Nuck cyst and 2 ligation failures (6%). There were 2 post-operative fluid collections but neither required intervention. There was on reoperation for a suture granuloma. There were no recurrences.
Conclusions: Initial experience in inguinal herniorrhaphy using ultrasound guidance in females is safe and effective. In the future this technique could be performed without laparoscopic confirmation and under sedation to avoid general anesthesia.

Paper #: 077

Clinical Decision Support in Pediatric Imaging: Results from a Quaternary Care Pediatric Emergency Center

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Purpose or Case Report: To analyze the effect of point-of-care ACR-clinical decision support (CDS) software embedded in the electronic health records (EHR) on CT ordering patterns in a quaternary care pediatric emergency center (EC).
Methods & Materials: This study was HIPAA compliant and exempt from IRB approval. All CT exams across the enterprise ordered on EC patients from 9/18/18 to 10/8/2019 were categorized by CDS software (n = 6907). ACR-CDS scores were recorded: Red (1-3; usually not appropriate), Yellow (4-6; may be appropriate), Green (7-9; usually appropriate) and a category of "no score". From 9/18/18 to 8/7/2019, no feedback was provided to the ordering provider (n = 5833). From 8/8/2019 to 10/8/2019, best practice alerts (BPA) provided feedback to the provider (n = 1074). Any changes in imaging management and order behavior were recorded and compared between the pre-BPA and post-BPA activation. Chi-square test for proportions was conducted.
Results: Differences between the pre- and post-BPA percentages were statistically significant for Red (22% vs 17%), Green (53% vs 64%), and no score studies (11% vs 5%), respectively ($p<0.0001$). Yellow (15% vs 14%) studies showed no statistically significant difference ($p = .841$). For Red scores, 8% (n = 15) of studies were cancelled after receiving a BPA. No studies were changed to a study deemed more appropriate by the BPA. Reasons for bypassing the BPA included: Disagree with appropriateness score (17%) and Consulted with Other Specialist (16%). 29% provided free text reasons for bypassing the BPA. Analysis of free text reasons found that 52% (n = 25) of the orders could have chosen more suitable indications which would have resulted in a non-Red appropriateness score.
Conclusions: ACR-CDS recommendations decrease the ratio of clinically inappropriate to appropriate CT exams ordered by referring physicians. A small percentage of CT exams when CDS feedback stated "not inappropriate" actually led to a cancelled order. This baseline study will serve as a foundation to measure future incremental positive change in CT appropriateness after additional clinical educational outreach and improved EHR CDS user interfaces have been effected.

Paper #: 078

Early Adoption of Clinical Decision Support at a Quaternary Pediatric Academic Hospital: Lessons Learned

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Purpose or Case Report: The purpose of this study is to share our experience implementing a clinical decision support (CDS)

solution for imaging at a quaternary care pediatric academic hospital.
Methods & Materials: Over the course of 16 months we implemented a clinical decision support system into our EHR. To improve adoption and maintain system stability we conducted the implementation in a step-wise manner. 6 different phases were employed: Planning, Building, Testing, Silent mode activation, Data Analysis, and Full operationalization. Each phase brought challenges and opportunities.
Results: Establishing a multi-disciplinary team of leaders from both within and external to Radiology prior to embarking on the project is essential. Customizing the product for a particular institution is a labor intensive process which requires individuals who are both technically savvy and have medical knowledge. Organizing focus groups of users to test the system prior to activation enhances the system by improving trust and buy-in. One of the biggest adjustments in using a CDS is the culture change from allowing free text indications to relying on structured indications; there will be late adopters not accepting the appropriateness criteria but they will be in the minority. Initially operating the product in the background without interrupting workflows encourages providers to experiment with the system and provides important data on ordering habits and usage. Data analysis is essential to iteratively improve the user experience and provide data driven feedback to providers and executives, whom are interested in both the clinical and financial aspects of the system. Full operationalization of the CDS requires a coordinated effort by physician leaders, administrators and information services to successfully implement.
Conclusions: Keys to successfully implementing a CDS system at a pediatric academic hospital include building a motivated multi-disciplinary team, anticipating the unexpected, and establishing strong communication with ordering providers and executives. The experience at our hospital can help other pediatric hospitals seeking to implement a CDS system.

Paper #: 079

Anesthesia Nothing-by-mouth Guidelines and Enteric Contrast use in Sedated Pediatric Patients: Where do we Stand in Pediatric Radiology?

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Purpose or Case Report: Administering oral contrast less than two hours before sedation/anesthesia is often needed for computed tomography (CT) studies of the abdomen in children, but violates the American Society of Anesthesiologists (ASA) nothing-by-mouth guidelines and may increase the risk of aspiration pneumonia. ASA guidelines are based on gastric aspiration. Oral contrast is best administered 1 hour prior to imaging for optimal abdominal CT evaluation. The aim of our study was to measure residual gastric fluid volume (RGV) by CT and with manual aspiration in subjects undergoing general anesthesia (GA) less than 2 hours after oral contrast.
Methods & Materials: Institutional review board approval was obtained. 71 subjects were enrolled in the study. Subject were given oral contrast 1 hour prior to GA, the CT was performed and gastric aspiration by anesthesia using a Salem Sump™ enteric tube using a BARD™ Toomey Catheter Tip Syringe, sequentially positioning the patient in supine, left and right lateral decubitus position and recording the volume and pH. Two observers measure the RGV by semi-manual segmentation while viewing the stomach contents in the 3 orthogonal planes using Vitrea® fx (Vital Images, Minnetonka MN, USA).
Results: 66 subjects completed the study, mean age was 2.7 years (1.59), mean weight was 13.4 kg (+/-3.96). Time from end of contrast to GA/CT was 92 minutes with a range of 63 to 134 minutes. Measurement of RGV by CT yielded a median of 13.6 ml (3.1 to 33.2 ml interquartile range). Aspiration of gastric contents yielded a median of 6 (0 to 110) ml of fluid (20 subjects had 0 ml aspirated). 17% met the ASA fasting guideline; 47% met the guideline by aspiration and 32% met guideline by CT volume. However, of the 17% that met the fasting requirement, 8/11 still violated the guideline by volume. Subjects with 0 ml aspirated: 9 violated the > 0.4 ml/kg RGV. Airway was secured by endotracheal tube in 52, laryngeal mask airway in 4 and one had a tracheostomy. 10 were managed without an artificial airway.
Conclusions: **(**1) Our current practice of a 1 hour preparation for GA results in 68% of subjects having > 0.4 ml/kg of enteric contrast in the stomach supports the continued practice of airway protection with a cuffed endotracheal tube. (2) CT and gastric aspiration results are often discordant. CT or MRI may be a superior method of measuring the residual gastric contents.

Paper #: 080

Iodinated Contrast Extravasation During CT in a Pediatric Population

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Purpose or Case Report: To report a single institutional experience with intravenous iodinated contrast extravasations (ICE) occurring during CT at a free-standing academic pediatric medical center.
Methods & Materials: IRB approval was not required as this project qualified for a quality improvement designation. This retrospective investigation evaluated ICE occurring over a 34 months period between January 1, 2017 and October 22, 2019. The radiology data, incident reporting system data, and medical records of patients in whom ICE occurred were reviewed to assess incidence, severity, management, and outcomes. ICE were graded according to hospital policy (grade 1 mild to grade 4 severe). Descriptive statistics were used for this observational study.
Results: There were 9,636 contrast enhanced CT studies. ICE occurred in 30/9,636 (0.3 % of all studies). There were 16 infiltrates in 2017, 4 in 2018, and 10 in 2019, with a decrease in infiltrates after initiation of saline test bolus in mid-September 2017. Patient age for ICE episodes ranged from 6 weeks to 26 years (19 females, 11 males; median age 15 years). Contrast injection volumes ranged from 8 mL to 120 mL (mean 72.8 mL), 13 injections with full volume extravasation, 17 with partial volume extravasation. 29/30 ICE episodes were given via power injector, 1 was hand injected (implanted port). Injection rate ranged from 1.2 mL/second to 5 mL/second. Grade 1 or 2 infiltrate occurred in 18 cases, grade 3 or 4 occurred in 12 cases. Hyaluronidase was administered in 22/30 extravasations. Symptoms progressed in 4 of 22 treated patients and 2 developed blisters over the site within 24 hours of ICE. In both patients the blisters resolved with continued monitoring. 2/22 patients were treated with 2 doses of hyaluronidase due to extent

of extravasation. Only 1/30 patients required surgical consultation, but no surgical intervention. ICE symptoms resolved within 24 hours for 12 patients, in less than 72 hours for 9 patients, after 72 hours in 2 patients. No sequelae were noted on limited follow-up.
Conclusions: A large single institutional experience with ICE is presented, showing an incidence of 0.3%. Incidence of ICE was decreased after introduction of saline test bolus. Hyaluronidase was used to treat 73.3% of ICE in our series with good outcomes, however, a randomized controlled trial is needed to determine its utility. No cases required surgical intervention.

Paper #: 081

Cost Comparison of Upper GI versus Ultrasound for Pediatric Patients with Suspected Midgut Volvulus

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Purpose or Case Report: While a definitive conclusion regarding the optimal diagnostic strategy for midgut volvulus remains elusive, value can also be derived from cost. The purpose is to quantify and compare the monetary and time costs, from a provider perspective of imaging with Upper GI (UGI) versus Ultrasound (US) of children with suspected midgut volvulus.
Methods & Materials: Process maps were created by direct patient shadowing, electronic medical record review and interviews with front-line staff. Using the time-driven activity-based costing (TDABC) methodology, practical capacity cost rates were calculated for personnel, equipment, and facility costs. The cost of each process step was determined by multiplying the step-specific capacity costs by the median time required to complete each step. Base case total pathway costs for UGI and US were computed by summing the costs of all steps through each process pathway. Multivariate sensitivity analysis was performed applying all minimum and maximum labor costs. Costs across the modality pathways were then compared.
Results: Base case process maps demonstrated an average time of 77 minutes for the UGI pathway and 53 minutes for the US pathway. UGI pathway time varied based on whether the patient was able to consume contrast or if a nasogastric tube (NG) tube was required. Total pathway time for patients' undergoing evaluation with UGI was on average 23 minutes longer than those undergoing evaluation with US.Total base case cost for an UGI evaluation was $223.80 when the procedure was performed by a radiology assistant (RA) and $343.06 when the procedure was performed by a radiologist. Multivariate sensitivity analyses for UGI evaluation applying all minimum and maximum labor cost variables revealed a total range of $198.74 (minimum) to $256.65 (maximum) when the procedure was conducted by an RA and $304.32 (minimum) to $389.58 (maximum) when conducted by a radiologist.Total base case cost for US evaluation was $149.60 when the procedure was performed by a sonographer and $210.23 when the procedure was performed by a radiologist. Multivariate sensitivity analyses for US evaluation applying all minimum and maximum labor cost variables revealed a total range of $129.36 (minimum) to $181.48 (maximum) when performed by a sonographer and $186.42 (minimum) to $243.49 (maximum) when performed by a radiologist.
Conclusions: Ultrasound is a more efficient and less costly alternative compared to UGI in patients with suspected midgut volvulus.

Paper #: 082

Imaging Sedation and Anesthesia Practice Patterns in Children – A Survey of the Society of Chairs of Radiology at Children's Hospitals (SCORCH)

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Purpose or Case Report: There is little data describing imaging sedation and anesthesia practice patterns in pediatric radiology. The purpose of this study was to understand current imaging sedation and anesthesia practice patterns based on a survey of member institutions of the Society of Chairs of Radiology at Children's Hospitals (SCORCH) in conjunction with the American College of Radiology's Pediatric Imaging Sedation and Anesthesia Committee.
Methods & Materials: A survey composed of 27 questions related to imaging sedation and anesthesia in pediatric radiology departments was distributed to SCORCH member institutions in January 2019 via SurveyMonkey (San Mateo, CA). A single reminder email was sent. Descriptive statistical analyses were performed.
Results: 21/84 (25%) SCORCH institutions completed the survey. 57% identified as academic/university-affiliated, 13% were a division/section in an adult radiology department, and 9% were private practice. Imaging sedation (excluding general anesthesia) is commonly performed by anesthesiologists (76%) and intensive care unit physicians (intensivists, 48%); only 14% allow radiologists to supervise imaging sedation. 96% of departments use child life specialists for patient preparation, while a similar percentage (91%) also use nurses and technologists for this purpose. 76% of departments have preparatory resources available for patients prior to their visit on a department website, 30% have simulation videos, and 20% have audio clips. Nearly half (48%) of the departments have a mock scanner to aid in patient preparation. Imaging sedation and anesthesia is most often scheduled by a scheduler at the request of the ordering clinician (65%), while 57% of departments allow schedulers to place patients into imaging sedation and anesthesia slots based on age or other guidelines; sedation is scheduled by nursing and imaging technologists in 35% and 22% of departments, respectively. 70% of departments contact the ordering clinician or patient's family to determine the level of sedation required, with this duty commonly performed by a nurse. 13% of departments expect radiologists to be able to discuss the risks of sedation and anesthesia with families, and 29% of departments provide information regarding such risks on their website.
Conclusions: Imaging sedation and anesthesia practice patterns vary considerably between pediatric radiology departments and understanding current approaches can help with standardization and practice improvement.

Paper #: 083

Standardizing QI in Head and Abdominal CTs to Improve Technologist Performance and Diagnostic Quality of Exams

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Purpose or Case Report: Repeat imaging is often a result of unnecessary errors in 1 or more diagnostic categories. To minimize the number of Head and Abdominal CTs with suboptimal diagnostic quality, we set out to create a standardized list of criteria that assess the quality of the study. This list of standards and evaluation criteria successfully provided the technologists knowledge and insight into what our radiologists require to diagnose our pediatric patients.
Methods & Materials: Six criteria for grading CT Head and CT Abdominal exams were agreed upon by consulting body and neuro radiologists. Head exams were graded on: gantry angle, presence of artifacts, written protocol followed, appropriate radiation dose, appropriate scan coverage and acceptable motion. Abdomen/Pelvis exams were graded on: contrast timing, presence of artifacts, written protocol followed, appropriate radiation dose, appropriate scan coverage and acceptable motion. Baseline data was collected from October 1st, 2018 to August 31st, 2019 and 15% of each Staff Technologist's exams were then graded under the supervision of the consulting radiologists. Points were assigned accordingly in each category (1 point/acceptable; 2 points/unacceptable). The target cumulative score was 6/6 representing optimal diagnostic quality. A given score higher than 6 contains one or more unacceptable elements within the exam carrying the potential of requiring a repeat study. On August 26th, 2019, an education stand down was held for all Staff Technologists
Results: From October 2018 to August 2019, 47.9% of CT Head exams and 52.9% of CT Abdomen Pelvis exams had met the target goal of 6/6. Our cumulative quality score for all graded exams was 49.7%. Immediately following technologist education in August 2019, 62.2% of CT Head exams and 55.6% of CT Abdomen/Pelvis exams scored 6/6 bringing our cumulative quality score up to 60%. The average score that was not a 6 pre education was 7.35. The average score that was not a 6 post education was 7.05. Pre and post education scores per category were as follows: Artifact – 97.8% to 100%; Contrast Timing: 76.7% to 66.6%; Head Angle: 57.0% to 70.3%; Motion: 97.0% to 98.2%; Radiation Dosage: 97.5% to 98.2%; Scan Coverage: 97.8% to 100%; Written Protocol: 89.4% to 92.7%. The Head Angle category was given extensive, hands-on training and was, by far, the most improved category
Conclusions: Knowledge of the QI project and education on what the radiologist wants reduces the number of errors and increases the number of successful exams.

Paper #: 084

Imaging Sedation and Anesthesia Practice Patterns in Children Under 6 Months of Age – A Survey of the Society of Chairs of Radiology at Children's Hospitals (SCORCH)

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Purpose or Case Report: The use of feed and swaddle (FS) technique in infants has increased in popularity due to the concern for neurotoxicity from medications used for anesthesia or sedation. The purpose for evaluating the age group < 6 months of age was to understand current imaging sedation and anesthesia practice patterns based on a survey of member institutions of the Society of Chairs of Radiology at Children's Hospitals (SCORCH) in conjunction with the American College of Radiology's Pediatric Imaging Sedation and Anesthesia Committee.
Methods & Materials: A survey composed of 27 questions pertaining to the use of imaging sedation and anesthesia in pediatric radiology departments was distributed to SCORCH institutions in January 2019 via SurveyMonkey(San Mateo, CA). Three questions (12,15 and 18) required recording the percentage of motion reduction techniques used over the past year in infants <6 months for specific exams - Chest CT with contrast enhancement(CTCE), Brain MRI with contrast enhancement(BMCE), and liver mass MRI with contrast enhancement(LMCE). The technique options included no sedation(NS), feed and swaddle(FS), sedation(S), and general anesthesia(GA). Numbers had to add up to 100. S and GA were combined in the analysis. Descriptive statistical analyses were performed.
Results: Question 12 focused on CTCE had 19 respondents. A majority of sites 17/19(90%) offered NS and/or FS. 14/19(74%) used NS as a technique with 4 sites using NS in 90-100% of cases. 8/19(42%) used FS. 1 site used FS for all cases and 1 site used NS for all cases. Most sites,15/19(79%), offered S or GA. 2 sites used GA for all cases, 1 site used S/GA in 80% and the remainder used S/GA in 50% or fewer cases. Question 15 focused on BMCE had 19 respondents. A majority of sites, 80%, offered FS with variable use: 3/19(16%) in >80%, 4/19(21%) in 30 to 50% and 8/19(42%) in 5-20%. 1/3 of sites used NS in 2-30% of cases. A majority of sites 12/19(63%) used S/GA in 80% -100% of cases. 1 site used FS for all cases. Question 18 focused on LMCE had 18 respondents. 5/18 (28%) of sites used FS or NS. Most sites, 13/18(72%) used S/GA only in 100% of cases.
Conclusions: The data shows variability in the use of motion reduction techniques and differences in use among sites. Results for FS and NS are promising with room for improvement with sharing of protocols. MRI studies had high use of S and GA, but there were sites performing exams without sedation. The experiences of those programs and collaboration may help decrease the use of sedation and GA.

Paper #: 085

Gadolinium Bone Detection in Pediatric Patients with and Without Exposure to Gadolinium Based Contrast Agents

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Purpose or Case Report: The long term effects of retained Gadolinium (Gd) are still under investigation, but may be of greater concern in pediatric patients.So far several factors that appear to influence Gd retention have been described. The chemical structure of the Gadolinium based contrast agents (GBCA) plays an important role, with linear agents showing greater deposition compared with macrocyclics, attributed to lower chelate affinity. Differences in GBCA washout may also play a role.In this study we investigated and quantified the presence of Gd bone deposits in pediatric patients receiving GBCA as well as in controls with no known exposure.
Methods & Materials: Following IRB approval, 51 bone fragments from craniotomies from 50 pediatric patients between 6 months and 20 years of age were analyzed for elemental Gadolinium using inductively coupled plasma-mass spectrometry (ICP-MS). 17 subjects had no known exposure to GBCA and were included as controls. This cohort included 17 subjects who were part of an earlier pilot study on gadolinium bone retention. Four subjects were excluded due to insufficient bone samples. Based on site and type of ossification, we analyzed 30 occipital bone samples (endochondral ossification) and 17 cranial vault samples (intramembranous ossification). Type and dose of contrast agent, number and timing of contrast-enhanced MR exams relative to bone sampling and renal function were documented for patients with known GBCA exposure.
Results: Patient exposures ranged from 1 to >19 doses of GBCA including linear agents only, macrocyclic and linear agents and macrocyclics only. Gd was found to be present in bone tissue in all exposed patients as well as in those with no GBCA exposure, likely reflecting environmental exposure. Those who received linear agents only (2 patients) or both macrocyclic and linear GBCA (4 patients) demonstrated higher levels than those only exposed to macrocyclic agents (24 patients), whose levels were similar to those found in patients with no known exposure to GBCA.
Conclusions: This study demonstrates pathologic confirmation of Gd retention in bone, both with endochondral and intramembranous ossification, of pediatric patients exposed to various GBCA, with greater accumulation seen with linear agents. Low levels of Gd were also detected in those without known GBCA exposure, suggesting some accumulation from environmental exposure to Gd. Interestingly, these levels were similar to those seen in patients exposed to macrocyclics only.

Paper #: 086

Advanced Imaging Utilization and Cost Patterns in Children Over an Eight-year Period from a Large Pediatric Accountable Care Organization

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Purpose or Case Report: To evaluate patterns of advanced imaging utilization and associated costs over an 8-year period in one of the largest pediatric Accountable Care Organizations (ACO) in the US covering over 300,000 children.
Methods & Materials: Advanced imaging claims data for each year from 2010-2017 from the ACO (Partner for Kids) were reviewed. MRI, CT, and US utilization trends from all emergency department (ED) and outpatient (OP) encounters and associated costs were analyzed. Utilization rate (UR) was defined as the number of procedures per 100 enrolled children per calendar year. Cost per procedure was calculated, and yearly utilization and expenditure trends analyzed using Pearson's correlation.
Results: Over the eight-year period, a total of 202,345 advanced imaging studies were performed. Average overall UR was 6.8 advanced imaging studies per 100 children per year (1.2 for MRI, 2.7 for CT, and 3.0 for US). The total cost of advanced imaging studies was $6,659,272 per year on average ($2.4 M for MRI, $2.7 M for CT, and $1.4 M for US). In the ED, between 2010 and 2017, UR of US increased from 0.5 to 1.0 (r = 0.99), UR of CT increased from 1.4 to 1.9 (r = 0.48) and UR of MRI in the ED changed from 0.03 to 0.04 (r=0.7). In the OP setting, between 2010 and 2017, UR of US also increased from 2.0 to 2.4 (r=0.94), UR of CT decreased slightly from 0.8 to 0.7 (r=-0.71), and UR of MRI remained similar from 1.12 to 1.13 (r = -0.24). Total advanced imaging UR in the ED showed a steady increase from 1.9 to 2.9 (r = 0.82). The overall advanced imaging use in the OP setting showed a smaller overall rise from an UR of 3.9 to 4.3 (r = 0.57). The cost per procedure did not demonstrate any significant increase from 2010 until 2017 with less than 1.7 % change each year, except for ED US (2.8% yearly growth).
Conclusions: This is the first study of imaging trends and associated costs in a large pediatric ACO. The 8 year analysis demonstrated an increase in overall advanced imaging utilization, which was more pronounced in the ED setting. By analyzing imaging utilization trends sorted by patient care setting, modality, and cost, it improves the global understanding of imaging to cover a diverse pediatric population. It also creates the foundation for studying value of imaging in the ACO in discrete patient care pathways, which in turn, will allow targeted interventions to improve quality, safety, and effectiveness of care.

Paper #: 087

Clinical Decision Support has no Effect on Payer Claim Denials

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Purpose or Case Report: At our children's hospital, we deployed clinical decision support (CDS) software to support appropriate use of imaging. The software is primarily based on ACR appropriateness criteria. To determine if by using CDS, lower rates of payer claim denials could be expected, we evaluated rates of payer claim denials based on CDS score prior to CDS go-live.
Methods & Materials: This study was HIPAA compliant and exempt from IRB approval. The specified indications on all CT exams performed 9/18/18 to 6/30/19 were rated by ACR-CDS software in silent mode; no feedback was presented to ordering providers. Claim denials for billed CTs were retrieved from hospital billing through 9/13/19. Rates of payer denials were analyzed for 5 categories: 1-3 red (not appropriate), 4-6 yellow (may be appropriate), 7-9 green (appropriate), indication not found (option the provider can use if available structured indications are not appropriate), and no score for the provided

indication in CDS. Chi-square test was used for statistical significance of denial rate differences. Additionally, reason for payer denial was evaluated to identify any denials attributable to the CT exam's indication.
Results: During the time period, there were 11,038 billed CTs: 1597 (14.5%) red, 1906 (17.3%) yellow, 5140 (46.6%) green, 1923 (17.4%) indication not found, 472 (4.3%) no score. The payer denied claims in 1,177 (10.7%): 181 (11.3%) red, 200 (10.5%) yellow, 533 (10.4%) green,198 (10.3%) indication not found, and 65 (13.8%) no score. There was no statistically significant rate difference in denials based on CDS category ($p = 0.18$). Of the red (not indicated) exams, there were no denials attributable to indication. In all, 2 denials were attributed to indication, both on exams with green indications.
Conclusions: At our institution, there was no correlation between CDS appropriateness category and payer denials. Reason for denial of red (not indicated) CT exams was not due to inappropriate indication. At this time, payer criteria is not aligned with appropriateness criteria. In the short term, a change in denial rates for billed CT exams following CDS go-live is not anticipated.

Paper #: 088

Peer Collaborative Improvement: Lessons Learned 2016-2019

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Purpose or Case Report: To evaluate the peer collaborative improvement (PCI) process used in our pediatric radiology department since January 2016, differences in sequential surveys and temporal change in types of submissions were assessed.
Methods & Materials: Study was HIPAA compliant and exempt from IRB approval. Faculty were anonymously surveyed online in August 2016 and March 2019. Response options were scaled 1 (disagree) to 10 (agree). Response differences were compared for 3 questions that were asked on both surveys via the Wilcoxon-rank test. Free text comments were tabulated and categorized, and compared via Fisher's exact test. In response to the 2019 survey, the PCI system was modified to improve anonymity. PCI database was queried over three time periods for number and types of submissions: 2016-2017 (16 months following go-live), current 2019 (5 months following modification), and 2018 (same 5-month period, one year prior). Rates of submission types were compared using chi-square test.
Results: In 2019, 33 of 42 faculty responded (79% participation rate, previously 30 of 40, 75%). Comparing 2016 to 2019, there was no statistically significant change in scores of either "Comfort in pointing out errors knowing data not used to judge peers" (2016 vs 2019 mean 8.0 vs 6.7 p=0.071) or faculty "usually receives helpful information in PCI monthly conferences" (2016 vs 2019, 8.4 vs 7.8 p=0.36), though both scores decreased. There was a significant decrease in response to "goal of PCI is improving patient care, not placing blame" (2016 vs 2019, 9.1 vs 7.9 p<0.0014). There were 17 comments in 2019 (51.5%), increased (p<0.0001) from 2016 (n=2, 6.3%). 2019 comments were to improve the punitive aspects of PCI (n=7, 41.2%), ensure improved patient care (n=6, 35.3%), and increase anonymity (n=4, 23.5%). The lowest rated question in 2019 was "The random auditing of cases contributes important learning material" (3.6). There was no significant difference between the types of PCI submissions over the time periods (p = 0.62), with most agree (2016-2017 90.7%, 2018 91.5%, 2019 91.4%), and no change in error types (perception/cognition 5.8%, 5.4%, 5.5%; reporting 1.9%, 1.7%, 1.7%; and other 1.6%, 1.4%, 1.4%).
Conclusions: Faculty have increasing concerns with anonymity and potential punitive effects of PCI submissions. Faculty affirm the value of learning from PCI conferences. Lack of identifiable change in PCI submission types over multiple time periods suggests the types of submissions reflects our error types in practice.

Paper #: 089

Risk of Acute Kidney Injury Following Intravenous Iodinated Contrast Material in Children and Adolescents: A Propensity Score-Matched Observational Cohort Study

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Purpose or Case Report: Acute kidney injury (AKI) remains a concern in hospitalized children undergoing computed tomography (CT) examinations with intravenous (IV) iodinated contrast material (ICM). Adult studies have shown frequencies of AKI after CT with IV ICM to be similar to propensity score-matched ICM unexposed cohorts. The purpose of this study is to evaluate the association between IV ICM exposure and AKI in hospitalized pediatric patients with stable kidney function undergoing computed tomography (CT).
Methods & Materials: This retrospective observational cohort study was institutional review board-approved and HIPAA-compliant; informed consent was waived. Hospitalized patients ≤18 years-old with stable kidney function and available pre- and post-imaging serum creatinine (SCr) who underwent CT with IV ICM or abdominal ultrasound (US) between January 2009 and November 2018 were identified. 1:1 propensity score matching was performed using 23 covariates, stratified by pre-imaging eGFR (estimated glomerular filtration rate; ≥/<60 mL/min/1.73m^2). AKI was defined by Acute Kidney Injury Network SCr-related criteria. Multivariable logistic regression was performed to identify risk factors for post-imaging AKI, including the effects of pre-imaging eGFR and IV ICM exposure.
Results: 1,850 unique patients were included in the propensity score matched population (n=925 per cohort). Frequency of post-imaging AKI in patients with eGFR≥60 mL/min/1.73m^2 was 2.2% (20/889) for both CT and US (odds ratio [OR]=0.98; 95% confidence interval [CI]: 0.52,1.86; p=0.95), and in patients with eGFR<60 mL/min/1.73 m^2 was 5.6% (2/36) and 11.1% (4/36) in the CT and US cohorts, respectively (OR=0.75; 95% CI: 0.11,5.00; p=0.76). Significant predictors of AKI included pre-imaging eGFR (p=0.0011), body mass index (p=0.0025), acquired kidney disease (p=0.049), and nephrotoxic antibiotic exposure (p=0.0007); IV ICM exposure was not predictive.
Conclusions: Hospitalized children with stable kidney function who underwent CT with IV ICM had a similar frequency of AKI compared to a propensity score-matched ICM unexposed cohort. In the majority of pediatric inpatients undergoing contrast-enhanced CT (eGFR≥60 mL/min/1.73m^2), ICM is not independently associated with AKI.

Paper #: 090

Diffusion Weighted Imaging (DWI) of the Kidneys in Healthy Controls and Patients with Autosomal Recessive Polycystic Kidney Disease (ARPKD)

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Purpose or Case Report: ARPKD causes diffuse microcysts in the kidney parenchyma, and cyst burden cannot be quantified by standard image segmentation methods. We sought to assess whether apparent diffusion coefficient (ADC) measured by DWI could serve as a non-invasive biomarker of ARPKD severity, with the hypothesis that ADC would be higher in cystic vs. non-cystic parenchyma due to higher extracellular water content. We examined whether ADC could distinguish healthy kidneys from those affected by ARPKD, and whether a threshold ADC value could be established to differentiate cystic vs. non-cystic parenchyma.
Methods & Materials: 12 individuals with ARPKD (age 14.4±5.9y) and 10 healthy controls (age 12.5±4.0y) were compared cross-sectionally. DWI was acquired in a fasting state with parameters: TR 7100ms; TE 67ms; slice thickness 4mm, b-values: 0, 200, 500, 800, and 1000 s/mm^2 (Siemens Skyra 3T). Whole-kidney regions of interest were drawn manually, excluding the collecting system and large blood vessels, and ADC was calculated using a mono-exponential decay model (pMRI software, parametricmri.com). Mean and median kidney ADC were compared in healthy controls vs. ARPKD (Mann-Whitney U test). Histograms of voxel-wise ADC frequencies were examined in control and ARPKD groups to determine if the distribution was skewed towards higher ADC in cystic parenchyma.
Results: Mean kidney ADC values were similar in the ARPKD group (3.42±0.40 x 10^{-3}mm^2/s) and healthy controls (3.44±0.47 x 10^{-3}mm^2/s) (p =0.9). On histogram analysis, voxel-wise ADC frequencies were not normally distributed in either control or ARPKD groups, with significantly right-skewed distribution with long tails towards high ADC values and a large number of high-ADC outliers in both groups (ARPKD vs. control skewness 3.6 vs. 4.0 and kurtosis 21.5 vs. 25.6). Given the non-normal distribution of ADC values, we also compared median kidney ADC between the ARPKD and control groups and found no statistically significant difference (p = 0.5).
Conclusions: ADC values obtained from DWI do not appear to distinguish between cystic and non-cystic kidney parenchyma in individuals with ARPKD, possibly due to confounding effects of kidney fibrosis on ADC measurements in individuals with ARPKD. Further studies are needed to determine if other MRI sequences could identify potential biomarkers of kidney disease severity in ARPKD.

Paper #: 091

Second Opinion Ultrasound for Appendicitis and Intussusception in a Pediatric Tertiary Care Center: Agreement, Discrepancy Rate and Outcome Assessment

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Purpose or Case Report: **Background**: Prior studies have shown significant discrepancy between the initial radiologist and pediatric radiologist interpretation of imaging exams performed on pediatric patients. Studies specifically focused on the rate of discrepancy of ultrasound (US) exams for suspected appendicitis and intussusception are deficient.**Objective:** To determine the agreement and discrepancy rates, and the clinical impact of discrepancies in the diagnosis of appendicitis and ileocolic intussusception between initial US performed at referring community hospitals and second (2nd) opinion US performed at an academic pediatric tertiary care hospital.
Methods & Materials: This was a retrospective study. The inclusion criteria were: 1) age≤18 yrs, 2) had an US performed at a referring hospital for suspected appendicitis or ileocolic intussusception, 3) availability of the initial US images and report or results of the report on our electronic medical record system or PACS, and 4) had a repeat US at our institution within 48 hours. The agreement and discrepancy between the results of the initial and the 2nd opinion US, and the agreement of the results with the final clinical diagnosis were evaluated.
Results: We included 234 patients with clinical suspicion of appendicitis (age range 1-16 years, mean age: 7.4 years) and 150 patients with suspicion of intussusception (age range 6 days-16 years, mean age: 3.6 years). We found only moderate agreement between the results of the initial US and those of the 2nd opinion US, with a kappa of 0.23 (95% CI 0.13-0.33) for cases with suspicion of appendicitis and kappa of 0.35 (95% CI 0.23-0.47) for those with suspicion of intussusception. There were discrepancies between the results of the initial and 2nd opinion US exams in 33.3%(78/234) of cases with suspicion of appendicitis, and in 31.3%(47/150) of cases with suspicion of intussusception. The results of the 2nd opinion US exams had a higher agreement rate with the final clinical diagnosis (83.8% and 99.3% for cases with suspicion of appendicitis and intussusception, respectively) compared to the agreement of the initial US exams with the final clinical diagnosis (55.6 % and 67.3% for cases with suspicion of appendicitis and intussusception, respectively).
Conclusions: Obtaining a 2nd opinion US by sonographers and radiologists with training in pediatric radiology is of value in pediatric cases with clinical suspicion of appendicitis and intussusception.

Paper #: 092

Factors associated with Sonographic Non-Visualization of the Appendix in 11,320 Consecutive Pediatric Patients Suspected of Appendicitis

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Purpose or Case Report: We sought to determine factors associated with sonographic non-visualization of the appendix in patients being evaluated for appendicitis.
Methods & Materials: We retrospectively identified all appendix ultrasound (US) studies performed on patients younger than 19 between 2012 and mid 2019. The studies were performed by dedicated pediatric sonographers and/or radiologists. Standardized radiology report impressions were classified by pattern matching into four categories: found (e.g.

reported as appendicitis or appendix identified, normal, or partially seen), not found (e.g. reported as not seen, limited, or nondiagnostic), status post appendectomy, or unclassifiable. The latter two categories were excluded. Demographic factors, time of day of exam performance, weight (and when available, body mass index {BMI}) were recorded for the encounter +/- 90 days. Univariate and multivariate association and logistic regression analyses were performed.
Results: We identified 11,320 patients (6,437 female) with an appendix-focused US and recorded weight. Overall, 6,743 appendices were found; 4,577 were not found; 25 were post appendectomy, searching for abscess; and 430 were unclassified. We found 6,718 of 11,067 appendices (61%) in patients weighing less than 95 kg and 25 of 253 (10%) in patients weighing more. In 2,235 patients with BMI available, we found 1,138 of 2,111 (54%) appendices in BMI less than 30 and 14 of 124 (11%) in BMI greater than 30. Increasing patient age and weight and female gender were all significantly associated with appendix nonvisualization ($p<0.0001$), but the effect sizes were small (AUC between 0.52 and 0.58). On univariate analysis weight was significantly associated with not finding the appendix (odds ratio {OR} 1.03 {95% CI 1.02-1.02}). In multivariate analysis, weight more than 95 kg (OR 9.6 {95% CI 6.45-14.94}), age (OR 1.07 {95% CI 1.06-1.08}), and female gender (OR 1.52 {95% CI 1.41-1.65}) were significantly associated with nonvisualization of the appendix. The percentage visualization of the appendix was 69%, 67%, and 59% for day, evening, and overnight shifts, respectively ($p<0.0001$).
Conclusions: Older, heavier, and female patients are more likely to have an appendix ultrasound that fails to demonstrate the appendix or show positive secondary signs. The working shift also affects the rate of appendix visualization. Consideration should be given to alternate modalities when there is clinical concern for appendicitis in patients weighing over 95 kg, especially overnight.

Paper #: 093

Quantitative MRI Biomarkers in Pediatric Nephron Sparing Surgery

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Purpose or Case Report: Nephron sparing surgery for renal masses is indicated for pediatric patients with bilateral renal masses and masses associated with syndromic conditions predisposed to recurrence. However, there is a paucity of literature on MRI-based biomarkers in patients undergoing partial nephrectomy. Relating these imaging biomarkers to patient outcomes might inform surgical decision making and patient counseling.
Methods & Materials: An IRB approved urologic surgical database was searched for all patients who underwent partial nephrectomy. Relevant preoperative MR was retrieved with axial DWI and T2-weighted fat-saturated (T2W-FS) sequences.ADC calculation using the log model was performed in the pMRI software package for the following segmented tissue types: (1) Whole tumor (2) Solid Tumor (excluding cystic areas) (3) kidney ipsilateral and (4) contralateral to the tumor. 3 b-values were used for ADC calculation (0 or 50, 500, 1000). Visual reference was made to T2W-FS images for anatomic deliniation. For each segmented region, the volume and mean ADC values were tabulated.
Results: 28 patients underwent 33 partial nephrectomy surgeries and, among these, 22 had adequate preoperative MRI with DWI. Median age at diagnosis was 24.5 months (IQR 13.1-35.2). Mean tumor volume = 49 cc (SD = 62).No significant differences were seen between whole tumor mean ADC values for Wilms Tumor (n=18) and RCC (n=2) and Angiomyolipoma (n=2), 1454 vs 1468 vs 913 mm^2/sec (ANOVA, p=0.38). ADC_{mean} [SD] for the following tissue types was Whole Tumor = 1429 mm^2/sec [450], Solid Tumor (excluding cystic area) =1180 mm^2/sec [673] , Ipsilateral Kidney = 1561 mm^2/sec [450], Contralateral Kidney = 1220 mm^2/sec[665].Positive correlations were seen between patient length of stay and both whole tumor and solid tumor volumes (β=19.4, adjusted R^2=0.38, p=0.001 and β=5.7, adjusted R^2=0.37, p=0.002). Weak negative correlation was seen between estimated blood loss and the mean ADC value of the ipsilateral kidney (β=-0.41, adjusted R^2=0.12, p=0.06) and mean ADC value of the solid-portion tumor ADC (β=-0.72, adjusted R^2=0.12, p=0.07). Patients who experienced any postoperative complications had higher solid-tumor ADC values (1712 vs 1188 mm^2/sec, p=0.01).
Conclusions: For pediatric patients undergoing partial nephrectomy, MRI is a vital tool for surgical staging. Our work suggests that tumor volumetrics and DWI may provide information regarding surgical outcomes including intraoperative blood loss, length of stay and post-operative complications.

Paper #: 094

R.E.N.A.L. Nephrometry for Pediatric Nephron Sparing Surgery

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Purpose or Case Report: There is no standardized system for assessment of which pediatric tumors are amenable to partial nephrectomy – a surgery that is considered in pediatric patients with bilateral renal masses and those with predisposition syndromes. The RENAL Nephrometry score is the most widely used system to assess renal tumor complexity for surgical decision making in adults. We evaluated the RENAL Nephrometry score and imaging features that might predict perioperative clinical outcomes.
Methods & Materials: An IRB approved urological database was searched for all patients who underwent partial nephrectomy for a renal mass from 2006-2019. Pre-op CT/MR imaging was anonymized for review. Following training sessions, 2 pediatric radiologists and 2 pediatric urologists scored images using a 14-question survey instrument that included RENAL Nephrometry features of tumor size, distance from the collecting system, and location in the kidney. Patients were grouped based on Nephrometry score (low complexity:<9, high complexity: $\geq$9). Fleiss's kappa and the intraclass correlation coefficient (ICC) were performed in R. Consensus Nephrometry scores were calculated using the median (continuous numeric variables) and mode (categorical variables). Outcome data was obtained from the EMR.
Results: 28 patients had 33 surgeries. Median age at surgery was 3.2 years old (IQR: 1.8-4.0). 17 patients (52%) were female and 14 (42%) had renal mass predisposition syndromes- most commonly Beckwith Wiedemann Syndrome (n=7; 21.2%). The cross-sectional imaging closest to surgery was MR for 27 and

CT for 7 patients. Mean imaging-to-OR time was 15 days (Range: 7-44 days).Good-to-excellent agreement was seen for tumor size (ICC=0.91), distance from collecting system (ICC=0.72), and exophytic nature of the tumor (ICC=0.77) (ps<0.001). Moderate-to-substantial agreement for whether the tumor crossed the renal midline (κ=0.74) and whether the tumor touched the hilar vessels (κ=0.56) (ps<0.001).Median Nephrometry score = 9 (range:4 - 11). High complexity tumors were associated with longer OR times (367 vs 267 min, p=0.003), increased length of stay (7 vs 4 days, p=0.006), and higher estimated blood loss (275 vs 200, p=0.28).
Conclusions: A standardized morphologic scoring system of renal tumors is reproducible, correlates with perioperative outcomes, and therefore has promise for pediatric patients undergoing partial nephrectomy. High tumor complexity correlated with increased hospital stay, operative time and blood loss at resection.

Paper #: 095

Predictors of Liver Diffusion-Weighted Imaging Apparent Diffusion Coefficient Measurements in Pediatric Autoimmune Liver Disease Patients

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Purpose or Case Report: Multiple noninvasive magnetic resonance imaging (MRI) methods have been described to detect liver fibrosis, including diffusion-weighted imaging (DWI). The purpose of our study was to evaluate predictors of liver MRI DWI apparent diffusion coefficient (ADC) measurements in pediatric patients with autoimmune liver disease, including the relationship between ADC measurements and liver stiffness.
Methods & Materials: Fifty-seven research liver MRI examinations performed between January 2017 and August 2018 that included DWI, liver MR elastography (MRE), and spleen MRE in pediatric patients enrolled in an autoimmune liver disease registry were identified. DWI ADC values were measured by manually drawing regions of interests (ROI) in the right hepatic lobe while avoiding visible vessels and artifacts at four anatomic levels using IntelliSpace (Philips Healthcare). Liver and spleen stiffness (kPa) were measured at the same anatomic levels. Iron-corrected T1 (cT1) was measured using LiverMultiScan (Perspectum Diagnostics). Patient age, sex, laboratory data (ALT, bilirubin, alkaline phosphatase, and GGT) were recorded. Spearman's rank-order correlation (r) and multiple linear regression (stepwise model selection) were used to evaluate the association between liver ADC measurements and liver predictor variables.
Results: Mean (SD) patient age was 15.0 (3.9) years. 23/57 (40%) examinations were performed in girls. Mean liver DWI ADC was 1.34 (0.14) x 10^{-3} mm^2/s. Mean liver stiffness was 3.42 (1.62) kPa. Liver ADC measurements showed weak to moderate significant inverse correlations with liver stiffness (r=-0.42, p=0.001), spleen stiffness (r=-0.34; p=0.015), ALT (r=-0.5; p=0.0001); GGT (r=-0.48; p=0.0004), and cT1 mean (r=-0.39; p=0.007). Multiple linear regression showed liver stiffness (p=0.0009) and sex (p=0.023) to be independent predictors of liver ADC measurements.
Conclusions: Liver DWI ADC values are significantly associated with liver and spleen stiffness, ALT and GGT, cT1, and patient sex, with liver stiffness and sex remaining significant at multivariable regression. Liver ADC may ultimately play a role in multi-parametric prediction of chronic liver disease/fibrosis severity.

Paper #: 096

Accuracy of Resident and Attending radiologist interpretations of abdominopelvic magnetic resonance imaging performed for pediatric acute appendicitis

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Purpose or Case Report: Acute appendicitis represents an important cause of abdominal pain in pediatric patients. Although imaging plays an increasingly important role in the rapid diagnosis and management of this condition, there is no universally accepted strategy for imaging children suspected of having acute appendicitis. Ultrasound and computed tomography have been used most commonly, but there is rising interest in the use of magnetic resonance imaging (MRI) due to its lack of ionizing radiation or need for intravenous contrast. Recent research has shown that MRI has high diagnostic performance when employed as a first-line test. However, when considering the generalizability of MRI outside of a specialized tertiary care center, the question of operator dependence arises. To determine the performance of MRI when interpreted by readers with limited experience, we performed a retrospective review of preliminary MRI interpretations rendered by radiology residents at our institution, compared with final (attending radiologist) interpretations.
Methods & Materials: A consecutive series of 377 pediatric patients (age < 19 years) who were imaged using abdominopelvic MRI for acute abdominal pain were included. The preliminary (resident) and final (attending) interpretations of each MRI examination were reviewed and coded as positive or negative for acute appendicitis. Reference standards were derived from the electronic medical record (surgical pathology results and clinical follow-up notes). Concordance (agreement) between preliminary and final reports were determined. Additionally, diagnostic performance (sensitivity, specificity, and positive/negative predictive value) of both residents and attending radiologists were determined by comparing to the reference standards.
Results: The overall concordance rate was high (97.1%) and did not differ significantly with factors such as the PGY level of the resident or the academic year. Analysis of diagnostic performance showed a trend toward lower sensitivity in resident interpretations (91.2% vs. 97.8% for attendings). Specificity was high for both groups (97.6% and 98.9%). Positive predictive value trended lower in residents (92.2% vs. 96.7% for attendings), while negative predictive value was high for both groups (97.2% and 99.3%).
Conclusions: Trainee residents demonstrated strong diagnostic performance in the interpretation of pediatric abdominopelvic MRI, suggesting that the modality may be appropriate for broader implementation outside of specialized tertiary care centers.

Paper #: 097

Comparison of Magnetic Resonance Imaging Appendix Measurements in Children with and without Acute Appendicitis

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Purpose or Case Report: Rapid, non-contrast MRI has been reported as accurate for diagnosing acute appendicitis at specialized pediatric hospitals, but there remains a dearth of evidence-based, MRI-specific criteria upon which the diagnosis should be established. To our knowledge, our study comprises the largest study with the most independent readers of MRI-specific diagnostic criteria for pediatric appendicitis reported to date.
Methods & Materials: Our human-factors experimental design included 210 studies from children (4-18 years) with suspected acute appendicitis who underwent rapid, non-contrast MRI following equivocal US exams from January 2014 to December 2017. A positive diagnosis of acute appendicitis was defined as resolution of acute abdominal pain after surgical or medical appendicitis-specific intervention. All exams were graded independently and blinded to clinical data by four fellowship-trained pediatric radiologists with experience ranging from 5-10 years. Complete experimental block design was used to determine the performance characteristics of individual diagnostic criteria. Data were modeled using generalized mixed modeling with SAS/GLIMMIX. The study was powered equally for sensitivity and specificity.
Results: MRI had a sensitivity of 0.93 and specificity of 0.98. The mean appendix diameter of positive and negative cases was 10.45mm (CI 9.97-10.95) and 5.78mm (CI 5.59-5.99), respectively. The mean appendix wall thickness of positive and negative cases was 2.57mm (CI 2.44-2.71) and 1.69mm (CI 1.54-1.85), respectively. Appendix intraluminal fluid-fluid level had a sensitivity of 0.26 and specificity of 1.00. Peri-appendiceal fluid had a sensitivity of 0.65 and specificity of 0.89. Peri-appendiceal fatty edema had a sensitivity of 0.92 and specificity of 0.97. Presence of appendix wall hyperintensity compared to small bowel wall intensity had a sensitivity of 0.37 and specificity of 1.00.
Conclusions: Appendix diameter wall thickness is a strong quantitative predictor of acute appendicitis with MRI. Presence of peri-appendiceal fatty edema on MRI is also an accurate predictor of acute appendicitis. Other categorical diagnostic criteria including presence of appendix intraluminal fluid-fluid level, peri-appendiceal fluid, and appendiceal fatty edema have high specificity but relatively low sensitivity with MRI. Overall, this study provides valuable information regarding the MRI-specific accuracy of various imaging features associated with pediatric appendicitis.

Paper #: 098

Will this Patient need a Bowel Resection? Intussusception Reducibility Scoring System to Predict the Surgical Outcome of Ileocolic Intussusception.

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Purpose or Case Report: Ileocolic intussusception is a common cause of intestinal obstruction in young children. Most patients undergo image-guided enema reduction followed by a surgical reduction in enema fails. Many factors associated with decreased enema success have been described in the literature, although a concise scoring system to identify patients who are at risk for surgical intervention and complications does not exist. The goal of this project was to develop a scoring system to identify patients who are at increased risk for enema failure and surgical complications.
Methods & Materials: The radiology information system at our institution was queried for fluoroscopic exams for the keyword "intussusception" from 9/1/2017 – 3/31/2019. Exams other than a therapeutic enema for ileocolic intussusception were excluded. This search yielded 148 cases. The pre-enema imaging for each case, including radiographs or fluoroscopic scout, and ultrasound, were then reviewed for four findings: bowel obstruction, trapped fluid, poor blood flow within the intussusception, and location of the leading edge of intussusception (proximal vs distal to splenic flexure). The medical record was reviewed for enema success and surgical outcomes. A point score was assigned to each imaging finding when present, then summed to a total score. A total score was then correlated with enema success and surgical outcomes.
Results: A total of 148 cases were identified of which 140 met the inclusion criteria. Overall, successful enema reduction was achieved in 86% of patients. Several variations of the scoring system were tested. The simplest and most specific scoring paradigm had 2 points assigned to the presence of obstruction and 1 point for the rest, with a summed score of 3 or more considered high risk. Within the high-risk group, 58% of patients had surgical intervention and 41% had bowel resection compared to 6.5% and 0.8% of patients in the low-risk group respectively ($p < 0.001$ for both). The sensitivity and specificity of this scoring system for identifying patients requiring bowel resection was 88% and 92% respectively.
Conclusions: A simple scoring system described can discriminate not only the patients that are at very high risk for failing therapeutic enema but also high risk for complications such as bowel resection. Utilization of such a scoring system can help to identify patients who may benefit from early surgical intervention, and prompt discussions between radiologists, clinicians, and surgeons regarding the best treatment approach.

Paper #: 099

MRI Assessment of Amniotic Fluid Maximum Vertical Pocket (MVP) and Amniotic Fluid Index (AFI)

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Purpose or Case Report: Amniotic fluid volume (AFV)

measured by maximum vertical pocket (MVP) or amniotic fluid index (AFI), is a key indicator of fetoplacental well-being and is assessed by ultrasound (US) after 20 weeks' gestational age (GA). Fetal magnetic resonance imaging (MRI) is sometimes performed in isolation, and there is no standard assessment of AFV by MRI. Our purpose is to assess the robustness of US AFV indices and interrater variability by MRI in patients with known normal indices at same day US.
Methods & Materials: Following IRB approval, consecutive singleton fetuses 20 weeks' GA or greater undergoing same day MRI and US from July 2018 to September 2019 were identified, and the electronic medical record was reviewed. Exclusion criteria were abnormal MVP (<2cm or >8cm) or non-diagnostic axial T2-weighted MRI of the maternal uterus. Following brief training, four pediatric radiologists with expertise in fetal imaging blinded to US independently reviewed MR images, measuring MVP and AFI. Interobserver variability for MVP and AFI was measured calculating the intraclass correlation coefficients (ICCs), using general linear mixed models with a random effect. Agreement between US and MR for each index was measured by ICC and Bland-Altman analysis.
Results: 200 fetuses divided equally by 2nd and 3rd trimester were included (49.5% male, mean GA 27.3 ± 4.7 weeks). Most MR exams were performed supine (85%, 170/200), with the remainder left lateral decubitus. Erroneous indices upon review of US images excluded some cases for comparison, leaving 198 and 167 pairs for MVP and AFI analysis, respectively. Overall interrater correlation of MVP and AFI was strong (0.81 and 0.89, respectively), with better correlation in the 2nd trimester (0.89 and 0.97 for MVP and AFI, respectively) than 3rd trimester (0.79 and 0.87). There was less strong ICC between US and MR MVP (0.46) and AFI (0.60). Modest Bland-Altman agreement between US and MRI for MVP (Bias:-1.61, Precision:1.44, LOA:-4.49, 1.27) was better than for AFI (Bias:-3.31, Precision:4.09, LOA:-11.49, 4.81). 38 patients (19%) with normal MVP and 33 patients (20%) with normal AFI by US had polyhydramnios by MRI, with no oligohydramnios cases.
Conclusions: Interrater ICC of MR MVP and MR AFI is high, though intermethod ICC between same day MR and US MVP and AFI is modest. This suggests that MRI MVP and AFI can be reliably measured, though MR normative ranges are different from US. If normal US metrics are applied to MR measures of AFV, polyhydramnios may be overdiagnosed.

Paper #: 100

Fetal Cardiac Magnetic Resonance Imaging (CMR) (FCMR) Correlation with Prenatal (echo) and Postnatal Imaging

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Purpose or Case Report: Purpose is to describe how FCMR is instrumental in diagnosis of congenital heart disease (CHD) and to present imaging findings and correlation in 50 fetuses with CHD.
Methods & Materials: 50 fetuses, 21 4/7-38 weeks gestation with known or suspected diagnoses of CHD underwent FCMR for confirmation of cardiac findings and/or diagnosis of associated fetal anomalies.A pseudo ECG-gating technique enabled steady state free precession images of the heart in coronal, sagittal and axial planes. Fetal neurologic and body anatomy was imaged using T2 and T1 sequences.FCMR findings were compared to fetal US and echo findings; prenatal diagnoses were correlated with postnatal echo, CMR and cardiac CTA.
Results: 8 of 50 fetuses were eliminated from study as fetal/postnatal echo, CT or MR was not available. In 42 fetuses CHD findings diagnosed on FCMR and fetal MR images were compared to fetal echo/US and/or postnatal cardiac imaging including echo, CMR and CT. Fetal echo was not available in 4 patients, postnatal cardiac imaging was not available in 16 patients.65 FCMR CHD diagnoses included HLHS(10), VSD(9), anomalous pulmonary veins(7), TGA(4), TOF(3), DORV(2).Fetal MR revealed additional anatomical findings including abnormalities of the lungs, bronchi, abdominal situs, intracranial abnormalities and skeletal dysplasia.FCMR images were diagnostic of complex and non-complex diagnoses of CHD in 37(88%) of 42 fetuses confirmed by fetal echo; 2(5%) had normal hearts, 4(9%) did not have fetal echo.Death occurred in 11 patients, fetal demise in 4(9.5%), early neonatal in 7(16.5%).Postnatal cardiac imaging was available in 26(62%), confirming FCMR CHD findings in 25(96%). In 1 fetus diagnosis of VSD on FCMR was missed on prenatal echo and confirmed on postnatal imaging. In 1 fetus vascular ring suspected on FCMR was not found on postnatal imaging.In 5(12%) fetuses FCMR findings of pulmonary lymphangiectasia, obstructed TAPVC, HLHS, and neurologic diagnoses guided decision making, genetic analysis and future genetic/fertility discussions, and end-of-life planning.
Conclusions: FCMR is an important diagnostic tool to confirm or clarify diagnosis of CHD which is most often made with echo. Fetal MR is known to be a highly sensitive and specific method for identification of non-cardiac imaging findings associated with CHD. Early knowledge of severity of and complexity of CHD and accompanying anomalies enables guidance for delivery planning, immediate postnatal care and opportunities for genetic counseling.

Paper #: 101

Fetal MR Colonography - T1-mDIXON Compared to T1-GRE

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Purpose or Case Report: T1-weighted imaging is a routine sequence in fetal MR imaging, which allows vicarious imaging of the fetal colon due to the short T1 signal characteristics of meconium. The purpose of this study was to compare image quality and acquisition time of a T1-mDixon sequence relative to a standard fast T1 gradient echo sequence, and to determine whether bowel pathology (such as colon hernaition in congenitial diaphragmatic hernia) can be more quickly and clearly delineated with T1-mDIXON.
Methods & Materials: This is a retrospective review of all sequential fetal MR cases performed in our institution to present. Inclusion criteria: all cases where both sequences have been acquired. Exclusion criteria: Limited or incomplete studies or where both sequences were not performed. All fetal MRIs were performed on 1.5 T Siemens machine, and reviewed by three Radiologists experienced in fetal MRI. Both sequence types were scored on five point (quality) scale to enable comparison. If multiple acquisitions of a sequence were performed in the same patient, the scores were averaged. The two groups' scores were compared using qualitative statistical analysis (t-test). Acquisition time of each sequence per patient

was also compared.
Results: The first 27 patients were exlcuded because the mDIXON sequence was not included in the routine fetal MRI protocol at that time. 3 patients were excluded because the exam was limited and the sequence was not run. A total of 28 patients had each sequence performed at least once and were included in the study group. Preliminary results indicate that T1-mDIXON is a significantly faster sequence and results in improved image quality (both in-plane and out-of-plane resolution).
Conclusions: T1-mDIXON provides added value in our fetal MR imaging protocol by improving image quality of the fetal colon and reducing acquisition time.

Paper #: 102

Analyzing Flow Distribution Among Twins uUsing PC-MRI Quantification of Fetal Aortic flow in Early Gestational Age Twin Pregnancies Complicated by TTTS and sIUGR

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Purpose or Case Report: Previous studies show that phase contrast MRI (PC-MRI) can successfully measure fetal blood flow in late gestation singleton fetuses. To date there is a paucity of data quantifying fetal blood flow of twin or early gestational age pregnancies (~19 weeks). Twin-twin transfusion syndrome (TTTS) is a rare complication of monochorionic pregnancies that is believed to result from inequal flow distribution between fetuses. In this novel investigation, we utilized PC-MRI to investigate fetal aortic flow in early gestational age fetuses with TTTS or selective Intrauterine Growth Restriction (sIUGR). We compared flow distribution between the smaller and larger fetus in each twin pair.
Methods & Materials: We retrospectively examined 11 subjects with twin pregnancies (22 fetuses) at early gestational age (> 18 weeks), 8 with TTTS and 3 with sIUGR. Using an established PC-MRI protocol (Ingenia 1.5T) fetal blood flow was quantified in the descending aorta at the diaphragm (DAo) for each fetus. The DAo flow measurement for each fetus (mL/min) was indexed to the fetal weight (mL/min/kg) using the ultrasound estimated weight of each fetus. Comparison between the smaller and larger fetus in each twin pair was performed with Ttest comparison of the indexed DAo flow ($p<0.05$ significant).
Results: Examined pregnancies had a mean GA of 19.43 weeks. 3 subjects had sIUGR and 8 had TTTS. Of those with TTTS, the majority (n=6) had advanced TTTS defined by Quintero stages 3 or 4. Among those with sIUGR, growth discordance ranged from 4% - 41%. There was no significant difference in the indexed DAo net flow in the TTTS twin pairs (Mean donor vs recipient: 387 mL/min/kg vs 403 mL/min/kg, p: 0.80) nor in the sIUGR twin pairs. Six TTTS patients underwent selective fetoscopic laser photocoagulation. Of these, two experienced donor demise. Those who did not receive intervention returned to their referring institutions and outcomes are unknown.
Conclusions: This study measures fetal blood flow in early gestational age twin pregnancies using PC-MRI, a technique that to date has only been measured in late gestational age singleton pregnancies. Flow measurements obtained in this study provide insight into the flow distribution between twins in complicated twin pregnancies. Although a small sample size, we found that there was proportional DAo indexed flow distribution between twins in the same pregnancy. This suggests that other factors drive fetal size discrepancies in TTTS and sIUGR, not purely inequal flow distribution.

Paper #: 103

Prenatal Neuroimaging in Arthrogryposis.

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Purpose or Case Report: To evaluate the utility of fetal MRI and prenatal ultrasound in establishing an underlying cause in fetuses with suspected arthrogryposis.
Methods & Materials: All patients in our institution who underwent fetal MRI in search of a cause for prenatally suspected arthrogryposis (period 2013 to 2019) were included. Data collected included demographics, gestational age, delivery details and postnatal follow-up. The images were assessed for intracranial abnormalities, spinal cord abnormalities, non-central nervous system (CNS) abnormalities, distribution of contractures of the neck, upper limbs, lower limbs, and abnormal spinal curvature.
Results: 21 fetuses were included. Intracranial or spinal cord abnormalities were found in 10 fetuses (48%) and included a total of 14 CNS findings. These included one instance each of the following: agenesis of the corpus callosum (4.8 %), polymicrogyria (4.8%), closed lip schizencephaly (4.8 %), ventriculomegaly (4.8%), delayed cerebral gyration (4.8 %) and cerebellar hypoplasia (4.8%). There were also, periventricular cysts in two fetuses (9.5 %), microcephaly in two fetuses (9.5%) and low-lying cord in 4 fetuses (19%). Postnatal imaging was available to confirm 8/14 CNS findings. In one case of low-lying cord, a post-natal MRI of the spine did not confirm the finding. For the other 5 findings, no postnatal imaging was available due to termination of pregnancy, stillbirth or no follow-up performed in our hospital. Non CNS abnormalities were found in 15 of the 21 fetuses (71.4 %) including pulmonary hypoplasia, midface dysplasia, intrauterine growth restriction (IUGR), polyhydramnios, oligohydramnios, fetal akinesia and short long bones. One patient in our series had hydrops fetalis diagnosed on imaging. In two patients the umbilical cord was noted to be wrapped multiple times around a limb at time of delivery. In the 5 patients who had a distal pattern of arthrogryposis no cranial or spinal cord findings were identified on imaging.
Conclusions: Prenatal neuroimaging in search for a central neurological cause in fetuses presenting with arthrogryposis is useful, demonstrating a potential intracranial or spinal cord cause in 48% of patients. This is essential to allow parental counselling and prognostication as well as to plan postnatal treatment. It also allows evaluation for associated non CNS anomalies and complications such as hydrops fetalis.

Paper #: 104

In Vivo Characterization of Emerging White Matter Connectivity in the Fetal Brain in the Third Trimester of Pregnancy

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Purpose or Case Report: To explore tract-specific developmental changes with deterministic tractography in a population of typically developing fetuses.
Methods & Materials: The study was IRB approved and HIPAA compliant. Healthy women with normal second trimester prenatal ultrasound were recruited prospectively. Subjects were imaged at 3T. Structural images were acquired using single-shotT2 images, which were processed using a validated slice-to-volume (SVR) reconstruction to generate isotropic images. DTI comprised 2–8 scans of the fetal head in orthogonal planes with 1-2 b=0s/mm2 images, and 12 diffusion-sensitized images at b=500s/mm2. DTI was processed using motion-tracked SVR algorithm. Deterministic tractography was performed with Trackvis with a FACT algorithm. ROIs were placed on the motion corrected T2 images to delineate the following tracts: forceps major, forceps minor, and bilateral inferior fronto-occipital fasciculi, inferior longitudinal fasciculi, cingula, uncinate fasciculi and corticospinal tracts. Fetal motion was estimated based on differences in position between individual slices of the diffusion acquisition. Descriptive statistics were used to summarize the population. A multiple regression analysis was used to evaluate the association with gestational age (GA) with volume, FA and ADC of each tract. Sex and motion were included in the regression.
Results: Tractography was successful for all tracts in 40/59 subjects (66%) (23 male and 17 female). The GA ranged from 29.3-38.1 weeks (w), with a mean of 33w (SD 3w). We found a trend of volume and FA increase, and ADC decrease in association with increasing GA in all tracts. This trend was statistically significant for most but not all the tracts and was independent of sex and motion. Volume increase with GA was fastest in the forceps minor (.23ml/w, P .004) and right UF (.068ml/w, P .001). The greatest rate of FA increase was seen in forceps major (.0076293/w, P .005). The right ILF had the highest rate of decrease in ADC (-.00000232 mms2/w, P <.001).
Conclusions: MT-SVR DTI enables high success rate of fetal tractography. Results show a complex process of age-related and tract-specific changes in volume, FA, and ADC that lays the foundation for the developmental landscape of the brain at birth and for the developmental trajectories that follow in the first year of life.

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Paper #: 105

Feasibility of Estimating Time of Death by Prenatal MRI in Cases of Intra-uterine Fetal Demise with Retained Fetuses

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Purpose or Case Report: Postmortem imaging is increasingly used following stillbirths and neonatal death. Estimating time of death has legal, biological, and ethical implications. This study aims to investigate feasibility of prenatal MRI in estimating time of death in intra-uterine fetal demise (IUFD).
Methods & Materials: Fetal MRIs performed between 2010 and 2019, containing the word “demise” in the report, and with at least one T2-weighted sequence including the brain of a demised fetus in the field of view were reviewed. Gestational age (GA) at demise was defined either as the day of procedures leading to IUFD or estimated GA of IUFD by ultrasonography. Based on the literature available on post mortem of stillbirths for estimating date of IUFD, the following parameters were adapted for MRI and evaluated: Opening of the mouth; Signal intensity of the globes; Appearance of the ventricles; Extra cranial soft tissue edema; Visualization of the cortical plate; Visualization of the laminar pattern of the fetal brain; Effacement of the sulci; Effacement of the pericerebral cerebrospinal fluid spaces; Collapse of the skull. Differences in time interval from fetal MRI to estimated IUFD (ΔT) for each imaging finding were explored with a Wilcoxon Sum of Ranks.
Results: In total, 44 fetuses met our inclusion criteria. Forty fetuses were monochorionic-diamniotic (MDA) twins, one dichorionic-diamniotic (DDA) twin, and three were singleton fetuses. Laser therapy was performed in 21 (48%) MDA fetuses and IUFD was spontaneous in remaining pregnancies. Median maternal age at time of MRI 30 years (IQR 27-35). Median GA at MRI was 24 weeks (IQR 23-28). Median GA at estimated IUFD was 20 weeks (IQR 18-22). Significant differences in ΔT (median in days; IQR) were identified for mouth opened (31;7) vs closed (25;7)(p=0.02); slit-like ventricles (34.5;18.25) vs non slit-like ventricles (25.5;10)(p=0.01); cortical plate visualization (27.5;13.25) vs non-visualization (39;13)(p=0.03); skull showing total collapse (37;15) vs mild/no collapse (23;7)(p=0.01). A trend association between ΔT and globes showing reduced signal intensity (34;10) vs preserved signal intensity (19;17) was found (p=0.05).
Conclusions: Opening of the mouth, non-visualization of the cortical plate, slit-like ventricles and total collapse of the skull are significantly associated with more days between IUFD and imaging. Estimating the time of IUFD is feasible by prenatal MRI.

Paper #: 106

Magnetic Resonance Angiography and T_2* Mapping of Placenta

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Purpose or Case Report: Both placental vascular density and oxygenation can indicate placenta health. MRA is a powerful tool to evaluate tissue vasculature but with limited applications because of the use of contrast agents. T_2* maps can be used to estimate the placental oxygen reserve. In this work, we acquired non-contrast enhanced MRA and T_2* maps to evaluate placental vasculature and oxygenation.
Methods & Materials: Two pregnant women were recruited for this study. One woman (Subject A, GA: 28+2/7w, fetal

hydrocephalus) was studied on a 1.5T Siemens Aera system with an 8-channel body coil, and the other one (Subject B, GA: 36+2/7w, normal) was studied on a 3T Siemens Verio system with a 6-channel flex coil and a 4-channel spine coil. A 2D time-of-flight sequence and 2D multi-echo GRE sequence were run for each subject to generate the MRA and T_2* maps. The sequence parameters were: at 1.5T:1)MRA: TR/TE=23/5.6ms, in-plane resolution=0.56×0.56mm^2, slice thickness=3mm, BW=245Hz/px, and flip angle=50deg; and 2)T_2*mapping: TR/TE/detTE=93/5/5ms, echo number=12, in-plane resolution=1.13×2.25mm^2, slice thickness=3mm, BW=230Hz/px, and flip angle=20deg; while at 3T:1) MRA: TR/TE=22/4.92ms, in-plane resolution =0.66×0.82mm^2, slice thickness=2mm, BW=241Hz/px, and flip angle=50deg; and 2)T_2*mapping: TR/TE/detTE=70/4/4ms , echo number=12, in-plane resolution =2.97×2.97mm^2, slice thickness=4mm, BW=501Hz/px, and flip angle=30deg.
Results: The placenta appeared inhomogeneous in the T_2*-weighted image. Since placenta cotyledons are brighter in T_2 HASTE image, these brighter regions in both T_2* weighted images and T_2* maps were taken to correspond to the cotyledons in this data as well. For each subject, we identified one cotyledon as the target cotyledon from 20 slices of T_2* map. The T_2* value of the placenta measured from one slice was 100.6±39.2ms for Subject A and 32.2±14.2ms for Subject B. The MRA of the entire placenta were well displayed. For both subjects, it is easy to identify the umbilical vessels, chorionic vessels and stem vessels. The umbilical vein can be distinguished from umbilical arteries for Subject A. Chorionic vessels and stem vessels can be identified for both subjects in the target cotyledons. Interestingly, in Subject A, it is possible to see some stem vessels branching off the chorionic vessels.
Conclusions: Both MRA and T_2* maps can provide key information for the evaluation of placental vasculature and oxygenation and could provide a tool to investigate abnormal pregnancy and predict fetal outcome.

Paper #: 107

Fetal Cardiac Magnetic Resonance Imaging (FCMR) Using a Prospective ECG-pseudogating Method: Frequency of Visualization of Standard Cardiac Planes and Image Quality Between 1.5 and 3 Tesla (T).

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Purpose or Case Report: The purpose of this study is to report visualization rates for standard cardiac axial views by FCMR using a prospective ECG pseudogating method and compare visualization rates for acquisitions performed in 1.5 and 3T. Secondary aims include a comparison of image quality between 2 observers and between 1.5 and 3T. Specific absorption rates (SAR) are also compared.
Methods & Materials: 118 fetuses underwent 119 FCMR examinations gated by an external ECG simulator (PS410 ECG simulator, Fluke Biomedical, Cleveland, OH). Images were obtained using balanced steady-state free precession sequences. Visualization rates for axial anatomical planes from stomach to superior mediastinum were compared between 1.5T and 3T and between 2 different examiners. Perceived image quality was rated using a 1-5 Likert scale (5=superb, 4=good, 3=reasonable, still of diagnostic quality, 2=poor, and 1=non-diagnostic) and compared between 1.5 and 3T and between examiners. Statistical analysis was performed using the student-t test, Wilcoxon rank-sum test, chi-square test and Fisher's exact test as appropriate.
Results: The left ventricle (LV) (76.7%), right ventricle (RV) (76.3%), 4-chamber view (4CH) (76.1%), right atrium (RA) (66.8%), left atrium (LA) (66.8%), ventricular septum (IVS) (66.6%), superior vena cava (SVC) (61.6%) and ductus arteriosus (PDA) (60.1%) had the highest confident visualization rates in normal and abnormal cases. There was a statistically significant difference in visualization rates for cardiac structures between 1.5 and 3T: 4CH 82.6% vs 53.7%, LV 82.3% vs 57.4%, RV 81.5% vs 58%, LA and RA 72.3% vs 48.2%, SVC 70.1% vs 54.6%, PDA 63.3% vs 45.4% ($p< 0.001$) for all comparisons. Overall perceived image quality score was 3.31 ± 0.95 for reviewer 1 and 3.27 ± 1.05 for reviewer 2 ($p=0.85$); however there was a significant difference in image quality score between 1.5 and 3T (3.38 ± 0.97 vs 2.57 ± 0.93 ($p<0.001$). SAR was not different between the 2 magnets (0.89 ± 0.89 and 1.02 ± 0.73, $p=0.48$).
Conclusions: Standard cardiac axial planes can be obtained by FCMR with reasonable image quality. As image quality and visualization rates for anatomical structures are significantly higher at 1.5T, this should be the magnet of choice for fetal cardiac imaging.

Paper #: 108

Prenatal Imaging of the Exstrophy Spectrum: A Review of Referral Diagnosis, Findings on Prenatal Imaging in a Tertiary Care Center, and Correlation with Postnatal Anatomy and Outcomes

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Purpose or Case Report: Bladder exstrophy (BE), cloacal exstrophy (CE), and "Omphalocele, Exstrophy of the Cloaca, Imperforate Anus, and Spinal Defects Complex" (OEIS) are very rare conditions. They can present in isolation or as part of a spectrum of congenital malformations involving multiple organ systems. The diagnosis can be missed or misidentified during prenatal imaging due in no small part to the rarity and complexity of these conditions. The purpose of this study is to determine whether prenatal referral to specialty centers improves diagnostic accuracy, with the potential to improve patient counseling through a multidisciplinary approach.
Methods & Materials: We conducted a single institution retrospective analysis of the cases of BE, CE, and OEIS complex that were referred to our fetal center over the last 20 years. All patients had ultrasound (US), magnetic resonance imaging (MRI) and counseling by our multidisciplinary team. We compared outside referral diagnosis to results after referral to our center. We further subcategorized the imaging findings on the basis of organ system and type of ventral abdominal wall defect identified. Finally, we obtained longitudinal information regarding the outcomes of patients who were followed by our clinicians after delivery.
Results: A total of 42 women between the age of 25 and 40 presented to our center with on-site fetal assessment falling into the spectrum of BE, CE, or OEIS. The average fetal gestational age at referral was 25.5 +/- 1.9 weeks. 22 of the 42 patients (59%) yielded discordant findings relative to the prior outside imaging which included a new diagnosis, new separate abnormality, or revision of the working diagnosis. We found

that 18 of 19 patients (95%) with a fetus demonstrating more than two abnormalities gained additional information upon imaging at our center. 13 patients interrupted the pregnancy or were lost to follow up. Of the 29 infants followed, all were correctly diagnosed at our center as regards the diagnosis of exstrophy type. 7 of the 29 had new findings on postnatal imaging such as a low lying spinal cord and renal ectopia.
Conclusions: Our study suggests that early referral to a specialized pediatric-oriented fetal center in suspected cases of BE, CE, and OEIS has the potential to provide additional critical anatomic information, changing counseling and impacting outcomes.

Paper #: 109

An imaging hip surveillance program with standardized reporting for children with cerebral palsy

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Purpose or Case Report: International data have shown that a hip surveillance program decreased and even prevented hip dislocations in children with cerebral palsy (CP). There are however, no published guidelines on reporting hip abnormalities in these children. Radiologic terminology and measurement technique varied widely in our department. The purpose of our quality improvement initiative was to standardize radiographic hip surveillance imaging and reporting as part of the newly implemented screening program at our institution.
Methods & Materials: Technologists were educated on the importance of uniform patient positioning. Next, we standardized measurement technique and reporting for screening pelvis radiographs with a report template and education via conferences, online module, and posttest for our pediatric radiologists. The primary metric was measurement of migration percentage (MP) of each hip, a quantification of hip subluxation. Nonstandard terms were discouraged. Report impressions categorized patients' hip abnormalities based on risk of dislocation (low, medium, and high). Compliance with the reporting template was tracked over 5 months and results reviewed.
Results: In the first 5 months, 183 (81%) of 225 children with CP referred for radiographic hip screening were found to have at least 1 abnormal hip. Reports using the standard template and terminology with MP measurement and risk category descriptions increased from 22 (of 42, 52%) in the first month to 35 (of 36, 97%) in the last month. Nine (5%) of the reports in the first 3 months and none in the last 2 months, included MP without including the risk category, while 44 (23%) of the reports in the first 4 months and none in the last month lacked current terminology. Only 2 exams had unsatisfactory positioning for migration measurement. There were no previously unrecognized hip dislocations, though two children demonstrated rapid increase in hip migration (from 30 to > 60% hip migration) during our study period, which prompted surgical intervention.
Conclusions: A successful hip surveillance program requires meticulous radiographic positioning, uniform measurement technique, and dislocation risk categorization, in order to promote timely detection, referral, and treatment of hip abnormalities in children with CP.

Paper #: 110

Defining Communicable Musculoskeletal (MSK) Diagnoses: Survey-based Assessment of Pediatric Radiologists and Orthopedics

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Purpose or Case Report: Effective triage and timely communication are critical for optimal patient care. MSK diagnoses that are considered emergent (requiring immediate attention), urgent (warranting attention sooner), and non-urgent (necessitating follow-up) are not yet defined. The purposes of this project are 1) to define the clinical importance of MSK diagnoses and the preferred communication methods, and 2) to investigate differences between subspecialties and between those with different years in practice.
Methods & Materials: This IRB-exempt, anonymized and web-based RedCap survey was generated by an expert-panel of 3 radiologists and 4 orthopedic surgeons at our institution, a tertiary children's hospital, and disseminated to all physicians within the departments of Radiology and Orthopedics. Participants provided their subspecialties (radiologist, orthopedic-specialized pediatrician, orthopedic surgeon), years in practice (fellow, <5 years, 5-10 years, and >10 years), all diagnoses they would consider emergent, urgent, and non-urgent and their preferred communication method. The data was analyzed using descriptive analyses and bivariate analyses including Chi-square and Fisher's exact tests.
Results: Thirty-nine surveys (49%) were received, 26 from radiologists, 4 pediatricians, and 9 surgeons, to yield a total of 265 diagnostic entries (111 emergent, 98 urgent, and 56 non-urgent). Fractures with potential for instability was the most frequently listed emergent (19%) and urgent diagnosis (16%), while non-aggressive lesion was the most frequently listed non-urgent diagnosis (23%). Communication by phone was preferred for emergent and urgent diagnoses and by email for non-urgent diagnoses. There was no significant difference in the distribution of diagnoses between subspecialties (p=0.257) or levels of experience (p=0.373). While radiologists listed post-instrumentation findings (not otherwise specified, malalignment, non-perfusion) and avascular necrosis as diagnoses that require communication, these were not listed by the orthopedics. No diagnoses listed by the orthopedics were not also listed by the radiologists.
Conclusions: Among physicians of different subspecialties and years of experience, there is an overall consensus on the clinical importance of various MSK diagnoses, which is particularly critical for radiologists as our field adapts to increasing patient/family access to electronic medical records and legislative requirements tocommunicate significant abnormalities directly with our patients.

Paper #: 111

Pediatric skeletal surveys performed with EOS whole-body biplanar radiographs: an improvement in workflow and patient satisfaction.

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Purpose or Case Report: EOS™ is a biplanar radiographic imaging system that can simultaneously acquire whole-body frontal and lateral standing radiographs with moving x-ray tubes and detectors. EOS has been shown to reduce radiation exposure and study time in comparison to standard digital radiography. While it has primarily found utility in evaluation of scoliosis, there has been limited study of EOS in performing pediatric skeletal surveys, which can be time-consuming and challenging given the age of the patient and the large number of images required. This study evaluates how implementing EOS in combination with digital radiography (DR) can reduce the number of images acquired and improve patient/family experience.
Methods & Materials: 66 pediatric patients underwent genetic or oncologic skeletal surveys with EOS combined with DR. The total number of images acquired for study completion were recorded for these patients and compared to a control group of 36 patients whose skeletal surveys were completed only with DR. Parents of children who underwent the combined EOS/DR study were asked to fill out a survey which included assessments of 1) estimated time of the total study 2) ease of the study on the patient, and 3) likelihood of preferring EOS to be used for any future studies on a scale from 1 to 5.
Results: The total number of images required for study completion was significantly lower ($p<0.001$) with the use of EOS in combination with DR (9.8 ± 1.3) when compared with DR only (17.8 ± 2.4). Among survey respondents, 100% of the parents felt that the skeletal survey performed in conjunction with EOS was easy on their child. The vast majority of the parents attributed this to the minimization of time required to complete the total study, with 97% estimating that the total study time with EOS took 15 minutes or less. All survey respondents rated the likelihood of requesting future skeletal surveys to be performed with EOS at least a 4 out of 5 with 89% rating 5 out of 5.
Conclusions: In its use for pediatric skeletal surveys, the ability to perform biplanar whole body radiography with EOS shows promise in improving workflow by significantly reducing the number of images required for the study and thus minimizing the time and radiation exposure required to complete the study. Given the ease and comfort with which an otherwise time-intensive study can be performed, it has also been met by a strong positive response by parents who have shown preference for EOS over only standard digital radiography.

Paper #: 112

Physeal Diffusion Tensor Tractography ROI Automation with a 3D Convolutional Neural Network

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Purpose or Case Report: There is growing research in diffusion tensor imaging (DTI) for providing metrics and images of physeal structure and function, particularly in evaluating children with possible growth disorders. There is a need for a faster automated process to segment the diffusion data, however. We utilized a deep learning algorithm to automatically generate a region of interest (ROI) for use in fully automatic diffusion tensor tractography of cartilage columns in the distal femoral physis.
Methods & Materials: Following IRB approval, the authors retrospectively analyzed 80 knee DTI studies from 40 children including 20 neuroblastoma survivors with growth failure and 20 matched controls.Manual binary segmentation of the femoral physis on B0 images was performed on all 80 sequences. Saved volumes were automatically cropped to a 40x24x40 voxel 3-dimensional ROI including the distal femoral physis, femoral condyles, and proximal tibia. A novel, fully connected CNN based on a 3D modification of the U-Net architecture was trained on the output volumes (n=70) to generate segmentation masks of only the distal femoral physis. A holdout set of B0 sequences (n=10) was segregated prior to training to serve as the testing set.Training data augmentation mainly included random rigid affine rotation of the input volumes about the 3 axes and simulated Gaussian noise generation. The segmentation network was trained for 600 epochs. Software code was written in Python v3.6 using the TensorFlow v1.13 module on a Linux workstation with two NVidia Titan X GPUs.
Results: The overall mean Dice correlation coefficient was 0.680 with a Matthews Correlation Coefficient of 0.672. Manual extraction and segmentation took 10 minutes per volume and had an interobserver correlation of 0.82, whereas DL segmentation took <1 second per volume and was deterministic, always producing the same result for a given input.
Conclusions: Deep learning (DL) techniques can be applied to B0 sequences in DTI examinations in order to generate a deterministic ROI of the distal femoral physis. DL automates physeal mapping, increasing speed, and decreasing variability of tractography.

Paper #: 113

Prevalence of Abuse and Additional Injury in Young Children with Rib Fractures as Their Presenting Injury

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Purpose or Case Report: Prior research describing risk of physical abuse in children with rib fractures has included children whose rib fractures were incidentally identified in the context of an abuse evaluation. In our practice, the child in whom a rib fracture is the first presenting injury can be a diagnostic challenge, and less is known about this population. Our objectives were to determine the prevalence of 1) additional

injuries concerning for abuse, 2) diagnosis of abuse and 3) a report to Child Protective Services (CPS) among children <60 months presenting with rib fractures or with rib fractures identified incidentally during evaluation of a chief complaint unrelated to abuse.
Methods & Materials: We conducted a retrospective study of children <60 months with rib fractures at a tertiary children's hospital from 2007-2018. Children in motor vehicle accidents, hospitalized following birth, known metabolic bone disease, or whose rib fractures were identified incidentally during an abuse evaluation were excluded. We limited our population to children in whom rib fractures were the presenting injury. Demographic and clinical information was abstracted from the records. The primary outcomes of interest were prevalence of additional injuries, a diagnosis of abuse, and a report to CPS. Associations between patient demographic and clinical characteristics and the outcomes of interest were examined using chi square or fisher exact tests.
Results: Of 67 subjects, 87% were <12 months, 25% had a single rib fracture, 60% had only chronic rib fractures, and 12% had only acute fractures. Additional injuries concerning for abuse were identified in 60%, including head injuries (31%), non-rib fractures (33%), spine injuries (7%), and cutaneous injuries (18%). After applying a standardized scale, 58% were classified as definite/likely abuse. Posterior rib fractures, multiple rib fractures, rib fractures in multiple planes, and rib fractures of multiple ages were all associated with presence of additional injuries and classification as definite/likely abuse (all $P<0.05$). Age <12 months was associated with classification of definite/likely abuse ($P<0.05$). African American race, multiple rib fractures, fractures in multiple stages of healing, and fractures in multiple planes were associated with an increased likelihood of reports to CPS ($P<0.05$).
Conclusions: The presence of a rib fracture in young children is associated with a high likelihood of additional concerning injuries and should prompt a thorough evaluation for physical abuse.

Paper #: 114

Quads or Quins? An Unexpected Cause of a Traumatic Restricted Knee Flexion.

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Purpose or Case Report: Underlying causes for loss of knee flexion in a child are myriad. Once an intrinsic cause has been excluded and a physical block to flexion has been confirmed, pathology within the extensor component must be sought. Idiopathic contractures, congenital contractures, and fibrosis of multiple components of the quadriceps muscle as causes of limitation to flexion of the knee have been reported in the orthopedic literature.More recently, additional structures within the quadriceps muscle have been described, leading to the new designation of a 'quinticeps femoris' muscle. This has been termed both an accessory quadriceps femoris and a tensor vastus intermedius (TVI). The latter has been described as a previously unrecognised common variant of anatomy, whereas the former presents as a pathological entity, resulting in progressive fixed flexion of the knee.Two such cases of 'quinticeps femoris' have presented to our institution. Both patients were reviewed by multiple health professionals and had a significant delay in diagnosis (of two and five years respectively), with marked progression of fixed knee flexion during this period. Both diagnoses were ultimately made on MRI, with the causative abnormality appearing as a fusiform structure of low signal intensity arising from the anterolateral proximal femur and blending with the common quadriceps tendon distally. This highlights the importance of radiologists being aware of this anatomical entity as they will often be first to suggest the diagnosis. Both patients underwent surgical release of the anomalous quadriceps band with significant functional improvement.Here we discuss the presentation, underlying pathology, and treatment of this uncommon cause of restricted knee flexion, to our knowledge unreported in the pediatric imaging literature, as well as the need for its recognition and inclusion in the differential diagnosis of progressive loss of knee flexion.:
Conclusions: In cases of progressive fixed flexion of the knee where no intrinsic pathology is evident, an accessory quadriceps muscle should be included in the differential of the extrinsic cause. Our experience demonstrated this to be readily identifiable on MRI, necessitating its inclusion in the radiologists' checklist. Early recognition of this rare condition is desirable to prevent unnecessary intervention such as repeat knee arthroscopy, and debilitating loss of flexion due to delayed diagnosis.

Paper #: 115

Radiologic Evaluation of Costochondral Junction Fractures in Pediatric Patients and the Association with Non-Accidental Trauma

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Purpose or Case Report: This study aimed to elucidate the imaging appearance of costochondral junction (CCJ) fractures in young children, determine the association with nonaccidental trauma (NAT), and suggest a mechanism for injury.
Methods & Materials: This IRB-approved, retrospective study identified 19 children ages 0-3 years with CCJ fractures over a 10 year period. Radiographs, CT, MRI, and ultrasound studies were reviewed by a pediatric radiologist to determine number, location, and imaging appearance of the CCJ fractures. Medical records were reviewed for concurrent injuries, predisposing risk factors for fractures, and conclusions of the child abuse team.
Results: A total of 92 CCJ fractures (36 right and 56 left) were found in 6 females and 13 males. The child abuse team concluded 17 cases (94%) were NAT. Most cases had additional injuries (78.9%) and all had multiple CCJ fractures. Fractures in 10 cases (53%) were bilateral, 1 (5%) was unilateral right, and 8 (42%) were unilateral left. Eleven of the 14 cases (79%) with both CT and skeletal survey showed 36 additional CCJ fractures on CT compared to skeletal survey. Key imaging features included: bucket handle fracture (n=28), corner fracture (n=45), corner irregularity (n=14), cortical buckle (n=35), longitudinal separation of the cortex from the shaft (n=51) and longitudinal bone growth along the costal cartilage (n=29). The cortical break was identified on the inner cortex (n=45), outer cortex (n=2), or both cortices (n=14).
Conclusions: This study reveals that CCJ fractures are highly associated with NAT and specific for NAT in this age group. Patients with CCJ fractures likely have additional injuries; therefore, laboratory, physical, and imaging tests should be

conducted looking for visceral and head injuries. The inner cortex of the CCJ is most commonly fractured, supporting the previously proposed injury mechanism as compressive force on the anterior chest. This study also shows the range of imaging appearances of CJJ fractures. The bucket handle and corner fracture appearance suggest that CCJ fractures are analogous to classic metaphyseal lesions (CMLs) of long bones. The longitudinal cortical separation not seen in CMLs is likely related to costal cartilage extension into the fractures during healing as reported previously. Finally, CT is superior to radiographs in identifying CCJ fractures. Given the high specificity of CCJ fractures for NAT, consider acquiring CT chest examinations in NAT cases to identify radiographically occult CCJ fractures.

Paper #: 116

Silent and Distortionless Diffusion MRI in Pediatric Extremity Pathologies: Comparison with Echo Planar Imaging Diffusion

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Purpose or Case Report: Diffusion weighted (DW) imaging is a standard component of many MRI exams. For musculoskeletal examinations, DW is used as a tool for assessing malignant and infectious/inflammatory processes. A recently developed novel silent and distortionless DWI sequence (DW-SD) has been previously shown to have less distortion and noise as well as having equivalent diffusion contrast and ADC values in normal tissues to standard echo-planar DW imaging (DW-EPI). We aim in this study to validate and assess this novel DW-SD method in pediatric extremity pathology cases.
Methods & Materials: DW-SD was implemented from a multi-segmented Rotating Ultra-Fast Imaging Sequence (RUFIS), modified with sinusoidal diffusion preparation gradients. The images were reconstructed with a total variation constraint. Phase cycling was used to reduce eddy current effects. With IRB approval and informed consent/assent, 33 pediatric patients (mean age 11.2 years, range 6 months–18 years) referred for extremity scans at 3T (MR750, GE Healthcare) and found to have osseous and/or soft tissue pathology were recruited (September 2018-October 2019). All examinations had both DW-SD and DW-EPI performed. DW-SD/EPI parameters: FOV: 160x160 mm, matrix: 128x128, slice thickness: 4mm, NEX: 2.5, b-values: 50 and 600. ADC values of both sequences were compared in lesions, normal bone marrow and normal muscle (two sided Wilcoxon sign-rank test). Comparative visualization of pathology was also assessed on b600 images and ADC maps (from -2=DW-EPI more delineated to +2=DW-SD more delineated, 0=same).
Results: Pathologies were malignant/benign/unknown osseous lesions (n=4/10/4), osseous/soft tissue infections (n=7/3), malignant soft tissue lesion (n=3) and other (n=2). DW-SD and DW-EPI ADC values for pathology, bone marrow and muscle had no significant difference (p=0.14, p=0.24 and p=0.16 respectively). Comparative visualization on b600/ADC was assessed as -2/EPI best delineation in 0/3%, -1/EPI preferred in 3/6%, 0/same in 61/45%, +1/SD preferred in 33/39%, +2/SD best delineation in 3/6%. DW-SD was at least preferred in all soft tissue pathologies due to greater geometric distortion seen on DW-EPI.
Conclusions: Silent distortionless diffusion has comparable ADC quantification with conventional DW-EPI in pediatric soft tissue and osseous pathologic lesions. DW-SD is likely to yield improved delineation of pathology due to reduced geometric distortion compared with conventional DW-EPI.

Paper #: 117

Zero Echo Time Musculoskeletal MRI: A Comparison Study with Radiography and Computed Tomography in Pediatric Patients

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Purpose or Case Report: Though first line evaluation of bone lesions is projection radiography (XR), this is often supplemented by both computed tomography (CT), with attendant ionizing radiation, and MRI for associated marrow and soft-tissue assessment. However, if bone can be evaluated on MRI as well, then a CT may be obviated. Thus, we aim to assess an isotropic Zero Echo Time (ZTE) MRI sequence.
Methods & Materials: A ZTE MR sequence utilized immediate signal acquisition after RF pulse, radial k-space filling to acquire images with near zero echo time. Inverting the display window yields a “CT-like” appearance. Ray-summation image processing on the inverted ZTE image using 3D software (TeraRecon) then produced “x-ray-like” images. With IRB approval and informed consent/assent, 32 consecutive pediatric patients with concurrent XR (mean age 10yr, range 6mo-18yr) referred for extremity exams at 3T (MR750, GE Healthcare) were recruited (May–October 2019) to undergo ZTE imaging. Image quality for native/raysum-ZTE was assessed from 1 (non-diagnostic) to 5 (outstanding). Visualization between raysum-ZTE and XR was assessed (from -2 = XR more delineated to +2 = ZTE more delineated, 0 = same) for bone cortex and intramedullary cavity. Cortical thickness was compared using Wilcoxon sign-rank test. 10 cases with concurrent CT and 23 pathology cases with concurrent XR were also compared visually with ZTE.
Results: For the consecutive case cohort, comparative visualization between raysum-ZTE and XR cortex/IMC was assessed as -2/XR best delineation 0/47%, -1/XR preferred 22/31%, 0/same 63/22%, +1/raysum-ZTE 15/0%. Image quality showed native/raysum ZTE with 84%/40% scoring good or outstanding for cortex and 13%/0% for IMC. Raysum-ZTE and XR showed no difference between measured cortical thickness (p=0.72). Visual comparison of Native-ZTE/CT cortex/intramedullary cavity/pathology -1/CT preferred 20/80/20%, 0/same 60/20/60%, +1/native-ZTE preferred 20/0/20%. Lastly, pathology raysum-ZTE and XR cohort visual comparison showed -1/XR preferred 17%, 0/same 57%, +1/ZTE preferred 13% and +2/ZTE best delineation 13%.
Conclusions: ZTE has comparable cortical visualization to XR and CT. ZTE has limited intramedullary cavity visualization and anatomy delineation, though this is better evaluated on conventional MR sequences. Pathology visualization was similar to slightly improved with ZTE, especially in cases with small lesions and radiographically occult fractures.

Paper #: 118

Contrast-Enhanced Brain Ultrasound Perfusion Parameters in Congenital Diaphragmatic Hernia in the Extra-uterine Environment for Neonatal Development

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Purpose or Case Report: Assessment of fetal brain perfusion with contrast-enhanced ultrasound (CEUS) has not been performed *in vivo* in congenital diaphragmatic hernia (CDH). The development of the EXTra-uterine Environment for Neonatal Development allows investigation of CEUS and fetal brain perfusion parameters. The purpose of this study was to assess for aberrations in brain perfusion using CEUS in fetal lambs with CDH and correlate with cardiac output data.
Methods & Materials: Following IACUC-approved protocols, 4 fetal lambs underwent surgical CDH creation at 71-76 days gestational age (GA) and were transferred from placental support to the EXTEND system at 115-120 days GA and maintained per protocol. 4 lambs without CDH served as controls. At 115-130 days GA, 0.9-1.3mL Definity® US contrast mixed in 50mL of saline was administered by infusion at 100-120mL/hr depending on estimated weight. Flash-replenishment CEUS cine clips (15 sec; in triplicate) were acquired using a GE Logiq E9 US system and a C2-9 transducer and analyzed with post-processing software developed in MATLAB. Time-intensity-curves were used to generate metrics including flux rate (FR), transit time (TT), and perfusion. CEUS parameters were compared between groups with univariate analyses and repeated measures ANOVA. Right-to-left ventricular cardiac output (RLCO) was calculated by daily echocardiogram.
Results: 206 CEUS examinations were quantified, of which 169 were considered adequate with curve fit $r^2 \geq 0.9$ and included in analyses. CDH animals demonstrated similar FR (median 0.65, IQR 0.56-0.74; vs. 0.65, IQR 0.57-0.72 a.u./sec; p=0.9), similar TT (median 2.14, IQR 1.87-2.48 vs. 2.14, IQR 1.94-2.48) sec; p=0.8), and slightly increased perfusion (median 54.2, IQR 44-65 vs. 49.9, IQR 40-66; p=0.6) when compared to controls. However, in CDH animals, GA was correlated with FR, TT, and perfusion (all $p \leq 0.01$). Models showed progressively decreased TT with GA in CDH animals ($p<0.01$) and increased TT in controls ($p<0.01$). Additionally, brain perfusion progressively increased with GA in CDH animals ($p<0.01$) while it decreased in controls (p=0.01). Mean RLCO was increased in CDH animals compared to controls [1.78 ± 0.51 vs. 1.46 ± 0.19; ($p<0.01$)].
Conclusions: Aberrant CEUS brain perfusion parameters are identified in CDH animals compared to controls. These perfusion parameters change with time suggesting progressive effects of CDH on cerebral blood flow, which may be partially explained by increased RLCO.

Paper #: 119

Quantitative Analysis Detects Abnormalities in MRI Scans Reported 'Normal' in Neonates with Hypoxic Ischemic Encephalopathy (HIE)

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Purpose or Case Report: Hypoxic Ischemic Encephalopathy (HIE) occurs in 1-6/1000 livebirths often leading to death or neurological disability. Neonatal brain magnetic resonance imaging (MRI) is used to assess severity of brain injury and provide prognostic information in the newborn period. However, 20-50% HIE patients do not have early abnormal MRI findings detected by qualitative neuroradiologic evaluation and yet have adverse outcomes evident by 2 years of age. Our aim was to investigate whether quantitative MRI analysis can find subtle abnormalities that help improve prognostication and reduce the incidence of falsely reassuring neonatal MRI among infants with HIE.
Methods & Materials: 28 neonates with HIE (mean gestational age=39 3/7 weeks; 11 females) with both neonatal inpatient MRIs (mean age=2.7 days) that were qualitatively interpreted as not having likely pathologic lesions and neurodevelopmental assessment data available at 2 years of age were identified by a retrospective review of health records from Boston Children's Hospital. Patients were grouped as Normal neonatal MRI-Typical 2-year outcome (NT; n=16) or Normal neonatal MRI-Atypical 2-year outcome (NA; n=12). Atypical outcomes included developmental delay, speech delay and/or motor impairment. Apparent Diffusion Coefficient (ADC) maps for all the patients were extracted. Using our recently-developed normal neonatal ADC atlases as a reference (Ou *et al*., *Hum Brain Mapp 2017*), we automatically and quantitatively assessed any voxel-level abnormalities for individuals in the NA group. Then we tested for group-wise ADC value difference across the NT and NA group at every voxel, using the atlas as common reference, with statistical significance threshold of $p<0.05$ after False Positive Discovery correction.
Results: Using individual MRI analysis, atlas-based automatic lesion detection found subtle lesions in two NA individuals (17%; one with cerebral palsy and one deceased) in bilateral thalami and temporal white matter. Group analysis identified significantly lower ADC values in the NA compared to the NT group, mainly in the left thalamus ($p<0.001$).
Conclusions: Our preliminary results demonstrate that quantitative ADC analysis shows promise in helping to identify abnormalities in brain MRIs of HIE neonates that are difficult to characterize visually, at the individual and group level. Expanding to include analyses of structural, diffusion and tractography changes will be an important next step to optimize early prognosis by neonatal MRI among infants with HIE.

Paper #: 120

Peripherally Inserted Central Catheters (PICCs) in Neonates: Is There Real Thrombus?

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Purpose or Case Report: Neonates with prolonged hospitalization often require PICCs. The concern for PICC-related complications, including venous thrombosis, infection, catheter migration and breakage, often prompts Doppler ultrasound (US) evaluation. However, peri-catheter thrombus in a neonate can be challenging to evaluate, as the accessed peripheral veins in neonates are small, some less than 1mm in luminal diameter. Small-bore catheters may occupy the entirety of the vessel lumen, which can produce absence of peri-catheter flow, which is confounding for thrombus. This distinction has implications for hematologic management.
Methods & Materials: IRB-approved A retrospective review of 644 extremity US studies for a PICC-related indication in 374 NICU infants and neonates (Sept 2009-Sept 2019). Reports were evaluated for descriptions of peri-catheter flow and frequency in venous thrombosis by categorizing findings into negative, occlusive or non-occlusive thrombosis, and indeterminate (reported as no definite thrombus, thrombus not excluded, or were purely descriptive). Catheter occupation of a vessel was identified by qualitative description of absent peri-catheter flow with catheter filling or occupying the vessel lumen. Chart review for patient demographics, underlying diagnosis, and initiation of anticoagulation was performed.
Results: The patient median age was 1.3 months (IQR 0.6-3.2 months), 44% female. An US diagnosis of thrombosis was reported in 52% (341/644) of studies performed for 109 patients (29% of total patients receiving an US). Catheter occupation was described in 16% (102/644) of studies for 83 patients, where 21% were reported negative for thrombus, 33% positive for thrombosis, and 46% indeterminate. Among studies reporting the catheter filling the vein, most with an indeterminate US did not receive anticoagulation (80%, 36/45). Alternatively, catheter occupation studies with a positive US finding for thrombosis were anticoagulated (74%, 20/27).
Conclusions: Absent pericatheter flow related to the catheter filling the vessel lumen is interpreted variably for thrombosis. Those reported positive for thrombosis often received anticoagulation, while those reported indeterminate were often not anticoagulated. Consensus on complete catheter occupation of a vessel lumen as it relates to thrombosis is important as it has implications on hematologic management of neonates. Further investigation of the normal progression of occlusive catheters is warranted in this population.

Paper #: 121

Germinal Matrix Hemorrhage in Extremely Premature Infants – Description of Previously Unrecognized Posterior Location and of its Diagnostic Pitfalls

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Purpose or Case Report: Before the germinal matrix (GM) begins to recede at approximately 26 weeks gestational age (GA), it extends along the floor of the lateral ventricles far posterior to the thalamocaudate grooves. As extremely premature infants (EPIs) as young as 23 weeks GA survive with current advances in neonatology support, germinal matrix hemorrhage (GMH) can occur along these sites from which the GM has not yet involuted and should be recognized. Further, such Grade I posterior GMH may be mistakenly diagnosed as an intraparenchymal grade IV event, particularly on coronal US or other axial images, with parasagittal images demonstrating the correct diagnosis. The aim of this study is to document and describe this phenomenon, differentiate it from traditional GMH findings, and assess its prevalence in this population.
Methods & Materials: The study was IRB-approved. All consecutive neonates admitted from 2013-2018 less than 27 weeks GA at birth with a GMH and initial studies available were included. All head ultrasounds were reviewed by consensus of two pediatric radiologists and one pediatric neuroradiologist. Original final interpretations from the medical record were recorded. A consecutive group of 100 older premature infants (OPI) of 31 weeks gestational age served as controls. Demographic data were extracted from the medical records.
Results: 106 EPI infants had GMH and were included in the study, with a mean GA of 25 weeks [23.1-26.6]. In nearly half of EPIs (45/106, 42.5%), GMH involved the posterior aspect of the germinal matrix. In 13 additional cases (12.3%), the patient had a large bleed and the site of origin from the GM could not be determined. In 20/45 (44.4%) patients with posterior GMH, the grade of GMH was misclassified. All GMH in the OPI control group occurred in the anterior thalamocaudate grooves.
Conclusions: Unlike the older premature infants that form the basis of our traditional head ultrasound findings, the EPI that are now routinely surviving have a more fetal pattern of GM distribution, extending posteriorly along the floor of the ventricles. We describe the routine occurrence of subependymal hemorrhage in these locations in EPI, which should be recognized and should not be confused with a Grade IV event, which is of great importance when making life support decisions. Knowledge of the typical involution patterns of the germinal matrix and the imaging appearance of posterior GMH is essential to ensure proper diagnosis.

Paper #: 122

Does Prenatal Opioid Exposure Predict Brain Parenchymal Loss on Neonatal Head Ultrasound?

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Purpose or Case Report: The purpose of this study is to determine whether prenatal opioid exposure is predictive of brain parenchymal loss on neonatal head ultrasound (HUS).
Methods & Materials: This is a retrospective study of 189 neonatal ultrasounds between March 2006-January 2016 identified from a database maintained through the department of Pediatrics. The indication for the HUS was categorized as being related to prenatal opioid exposure (e.g. “neonatal abstinence syndrome” or “neonatal opioid withdrawal syndrome”) and within the first 7 days of life. The indication for the control group HUS were categorized as being unrelated to intrauterine growth restriction, perinatal depression, need for intubation, hypotension of the neonate, neonatal seizures, prenatal opioid exposure, and APGAR <7. Three variables of lateral ventricle

size were obtained to assess brain parenchymal volume, including: ventricular index (VI), anterior horn width (AHW), and thalamo-occipital distance (TOD) measured through Picture Archiving and Communication Systems. The association between these variables and the presence or absence of brain parenchymal loss was analyzed using SAS 9.3.
Results: Forty-eight percent (N=91/189) of neonates had intrauterine opioid exposure and HUS within the first 7 days of life. Studies that were ordered with an indication related to intrauterine opioid exposure were more likely to have brain parenchymal loss for right VI (p=0.002) and left VI (p=0.024) through a student's t-test for continuous variables. Through the same test, brain parenchymal loss was seen at borderline significance for right AHW (p=0.272) and right TOD (p=0.272). A lower gestational age (mean difference 3.2, p>0.05) and number of days since birth (mean difference 1.1, p>0.05) were not found to be predictive of brain parenchymal loss, either.
Conclusions: Brain parenchymal loss (and ventricular enlargement most evident in the anterior horns of the lateral ventricles) can be predicted and diagnosed very easily in neonates with intrauterine opioid exposure through HUS. A lower gestational age and number of days since birth were not found to affect ventricular volume, either. Thus, lateral ventricular enlargement in prenatal opioid exposure is suggestive of loss of volume in the basal ganglia or periventricular white matter and can be said to be secondary to prenatal opioid exposure.

Paper #: 123

Feasibility of Intracranial Contrast-Enhanced Ultrasound in Neonates: Comparison with MRI

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Purpose or Case Report: Timely intracranial imaging enables diagnosis, directs treatment, and provides prognostic information of infant malformation or injury. MRI is the gold standard for neuroimaging, but can be inhibited by transportation risk and incompatible support devices. Ultrasound (US) is portable, rapid, and inexpensive, but limited by lower sensitivity and specificity. Contrast-enhanced ultrasound (CEUS) improves diagnostic accuracy of US in other clinical applications. Our aim was to prospectively compare CEUS of the neonatal brain to MRI.
Methods & Materials: Infants in our NICU with vascular access undergoing brain MRI were recruited. A GE Logiq E9 or E10 US system (GE Healthcare Milwaukee, WI) was used, performed by a radiologist blinded to MRI results. The contrast agent (Lumason, Bracco Diagnostics, Monroe Township, NJ) was used off-label, with dose of 0.03mL/kg IV, per departmental CEUS protocol. Infants were monitored for adverse events. CEUS followed routine US. Coronal plane cinematic clips were saved during wash-in of contrast, followed by coronal and sagittal sweeps of the entire brain parenchyma, with trans-mastoid sweeps last.
Results: Twenty-three neonates (mean age 17 days, mean gestational age 37+4 weeks) were imaged on average 17.5 hours following MRI. MRI indications included: 6 infection, 6 seizure, 4 suspected hypoxic ischemic injury, 4 follow-up malformations, 2 abnormal prior screening US, 1 prematurity. CEUS examinations were diagnostic quality and improved diagnosis compared to US. MRI and CEUS were concordant in 13 patients (57%) and discordant in 10 (43%). Discordances, with diagnoses seen only on MRI, included tiny acute infarct, small ischemic hemorrhagic transformation (ischemia was concordant), hemosiderin staining from old intraventricular hemorrhage, small posterior fossa subdural hemorrhages, and brainstem calcifications, several of which were clinically insignificant. Two MRI abnormalities not seen on CEUS had normal follow up MRI, including focal T2 signal hyperintensity and focal hyperperfusion on arterial spin labeling. One case of MCA infarct luxury reperfusion was seen at CEUS but not MRI. There were no false positive CEUS cases and no adverse events with CEUS were encountered.
Conclusions: Neonatal brain CEUS is feasible, safe, and increases diagnostic ability of US. Additionally, CEUS directly visualizes dynamic vascular perfusion that may prove to be an added benefit of CEUS over MRI. Although further study is needed, CEUS may be a valuable additional diagnostic tool.

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Paper #: 124

Fetal Midface Hypoplasia as Observed on Sonography (US) and 3 Tesla Magnetic Resonance Imaging (MRI): Prenatal Findings, Associated Anomalies and Clinical Outcomes

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Purpose or Case Report: To determine the accuracy and significance of a fetal diagnosis of midface hypoplasia.
Methods & Materials: This is a retrospective single center review of all fetuses referred to a tertiary fetal care center for, or subsequently diagnosed with, midface hypoplasia on same day sonography (US) and 3T MR imaging between 2014 and 2019. During this period, 38 pregnant women carrying fetuses with concern for midface hypoplasia were identified. Evaluated variables included: gestational age at referral and delivery, demise or termination, gender, singleton versus multiple, US based classification of degree of midface hypoplasia using the maxilla-mandible-nasion (MMN) angle and the prefrontal space ratio (PFSR), associated anomalies on referral, upon assessment in our fetal care center, and respiratory outcomes in the delivery room. Survival outcomes were known for 30 fetuses.
Results: Gestational age at referral ranged from 18.4 to 34.1 weeks, mean GA 23.3 weeks. 27% (8/30) fetuses underwent pregnancy termination (TOP), 13% (4/30) had intrauterine fetal demise, 13% (4/30) had neonatal demise, and 47% (14/30) were live born at gestational ages ranging from 20 to 40 weeks. There were equal numbers of males and females. All but one were singletons. Only 13% (4/30) had MMN angles in the normal range. 40% (12/30) had PFSR measurements in the normal range. Consequential associated anomalies were present in 80% (24/30), and included genetic and syndromic etiologies. 2 fetuses had cleft lip/palate, a diagnosis known to be associated with deformity of the nasal contour and profile. Of the 12 live born infants with delivery room follow up, 67% required respiratory support.
Conclusions: Fetal midface hypoplasia is strongly associated with additional anomalies and can be accurately diagnosed in the fetus by the combination of fetal US and MRI. Many fetuses with midface hypoplasia have serious underlying diagnoses. A third of fetuses who did not undergo TOP died in utero or in the neonatal period and for those born live, respiratory support may be required in the delivery room.

Paper #: 125

Lumps and Bumps of the Head and Neck in Children: a 5-year Retrospective Review, and Radiologic-Pathologic Correlation

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Purpose or Case Report: Identify the most common diagnoses of superficial head and neck lesions in children under 4 years of age, and correlate imaging and pathologic findings.
Methods & Materials: A HIPPA compliant, IRB approved, 5-year retrospective review was performed at a tertiary care pediatric hospital. Patients up to 4 years of age, with head and neck sonogram (US), and imaging indication that included "lump", "bump", or "mass" were included, with or without imaging follow up with US, radiography (XR), computed tomography (CT), or magnetic resonance (MR) within next 180 days. EMR, radiology reports, and pathology reports were reviewed. Patients with no palpable lump, known malignancy, lost to follow-up, or unavailable imaging information were excluded.Imaging diagnoses were categorized as; N: negative, AS: anatomic structure, C: cystic, S: solid, O: other. Pathology reports were classified as; I: inflammatory/infectious, neoplasm (BN: benign, MN: malignant), CL: congenital, NOS: nonspecific. Percentage of most common imaging and pathologic diagnoses were calculated and tabulated. A Radiologic-pathologic correlation for the most common benign and malignant lesions was performed.
Results: A total of 915 patients of 0-4 years (mean: 1.4y; 50% M, 50% F), with head and neck US, from 5/2014 to 5/2019 were evaluated. 75.7% (693) had a single US, and 24.2% (222) had follow up imaging within 6 months (US:126, XR:7, CT:41, MR:47, PET/CT:1). Lesion diagnosis was 77% (710) by imaging (91% US, 4.3% US/MR, 3% US/CT, 0.7% US/XR) of likely benign lesions (S: 44%, C: 27% AS: 14%, O: 2.5%. N: 10%). 22% (205) of lesions had pathologic confirmation, BN: 51% ([105] C: 82%, S: 16%, O: 2%), CL: 27% ([56] C: 84%, S: 7%, O: 4%, N: 6%), I: 18% ([38] S:55%, C: 42%, O: 3%), MN: 2.4% ([5] S:100%), NOS: 0.5% ([1] C: 100%).Of 693 patients with single US, 18% (128) were excised and benign. Of 222 lesions with additional imaging, 34% (77) were excised. Only 1 malignant and 15 benign lesions had incorrect imaging diagnosis. Common imaging diagnoses were solid (lymph nodes, infantile hemangioma, fibromatosis colli). Common pathologies were cystic and solid (dermoid cyst, thyroglossal duct cyst, lymphadenitis). Malignant lesions were uncommon, >3cm, solid, and heterogeneous.
Conclusions: Ultrasonography is highly accurate for evaluation of head and neck lesions in infants and young children. Benign lesions are common, cystic and solid. Malignant lesions are uncommon, larger, solid, heterogeneous, and require further imaging evaluation.

Paper #: 126

Diagnostic Accuracy of Abdominal Ultrasound for Midgut Volvulus

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Purpose or Case Report: Rapid detection and accurate diagnosis of midgut volvulus are crucial due to the risk of bowel infarction with delayed diagnosis. The purpose of our study is to evaluate the diagnostic accuracy of abdominal ultrasound (US) for midgut volvulus in the clinical setting of multiple sonographers and radiologists.
Methods & Materials: A retrospective review of all abdominal US exams performed to evaluate for malrotation and midgut volvulus from January 2018 through September 2019 was performed. The abdominal US exams assessed the relationship between the superior mesenteric artery and vein (SMA/SMV), the presence of a whirlpool sign (swirling of the SMV around the SMA), and the position of the third portion of the duodenum. Demographics and clinical outcomes were obtained from the electronic medical record. Sensitivity and specificity of the whirlpool sign for midgut volvulus were determined. Reference standard for midgut volvulus was diagnosis at surgery. Or, if no surgery normal upper gastrointestinal (UGI) series or computed tomography (CT), or a minimum of 1-month clinical follow-up.
Results: 173 abdominal US exams for suspected midgut volvulus were performed by 35 sonographers and interpreted by 23 pediatric radiologists on 171 children (median age 38 days, range 0-6269; 52% male). Fifty US exams were excluded due to inadequate follow-up, leaving 123 for analysis. 33/123 (27%) were considered nondiagnostic due to bowel gas or other technical limitations, one in a patient with midgut volvulus. Although other findings on this patient's ultrasound indicated need for exploratory laparotomy and the exam was reported as such. For the 90 US exams considered diagnostic, the whirlpool sign had a sensitivity and specificity of 100% (8 true positives, 0 false positives, 82 true negatives, 0 false negatives).
Conclusions: Abdominal US demonstrates high accuracy for the diagnosis of midgut volvulus in the setting of multiple sonographers and interpreting radiologists when not technically limited. This provides evidence that US may serve as a first-line imaging exam for suspected midgut volvulus, with the UGI series reserved for inconclusive US exams. Larger multi-institutional studies are needed to more precisely characterize the test performance and generalizability of US for suspected midgut volvulus.

Paper #: 127

Imaging Of Infantile Brachial Plexopathy

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Purpose or Case Report: Brachial plexus is a relatively common site of pediatric nerve pathology. This study was aimed at evaluation of utility of MRI and USG in the localization of brachial plexus injury in infants
Methods & Materials: This prospective study was conducted in a tertiary level hospital. A total of 34 infants who presented to the Pediatric Neurology OPD with signs and symptoms suggestive of brachial plexus injury were included in the study. Clinical examination, Electrophysiological study (EPS) and imaging using MRI (3 Tesla Scanner- Achieva, Philips) and USG (Supersonic Imagine, Aixplorer, France) were performed in all the 34 patients. Inter-rater agreement (k) between clinical findings and MRI; EPS findings and MRI; USG and MRI

findings were determined in all patients using STATA/SE14.0 software. MRI and USG findings were correlated with intraoperative findings in the 8 subjects who underwent surgical management. Also, the quality of various MRI sequences and their diagnostic efficacy were compared and the significance of difference, if any, was tested using Fischer exact test
Results: The commonest findings of preganglionic injury and post ganglionic injury were pseudomeningocele and nerve thickening respectively. The agreement between clinical findings and MRI was 'almost perfect' (k=0.89); between MRI and EPS was 'substantial' (k= 0.76). There was 'substantial' agreement between MRI and USG in detecting neuromas that were involving all the three trunks of brachial plexus (k=0.79).Among the MRI sequences 3D STIR was found to be superior for the detection of postganglionic injuries ($p<0.05$)
Conclusions: The role of imaging in brachial plexopathy is trifold.- Locating the site of injury, defining the extent of injury and detection of denervation changes- Ultrasound imaging can detect post ganglionic injury, but fare poorly in detecting preganglionic injury- MRI is superior in detection of both preganglionic and post ganglionic injuries

Paper #: 128

Ascent of the Conus Medullaris Level in Infants Less than 3 Months Old with Borderline or Low Position of the Conus

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Purpose or Case Report: Evaluate temporal change in position of the tip of the conus medullaris in infants with borderline or low position of the conus on initial spine ultrasound (US) performed at less than 3 months of age.
Methods & Materials: This is an IRB-approved study. From the radiology information system, we retrieved all spine US studies from 2004-2018 in children younger than 3 months of age. Based on the radiology report, we included only studies with conus level from L2-L3 to L3-L4 who had follow-up spine US or MRI within one year. All patients with neurological abnormalities related to the lower cord, including lower extremity and bladder dysfunction, or known spinal dysraphism were excluded.Study indication, age, gender, and time interval between US and follow-up studies were documented. We noted whether the level of the tip of the conus on the initial spine US and follow-up US or MRI study was at the intervertebral level, or at the upper third, middle third, or lower third of a vertebral body level. If this detailed information was not available on the radiology report, it was determined by reviewing the study.
Results: The study group included 72 children (34 females), with age range 0-79 days (average 19 days) at initial spine US. The most common indication for spine US was sacral dimple (34/72, 45.8%). 15 infants had US follow-up and 57 had MRI follow-up. The average follow-up time interval was 118 days.On the initial US, the tip of the conus was in a borderline position (L2-L3) in 19/72 (25.7%) children and at the upper L3 to L3-L4 level in 53/72 (74.3%). On follow-up, the tip of the conus was normal (at or above L2) in 43/72 (59.7%) children, borderline in position (L2-L3) in 28/72 (37.8%), and at the level of upper L3 in one child.On average, there was ascent of the tip of the conus by 0.73 vertebral body level over 3.9 months time.
Conclusions: In asymptomatic infants less than 3 months of age, isolated finding of borderline or low conus medullaris (L2-L3 to L3-L4) on spine US may not be a reliable indicator of tethered cord as most will ascend to a normal level in later infancy. Therefore, follow-up imaging of the spine should be considered in selected patients.

Paper #: 129

Evaluating the Correlation Between Bolus Perfusion kinetics using Contrast-enhanced Ultrasound and Intracranial Pressure in a Pediatric Porcine Model of Asphyxia-associated Cardiac Arrest

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Purpose or Case Report: The purpose of this experiment was to evaluate the correlation between the doppler and intracranial pressure (ICP) and mean arterial pressure (MAP) in a pediatric porcine model of asphyxia-associated cardiac arrest.
Methods & Materials: In 6 infant piglets, a bolus of 0.1 dose mL of ultrasound contrast (Lumason, Bracco Diagnostics Inc) was injected into swine during 10 minutes pre-asphyxia (baseline) and 3 hours post-return of spontaneous circulation (ROSC). During each period, 2-3 boluses were performed. Early washout rates were acquired when CEUS intensities of the bolus was 30% of the maximum intensity. In addition, Time to peak (TTP) and peak enhancement were measured. ICP was collected continuously and later normalized to the baseline. Average relative changes of ICP, TTP, early washout rate, and peak enhancement from baseline to 3 hours post-ROSC were compared.
Results: The average of peak systolic velocity at baseline was 14.01 cm/s and at 3 hours post-ROSC was 15.03 cm/s. The average of end diastolic velocity at baseline was 7.11 cm/s and at 3 hours post-ROSC was 3.73 cm/s. The average of normalized ICP at baseline was 0.97 a.u. and at 3 hours post-ROSC was 1.26 a.u.. The average of the normalized MAP at baseline was 1.01 a.u. and at 3 hours post-ROSC was 1.12 a.u.. The difference between values at baseline and 3 hours post-ROSC for all parameters are statistically insignificant ($p=0.60$, $p=0.75$, $p=0.47$, and $p = 0.11$ for peak systolic velocity, end diastolic velocity, MAP, and ICP respectively). Both peak systolic velocity and end diastolic velocity had a negative linear correlation with MAP, both with Pearson coefficients of -0.86. The variation in peak systolic velocity and end diastolic velocity that is relative to the variation in MAP is 74.0%. There was no significant linear correlation between peak systolic velocity or end diastolic velocity with ICP, with a Pearson coefficient of -0.01 for peak systolic velocity and a coefficient of -0.13 for end diastolic velocity. The variation in peak systolic velocity and end diastolic velocity that is relative to the variation in ICP is 1.7%.
Conclusions: This preliminary investigation reveals that the early washout rate, but not TTP or peak enhancement, is strongly correlated with ICP, indicating that the bolus-based early washout rate change can be used to predict ICP changes. CEUS intensity has less risk associated with it than invasive hemodynamic measurements such as ICP, offering a safer alternative method.

Paper #: 130

Evaluating the Correlation Between Doppler Ultrasound Parameters and Invasive Hemodynamic Measurements in a Pediatric Porcine Model of Asphyxia-associated Cardiac Arrest

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Purpose or Case Report: The purpose of this experiment was to evaluate the correlation between the doppler and intracranial pressure (ICP) and mean arterial pressure (MAP) in a pediatric porcine model of asphyxia-associated cardiac arrest.
Methods & Materials: In 5 infant piglets, 5 doppler samplings of thalamic vessels were taken during 10 minutes pre-asphyxia (baseline) and 3 hours post-return of spontaneous circulation (ROSC). Invasive hemodynamic measurements ICP and MAP were collected continuously and later normalized to the baseline. Average relative changes of ICP, TTP, and doppler ultrasound parameters (peak systolic velocity and end diastolic velocity) were compared baseline measurements to measurements at 3 hours post-ROSC.
Results: The average of peak systolic velocity at baseline was 14.01 cm/s and at 3 hours post-ROSC was 15.03 cm/s. The average of end diastolic velocity at baseline was 7.11 cm/s and at 3 hours post-ROSC was 3.73 cm/s. The average of normalized ICP at baseline was 0.97 a.u. and at 3 hours post-ROSC was 1.26 a.u.. The average of the normalized MAP at baseline was 1.01 a.u. and at 3 hours post-ROSC was 1.12 a.u.. The difference between values at baseline and 3 hours post-ROSC for all parameters are statistically insignificant ($p=0.60$, $p=0.75$, $p=0.47$, and $p = 0.11$ for peak systolic velocity, end diastolic velocity, MAP, and ICP respectively). Both peak systolic velocity and end diastolic velocity had a negative linear correlation with MAP, both with Pearson coefficients of -0.86. The variation in peak systolic velocity and end diastolic velocity that is relative to the variation in MAP is 74.0%. There was no significant linear correlation between peak systolic velocity or end diastolic velocity with ICP, with a Pearson coefficient of -0.01 for peak systolic velocity and a coefficient of -0.13 for end diastolic velocity. The variation in peak systolic velocity and end diastolic velocity that is relative to the variation in ICP is 1.7%.
Conclusions: This preliminary investigation reveals that the end diastolic velocity and peak systolic velocity is correlated with MAP, but not ICP, indicating that both parameters can be used to noninvasively predict MAP changes. Doppler ultrasound has less risk associated with it than invasive hemodynamic measurements, offering a safer alternative method.

Paper #: 131

3D Printing of the Brain from Delayed MRI Scans of Paediatric Cases with Hypoxic Ischaemic Injury, Improvements to Workflow and Settings to Produce Highly Accurate and Reproducible Cortical Surface 3D Print Models

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Purpose or Case Report: 3D printed models from MRI scans can effectively demonstrate the surface structure of the brain. Previous workflows focus on adult brains as a basis for prints. Our database of pediatric MRI brains who had perinatal hypoxic ischemic injury and presented late for imaging, with pathology causing cortical surface irregularities and parenchymal cysts. Difficulties arise in accurate depiction of the cortex on 3D print models in these pathologic brains. We aim to demonstrate effective workflows to accurately and efficiently print 3D models of especially pathologic pediatric MRI brains. Also, to critically and empirically test and refine the various steps involved in producing 3D print models which include segmentation of the MRI volume into tissue classes, generation of a surface model from this volume, preparation and final print of a 3D model.
Methods & Materials: 35 MRI brain scans of patients presenting with hypoxic ischemic injury were used and preliminary reads enabled categorization of the scans into normal, atrophy, cavity and other. Initial segmentation performed then allowed further refinement of variable settings and evaluation of other methods of segmentation, to generate segmentation models. Mesh surface generation was then performed with further refinements, using various application extensions of Matlab, Mathworks. Print preparation involved surface mesh repairs, removal of internal structures and surface smoothing. Comparison was also made between printers/printing technologies.
Results: Initial segmentation produced only 20 out 35 (57.1%) usable models. Further refinement increased this to 31 out of 35 (91.4%). The best quality segmentation models for normal and other patients were produced by CAT12 segmentation. The best quality depictions were created using SPM12.FDM printing was found to be more accessible and economic although all print methods produced high quality models. Print settings were found to be optimal at 0.2mm layer height and 5% infill.
Conclusions: We showed improved MRI segmentation success rate for pathological pediatric brains as compared to using default, previously successful for segmenting adult brains. Through methodically testing various combinations of parameters, ideal settings have been determined for improving segmentation success rate and quality. High quality models were printed with compromise between reducing printing time and maintaining quality and structural strength of the models.

Paper #: 132

Radiological Patterns in Late Magnetic Resonance Imaging of Children with Cerebral Palsy Due to Perinatal Hypoxic Ischemic Injury

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Purpose or Case Report: Hypoxic ischemic injury (HII) is a leading cause of neonatal encephalopathy and resultant cerebral palsy. Most studies focus on early magnetic resonance imaging (MRI) findings and patterns of injury, with few studies evaluating patterns in delayed MRI of patients with cerebral palsy.We aim to categorise the delayed imaging MRI findings and distribution of abnormalities in a large cohort of children with cerebral palsy and obtained for medicolegal purposes to determine the causes of cerebral palsy, and to map the frequency of anatomic involvement in those with hypoxic ischemic injury.

Methods & Materials: 252 MRI studies were read by 3 radiologists who were blinded to each other and to clinical history. Specific focus was made on areas typically involved in HII with specific imaging patterns, and signs elicited. The responses were then collated and analysed for frequencies and distributions of areas of involvement with linear regression and co-variate analysis to determine interrelationships.
Results: Average results were obtained for Multicystic encephalomalacia (11,3%), Focal cysts (14%) and Ulegyria (37,2%). Regional involvement was of the Peri-Rolandic (43,7%), Corticospinal tracts (68%), posterior limb of the internal capsules (61,8%), Peri-Sylvian (29,8%), Para-Falx (17,1%), Occipital (49%), Anterior inter-vascular watershed (IVWS) (35,2%), Posterior IVWS (40,3%) & Corpus callosum (43%).Pituitary bright spot was absent in 9,3%. Ventriculomegaly in 61,9% of patients. Thalamic (78,5%), Putamina (40,7%), Pallidus & Caudate (20,2%), Hippocampal (47,5%), Superior vermis of cerebellum (15%), Inferior vermis (6,7%), Right cerebellar hemisphere (8%) and Left cerebellar hemisphere (8%) involvement was also determined.Final diagnoses were multicystic encephalomalacia (11,3%), term acute profound (32.3%), term partial prolonged (10%), term combined (35,7%), premature periventricular leukomalacia (3,3%), hypoglycemic injury (29,7%) and other (10%). Inter-reader concordance was high with a Fleiss kappa of 0,55 overall and with higher scores for individual selections/ data points. Linear regression and covariate analysis has been performed to analyse inter-relationships and dependencies.
Conclusions: We have demonstrated the frequency of pathology and signs in various areas of the brain in children with cerebral palsy and determined the patterns of injury with frequency of final diagnoses (especially with regards to timing of injury) as well as inter-relationships between the various patterns of abnormality.

Paper #: 133

MRI Findings in CNS Manifestations of Leukemia

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Purpose or Case Report: To identify the main neuroimaging findings using MRI on pediatric patients with known diagnosis of leukemia at our institution during a period of 4 years.
Methods & Materials: We retrospectively evaluated all patient with confirmed diagnosis of leukemia and included all patients with neurologic symptoms whom MRI were performed. Findings were divided in primary (effects related to leukemia) and secondary (therapeutic effects).
Results: From the 197 patients with Leukemia, 37 had clinical neurologic symptoms and imaging of the brain. The average age was 8.37 years (+/- 4.2), from 1.8 to 15 years old. 17 females, 20 males. We found 31 patients with Acute Lymphocytic Leukemia (ALL), 3 with Acute Myeloid Leukemia (AML) and 3 with Mixed-phenotype Acute Leukemia. Intense headache was the most common symptom reported in 16 patients, follow by epilepsy in 10 patients. In the group of manifestations of primary disease we had 19 findings, the main findings were meningeal infiltration (7), parenchymal hemorrhage (3), optic nerve infiltration (3) and chloroma (3). In the group of therapeutic effects we had 32 findings, being the most frequent cortical atrophy (12), parenchymal hemorrhage (6), PRES (5) and leukoencephalopathy (4).
Conclusions: The most frequent neuroimaging findings in patients with leukemia were related to therapeutic effects with cortical atrophy and parenchymal hemorrhage. These were followed by changes related to primary disease such as meningeal infiltration, parenchymal hemorrhage, optic nerve infiltration and chloroma. To be aware of more frequent CNS manifestations of leukemia is crucial for radiologists, in order to ensure an accurate diagnosis and prompt treatment.

Paper #: 134

Radiologic-pathologic Evidence of Brain Injury: Hypoperfusion in the Papez Circuit Results in Poor Neurodevelopmental Outcomes in Neonatal Hypoxic Ischemic Encephalopathy

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Purpose or Case Report: To provide radiologic-pathologic correlation of brain injury in the Papez circuit in neonates with hypoxic-ischemic encephalopathy (HIE) and correlate radiologic findings with long-term neurodevelopmental outcomes.
Methods & Materials: A total of 20 full term neonates were evaluated. The cerebral pulsed arterial spin labeling (PASL) values were compared by permutation test to identify brain regions with statistically significant perfusion changes between 14 HIE neonates without evidence of developmental delay by Bayley-III scores(8/6 males/females, mean age 8.2±7.2 days) and 6 HIE neonates with evidence of developmental delay (4/2 males/females, mean age 13.1±8 days). Linear regression was performed to eliminate the effect of age and gender on PASL data. Developmental assessments were carried out at mean (range) age of 16 (6-40) months. The histopathologic studies on specimens were taken from post-mortem brains of another group of infants (1/3 males/females, mean age 10±6.8 days) with HIE. The infants were not the same ones who had MRIs.
Results: Significantly decreased perfusion in the Papez circuit was found in the HIE neonates with developmental delay compared with HIE neonates without findings of delay via Bayley-III. Decreased ASL perfusion values were seen in Papez circuit structures of the fornix ($p=0.002$), entorhinal cortex ($p=0.048$), amygdala ($p=0.036$), hippocampus ($p=0.033$), and thalamus ($p=0.036$). In autopsy specimens of neonates with known HIE, anoxic (eosinophilic) neurons, reactive astrocytes, and white matter rarefaction were observed in these regions, providing pathology correlation to the imaging findings of HIE.
Conclusions: The Papez circuit is susceptible to hypoxic-ischemic injury in neonatal patients as demonstrated by perfusion-weighted imaging and histopathology. This sheds new light onto a possible non-familial mechanism of neuropsychiatric disease evolution initiated in the infant period and raises the potential for early identification of at-risk children who could benefit from further surveillance and interventions.

Paper #: 135

Medical Radiation Exposure in the United States: The Big Picture in Little Ones National Council on Radiation Protection and Measurements (NCRP) SC4-9 Report No. 184

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Purpose or Case Report: From NCRP Report 184, to (1) provide summary data from diagnostic medical radiation exposure in children compared with adults and (2) identify challenges and needs with such reporting.
Methods & Materials: NCRP Scientific Committee 4-9 (composed of experts in pediatric and adult and diagnostic, interventional, and therapeutic imaging) recently concluded a 10 yr update on NCRP 160 to now include US per capita medical radiation exposure data in children. Pediatric (2016 US census for <18 yr =74,000,000; ICRP age categories used) sources included published peer review articles (~150), IMV, and SCORCH from 2006-2016. Effective dose (E), collective E (S), and average individual E (E_{us}) (results are minimally rounded) from ionizing radiation were determined based on ICRP 103 coefficients. Comparison data from adults were obtained from Medicare B, IMV, VA, several other agency reports and published peer review articles.
Results: Annual pediatric medical radiation S is 21,500 person-Sv, 3% of total (all ages) medical radiation S (755,000 person-Sv). Pediatric medical radiation E_{us} is 0.3 mSv. Pediatric medical radiation S was 9% of total with the remaining 91% from background exposure (vs 51% from background in adults, assuming background E_{us} 3.0 mSv). Modality use for children: radiography 86%, CT 9.5%, fluoroscopy 3%, nuclear imaging 1%, interventional 0.5%. Contributions to medical radiation S in children: CT 84%, radiography 6%, interventional 4%, remainder $\leq$ 3%. 5-7% of total (all ages) CT volume was pediatric (previously understood as ~10%). Pediatric CT frequency: head 55%, AP 25%, spine 10%, others $\leq$ 5% with radiation exposure contributions for CT: AP 51%, head 32%, spine 10%. Challenges in the analyses included limited data on procedure numbers especially for different age classifications, effects of ongoing dose reduction techniques, limitations in effective dose estimation, current changes in patterns of use for some modalities (e.g. decrease trends for nuclear medicine, fluoroscopy), and data predominantly from academic practices. There is no baseline from NCRP 160 for comparison.
Conclusions: NCRP 184 report provides data on current pediatric medical radiation exposure and modality use. There are large uncertainties and gaps. Future projects could provide trend information for medical radiation exposures from which dose management could be linked or attributed and should include organ doses, multimodality national registry data and reporting of quality metrics in addition to exposure based data.

Paper #: 136

Comparison of Radiation Dose Between 100 kVp Using Spectral Filtration and Conventional kVp imaging in Non-contrast Enhanced Chest CT in a Pediatric Transplant Population

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Purpose or Case Report: Patients undergoing lung and stem cell transplants require serial CT examinations and hence dose reduction techniques are mandatory. The newest 3rd generation dual-source CT scanner incorporates spectral beam shaping at 100 kilovoltage (kVp) using a dedicated tin filter (100 kVp Sn), which improves dose efficiency by removing low-energy photons that contribute little to noncontrast image quality. The purpose of this study was to compare radiation exposure in non-contrast-enhanced pediatric chest CT at 100 kVp Sn imaging and at conventional low kVp imaging in the same patient cohort.
Methods & Materials: This is an institutional review board-approved, retrospective study of 61 children with lung or stem cell transplants (median age 12 years, range 1 month to 21 years) who underwent standard of care, non-contrast chest CT at 2 techniques. Baseline scans were acquired on a 2nd generation dual-source scanner using conventional 80 or 100 kVp and follow-up scans were performed on a 3rd generation scanner using 100 kVp Sn. Patients served as their own controls. Scanned volume CT dose index ($CTDI_{vol}$) values were recorded and compared. Quantitative image quality metrics, including mean CT attenuation, noise and signal-to-noise ratio (SNR) in the lung parenchyma were calculated in a subset of 37 patients. Subjective image quality was assessed on a 4 point scale (excellent, good, poor, non-diagnostic). Parametric testing of paired samples was performed.
Results: In the same patients, the mean ± standard deviation $CTDI_{vol}$ was significantly lower in the 100-kVp SN group compared with the conventional CT group (2.35 ± 1.51 mGy vs 0.84 ± 0.18 mGy, P<.0001), representing an average $CTDI_{vol}$ reduction of 55.5%. Compared to conventional scans, spectral filtration CT had similar lung attenuation (-790 HU vs -804 HU, $P > 0.05$), reduced noise (70.5 HU vs 59.4 HU, $P < .001$), and increased SNR (11.6 vs 14.5, $P < .001$). Subjective image quality was similar for both examinations ($P > 0.05$).
Conclusions: Pediatric chest CT performed at 100 kVp with tin filtration for spectral shaping allows for significant radiation dose reduction compared with CT performed at 80 or 100 kVp while maintaining image quality. The results support the use of 100 kVp Sn non-contrast enhanced pediatric chest CT in evaluation of the lung parenchyma.

Paper #: 137

Digital Radiography Dose Index Registry: Pilot Single-Site, Single-Vendor Experience

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Purpose or Case Report: The American College of Radiology

(ACR) Dose Index Registry (DIR) compares site or practice exposure indices among regional and national values. While the CT DIR was established in 2011, Digital Radiography (DR) is only in the pilot phase. This single-site, single-vendor experience will inform the pediatric radiology community of the establishment of the ACR DIR DR module.
Methods & Materials: Radiation dose structured report data from images obtained on Siemens Ysio DR systems with Fluorospot Compact FD software from a single pediatric hospital system were anonymized using the ACR TRIAD software. This Siemens software used the International Electrotechnical Commission (IEC) 62494-1 exposure index standard. The data was transmitted to the ACR DIR. Each individual radiation event was recorded. The data was retrieved from the ACR records by the sending institution using an Excel spreadsheet. The 5 most common exams, excluding stitched exams, were reviewed. The mean and standard deviation of the Exposure Index (EI), Target Exposure Index (EIT), and Deviation Index (DI) were analyzed.
Results: There were 7 rooms (2 in-department, 2 orthopedic, 2 outpatient, and 1 emergency) that supplied data from 6/25/18 until 9/23/19. 143921 exposure events were recorded. 1207 events had no values listed (0.83%). The 5 most common exams (number of events) were: 2-view CXR (22134), foot (9429), knee (9158), wrist (8060), and 2-view abdomen (7086). The preferred EIT for CXR, abdomen, and knee was 250 and EIT for wrist and foot was 350. The EI (std) was for CXR 341 (165), foot 419 (213), knee 545 (387), wrist 440 (190), and abdomen 411 (199). The DI (std) was for CXR 0.9 (2.0), foot 0.2 (2.3), knee 2.6 (2.7), wrist 0.6 (1.8), and abdomen 1.7 (2.0). Most common and impactful difficulties encountered were incorrectly programmed EIT and proper naming protocols.
Conclusions: Dose Index Registries are important to assure quality and safety of patient care. The ACR CT DIR has established diagnostic reference levels for the 10 most common adult CT exams. Radiographs comprise 85% of all pediatric examinations, but there is no national benchmarking of dose indices. This single-site experience indicates that the exposure data can be easily acquired and analyzed using ACR TRIAD. There was a tendency to overexposure with the mean knee and abdomen exams approaching overexposure by a factor of 2 and the foot exam close to optimal. Additional sites need to be recruited to help benchmark exposure indices for common pediatric examinations.

Paper #: 138

Dose Line Integral, A New metric for Adding Doses from Multiple Multi-sequence CT Exams

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Purpose or Case Report: Scanner console-provided volume CT Dose Index (CTDIvol) and Dose Length Product (DLP) are frequently added up inappropriately to obtain cumulative dose values in patients exposed to multiple multi-sequence CT exams, performed with varying z-axis coverage and often with longitudinal tube current modulation. We present the patient-size specific Dose Line Integral (DLI) as a new metric that allows this task to be performed in a more precise fashion across multiple scanner platforms
Methods & Materials: We reviewed all pediatric abdominal CT scans performed from 2013 through 2019 in patients who had at least two scans performed during the study period, recorded CTDIvol and DLP, and calculated Size Specific Dose Estimates (SSDE) for all scans with commercially available software. One author mapped an anatomic landmark (the take-off of the superior mesenteric artery from the aorta) to the z-axis position of each (sub)acquisition, to align the scans for construction of DLI curves as a function of z-axis location. The areas under these curves were then integrated and their sum calculated for all acquisitions each patient underwent. For each patient, z-axis-dependent cumulative DLI dose profiles were compared with summated SSDEs, and summated areas under all DLI curves were compared with summated DLPs
Results: We recorded data in 143 scans obtained in 48 patients, ranging in ages from 0-1 (n=15), 8-10 (n=21), 11-14 (n=7) and 15 (n=5) years. Number of scans per patient ranged from 2 to 6. The accumulated maximum point dose value of DLI was different from SSDE by an average of 24±14% (18.1 vs 15.5 mGy), ranging from -32% (6.8 vs 10.0 mGy) to +81% (46.3 vs 25.6 mGy). Globally-absorbed DLI exceeded summated DLPs by an average of 118±39% (649 vs 319 mGycm), ranging from 35% (1002 vs 742 mGycm) to 194% (273 vs 93 mGycm)
Conclusions: The graphic dose profile DLI gives a complete description of z-axis dose distribution for the studied CT examinations under a wide range of patient variables and acquisition conditions. Visualization of DLI profiles across and beyond the scan ranges provided a more precise tool for cumulative dose documentation than simple arithmetic summations of CTDIvol, SSDE and DLP. Accumulated dose estimates from simple summation of these conventional dose values substantially underestimated those calculated with the more precise DLI method in the majority of patients. This improved characterization of cumulative absorbed dose will guide better dose optimization efforts in this vulnerable population

Paper #: 139

Dose Reduction in PET/MRI in Young Pediatric Patients Under 5 years of Age

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Purpose or Case Report: We aim to evaluate qualitative and quantitative image quality of low-dose PET-MRI in young patients.
Methods & Materials: 25 PET/MRI scans from 14 patients under the age of 5 years were analyzed. Mean age was 2.78 years. Imaging protocol included 4 minute PET acquisition per bed position with a mean of 4.1 MBq/kg activity of FDG. Simulated half-dose images were created by removing events from the PET file list. In addition to ordered subset expectation maximization (OSEM) reconstructions, PET data was reconstructed with Bayesian penalized likelihood reconstruction (Q.Clear, $\beta = 350$) for full and half-dose images.MIP images from 4 reconstructions were viewed and rated by 2 radiologists based on image quality, noise, and sharpness on a 5 point Likert scale and artifacts on a 3-point Likert scale. Likert scale data was analyzed with Kruskall-Wallis test. Post-hoc pairwise analysis with Dunn test was performed with statistically significant differences ($p<0.05$). Weighted Cohen's kappa was calculated for interobserver agreement.SUV analysis included the SUV_{max}, SUV_{avg}, signal-to-noise (SNR) for liver, and contrast-to-noise (CNR) for lesions. SUVs were analyzed by Friedman's test and post-hoc analysis with Nemenyi test.
Results: Likert data showed no statistical difference for image

quality (chi^2 = 5.1394, p= 0.16), sharpness (chi^2 = 2.81, p = 0.24) Kruskal-Wallis test showed a significant difference for noise (chi^2 = 20.187, df = 3, p = 0.0001). Post-hoc Dunn test showed half-dose scans were subjectively noisier than the full-dose scans. The Q.clear did not subjectively decrease noise when compared to the OSEM reconstructions. No artifacts were detected. Moderate agreement was shown (K= 0.411).Liver SUVmax was higher in the half-dose scans (p from 4.9 x10^{-14} to 1.9 x10^{-5}). However, liver SUV_{avg} showed a statistically significant difference in only the half-dose OSEM vs. full-dose Q.Clear with bias of only 10%(p = 1.6 x10^{-5}). Liver SNR decreased with half-dose and Q.Clear (p-value from 3.8 x10^{-14} to 0.024). Lesion SUVavg and SUVmax were significantly increased in the Q.Clear than the OSEM (p-value ranging 1.5 x 10^{-7} to 0.007) in both dose reconstructions. CNR was decreased in the half-dose (p from 6.1 x 10^{-5} to 0.006) and did not improve with Q.Clear (p from 0.65 to 0.91).
Conclusions: Simulated half-dose show qualitatively diagnostic but nosier images. Quantitatively, Q.Clear did not improve SNR or CNR. Future directions could explore optimization of Q.Clear's β value.

Paper #: 140

Application of Contrast-enhanced Ultrasonography and Shear Wave Elastography for Evaluation of Thyroid Nodules with Biopsy Correlation: Early Experience in Children

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Purpose or Case Report: Contrast-enhanced ultrasound (CEUS) and shear wave elastography (SWE) have been widely studied in adult thyroid disease. However, evaluation of thyroid nodules using these tools in pediatric patients has yet to be published.We aim to evaluate the feasibility and safety of CEUS and SWE for thyroid nodules in children at the time of cytologic biopsy.
Methods & Materials: An IRB approved prospective pilot study of children who underwent US-guided thyroid nodule biopsy was performed. SWE protocol; 9 mHz GE EPIQ E9 linear probe, regions of interest placed on nodules and normal thyroid gland (as a control) to obtain an SWE value. CEUS protocol; 9 mHz linear probe, 0.03 ml/kg Lumason, mechanical index 0.12, dynamic imaging of thyroid nodule and normal thyroid for 2 minutes. Average contrast intensity over 2 minutes was used to generate a time-to-peak (TTP) enhancement curve. Inclusion criteria was any patient who underwent thyroid biopsy under sedation/anesthesia due to the presence of a pre-existing IV which could be used for CEUS. Exclusion criteria included simple thyroid cysts or diffuse thyroid abnormality.
Results: At initiation of protocol, 5 consecutive patients (4F, 1M) were included (5 SWE, 4 CEUS). Mean patient age was 16.6 years (9-20). 9 nodules was included. Mean maximal diameter of nodule was 21 mm (5-26). There were 5 solid and 4 solid/cystic nodules.There were 6 Bethesda grade 2 (hyperplastic) nodules, 2 Bethesda grade 3 (follicular lesion of undetermined significance) nodules and one organizing hematoma. SWE values were higher in the nodule compared to normal thyroid gland in 2/5 patients (p <0.05), follicular lesion of undetermined significance and organizing hematoma. SWE values were trending toward significance in 3/5 patients, (p 0.05-0.069), all hyperplastic nodules.For CEUS, mean TTP of normal thyroid was 6.9 secs (5.8-8), for Bethesda grade 2 nodules was 7.0 secs (6-7.9) and for Bethesda grade 3 nodules was 6.9 secs (5.8-8). There was no statistically significant difference between TTP of normal thyroid compared to thyroid nodules (p = 0.27).
Conclusions: This is the first evaluation of CEUS and SWE characterization of thyroid nodules in children. This pilot study demonstrates that SWE and CEUS is safe and technically feasible for evaluation of thyroid nodules in children. A larger cohort is needed for imaging validation and is ongoing.

Paper #: 141

Patient-Specific 3D-Printed Customizable Pediatric Renovascular Phantom for Complex Renal Artery Stenosis (RAS) Pre-procedural Planning

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Purpose or Case Report: The renal artery ostial anatomy, balloon profile, and stent deployment are all challenges of complex procedural RAS planning in children. In such cases there is an increased risk of renal artery rupture secondary to angioplasty requiring placement of a covered stent. This study aims to establish the feasibility of simulating renovascular stent deployment in three 3D printed pediatric patient-specific RAS endovascular phantoms.
Methods & Materials: A removable patient tailored RAS module facilitated patient specific pre-procedure planning and a training for rare procedure. Silicone poured in 3D printed molds were created from the patient's CTA to create patient-specific models. Vascular access points were added for upper and lower extremity simulation and a pump was installed to simulate circulatory flow.The three patient-specific models included bilateral kidneys with i) left inferior branch high grade RAS (80%),(ii) bilateral RAS (63% and 45%) with steep ostial angle, and (iii) moderate left RAS (30%) and high grade right RAS (80%).Simulation steps: catheter and balloon entry via upper extremity, selective renal angiography, stenosis identification and transgression, non-low-profile cutting balloon angioplasty and balloon expandable stent simulation.Operators completed a 10 point questionnaire, rating their experience using a 5-point Likert scale (1-Strongly disagree to 5-Strongly agree).
Results: Three complex renal angioplasty simulations were performed; for treatment planning, with simulation stent placement. Post simulation, an upper extremity approach was deemed necessary for cutting balloon stenosis transgression due to the steep renal artery ostial angulation, and change in clinical procedure approach planning.Stents included; 1 PK Papyrus™ stent graft, 1 Viabahn, 1 Graftmaster. PK Papyrus™ and Graftmaster stents are humanitarian devices and off label in children.Three operators Likert scale had good agreement (k=0.46) that the 3D printed phantom is helpful in procedure planning, skill development and provides a realistic experience from catheterization to stenting. The simulation resulted in a planned live patient brachial access in all 3 patients. Stent deployment simulation provides pre procedure training for a rare indication in children.
Conclusions: This first described renovascular "plug and play" phantom provides customized patient renovascular angioplasty pre procedure planning together with stent deployment simulation, all complex elements of this procedure in children.

Paper #: 142

Renal Perfusion Changes Pre- and Post- renal Artery Angioplasty: Early Quantitative Experience Using Contrast-enhanced US in Children

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Purpose or Case Report: Conventional Doppler US is known to have low sensitivity for the diagnosis of renal artery stenosis (RAS), in particular segmental renovascular disease. This study aims to determine if contrast-enhanced US (CEUS) can quantitatively provide assessment of renal arterial and parenchymal perfusion pre- and post- renal artery angioplasty in children and potentially be used as a follow-up imaging tool.
Methods & Materials: This is a pilot study for pre-, immediate post-angioplasty and 24h post- CEUS exams during quiet breathing to include main renal artery at the hilum and all renal poles in one imaging plane for 2 minutes to assess parenchymal wash-in and peak intensity. Regions-of-interest were placed in upper, mid and lower pole and main renal artery in each study. Average contrast intensity over the total duration of imaging time was used to generate a time-to-peak (TTP) enhancement.
Results: Five consecutive children were identified as meeting inclusion criteria. All cases involved the use of a cutting balloon, a novel technique for resistant renal artery angioplasty. Mean degree of stenosis pre-angioplasty improved from 64.2% (60-74) to 20% (10-31) post-angioplasty. Mean pressure gradient pre-angioplasty was 15.2 mmHg (5-31), post-angioplasty was 11.5 mmHg (3-19).Mean TTP main renal artery: pre-angioplasty 7.8 secs (6.3-8.7); immediate post-angioplasty 4.4 secs (3.8-5.5); 24h post- 5.4 secs (4.2-6.7).Mean TTP parenchyma: pre-angioplasty 10.7 secs (8.6-13.7); immediate post-angioplasty 7.2 secs (5.3-8.8); 24h post- 6.8 secs (5.7-10.1).There was significant improvement of TTPs in renal artery and parenchyma both immediate post-angioplasty and at 24h post- compared to pre-angioplasty ($p<0.05$).The mean improvement of TTP in the immediate post-angioplasty and 24h post- follow-up compared to pre-angioplasty in the main renal artery were 3.0 secs (0.8-4.4) and 2.2 secs (1.2-3.4), and in the parenchyma were 3.4 secs (0.2-7.8) and 3.8 secs (1.9-6.8). There was no difference in TTP improvement between immediate post-angioplasty and 24-hour follow up compared to TTP pre-angioplasty in both renal artery and parenchyma ($p = 0.29$ and 0.32, respectively).
Conclusions: This pilot study suggests that CEUS imaging with standardized protocol may be a useful quantitative adjunctive technique to evaluate pre- and post- angioplasty renal perfusion. It may have the potential to be used as a follow-up tool to monitor the success of the angioplasty and potentially in follow-up studies serve as an early indicator.

Paper #: 143

Validation of CT Angiogram (CTA) in Assessment of Pediatric Renal Vascular Hypertension: A Comparison with Digital Subtraction Angiography

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Purpose or Case Report: Renal artery stenosis (RAS) is an important cause of hypertension in children. When suspected, imaging options include Doppler US, CTA and MRA. However, conventional angiography remains the gold standard. We investigate the accuracy and inter-reader reliability of CTA in children with suspected renal artery stenosis.
Methods & Materials: This is an IRB-approved retrospective study that included all patients who underwent DSA for suspected RAS with a CTA within 6 months prior to a DSA between 2008 and 2019. Basic demographics were retrieved from the electronic medical records. Each CTA was reviewed by 2 pediatric radiologists, blinded to clinical data and other imaging studies, to determine the presence of stenosis at the main and/or segmental renal artery. Angiograms were performed by a pediatric interventional radiologist with over 20-year experience, whose reports were used as standard reference for diagnosis of RAS. The sensitivity, specificity, and accuracy were calculated. Kappa statistics was performed to assess inter-reader agreement. Agreement was categorized as follows: less than 0.20, slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; and greater than 0.81, almost perfect agreement.
Results: Seventy-four renal assessments of 37 patients were included. Mean patient age was 9.6 years (range, 1-21). The overall prevalence of RAS was 62.1% (n=23/37).Six patients had a pre-existing diagnosis, 2 patients with neurofibromatosis type1, 2 patients with William syndrome and 2 patients with fibromuscular dysplasia. At the patient level, the diagnostic performance of CTA was: sensitivity 84.8% (95%CI: 71.1-93.7%), specificity 78.6% (95%CI: 59.1-91.7%), accuracy 82.4% (95%CI: 71.8-90.3%). The inter-observer agreement was almost perfect (k=0.83). At the main renal artery level, the sensitivity was 78.6% (95%CI: 65.6-88.4%), specificity 92.4% (95%CI: 85.0-96.9%), accuracy 87.2% (95%CI: 80.7-92.1%). The inter-observer agreement was moderate (k=0.73). At the segmental renal artery level, the sensitivity was 71.4% (95%CI: 0.2-33.9%), specificity 97.8% (95%CI: 93.6-99.5%), accuracy 89.2% (95%CI: 83.0-93.7%).
Conclusions: CTA has moderate to high sensitivity and high specificity at the patient and main renal artery levels. However, it performs moderately at the segmental level. Therefore, it offers good quality as a screening and pre-procedure planning modality but cannot substitute DSA in patients with high suspicion of RAS.

Paper #: 144

The Pediatric Interventional Radiology Experience: Perspective of Patient Families

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Purpose or Case Report: Little is known about how families of children undergoing interventional radiology (IR) procedures experience their interactions with IR teams; therefore, we conducted a qualitative study to explore and learn from families experience with IR teams in order to educate pediatric IR staff and ultimately improve delivery of care.
Methods & Materials: We conducted semi-structured interviews with 30 families of children (outpatient and inpatient) who recently underwent an interventional radiology procedure. Questions solicited information about their understanding of the procedures, their experiences with scheduling, and their pre- and post-procedure interactions with IR teams. We developed codes from important concepts in the data and revised codes based on

team consensus. Four research assistants then applied codes to interview transcripts. The team reconvened to arrange codes into thematic categories that illustrated families experience with IR teams.
Results: Families identified a range of facilitators and barriers to overall positive experiences of family's experiences with IR staff. Facilitators included (a) taking a role of advocate for their child, specifically one parent emphasized "I feel like it was good that I asked, because I think that the information he gave me was valuable, and I don't know if otherwise anyone would have told me." (b) receiving clear and useful education about the procedure and (c) the reputation of the hospital. Barriers to an overall positive experience with IR teams included (a) confusion about the location of the IR suite and (b) misalignment and uncertainty about what to expect pre/post procedure, one parent highlighted "it might have been helpful had I known roughly how long I was going to be there. I was afraid to just step out…because I didn't want to miss somebody coming out to get me." Reported facilitators and barriers were not substantially different between families whose children were inpatient vs outpatient.
Conclusions: Adding IR specific-findings to the patient experience literature, we found that families express a range of experiences with IR teams; while most reinforce existing, positive interactions there is room for improvement. Relatively simple steps to improve families' experience (e.g., signage) in addition to more complex communications education could advance the delivery of care by IR teams.

Paper #: 145

Thyroid Imaging Characteristics and Diagnostic Outcomes of Patients with Syndromes Predisposing to Thyroid Cancer

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Purpose or Case Report: Cancer predisposition syndromes (CPS) are rare genetic disorders with increased risk of benign and malignant neoplasms. A few of these syndromes predispose to thyroid gland pathology, including thyroid carcinoma. The purpose of this study is to review the spectrum of diagnostic outcomes of thyroid abnormalities in pediatric patients diagnosed with a CPS at a tertiary care pediatric hospital.
Methods & Materials: This research ethics board-approved retrospective analysis evaluated thyroid gland imaging in patients <18 years of age with a confirmed diagnosis of a CPS associated with an increased risk for thyroid gland lesions, who were seen in the Division of Endocrinology and Metabolism and the Department of Genetics of a tertiary care pediatric institution between January 2000 to September 2019. Diagnoses of thyroid lesions were obtained by histopathology from thyroidectomies, fine needle aspiration, sonographic and clinical follow-up for up to 2 years. The CPS included in our database search were: Familial adenomatous polyposis (FAP), Carney complex, DICER1 related disorders, PTEN hamartoma tumor syndrome (PHTS), Werner syndrome, multiple endocrine neoplasia (MEN), familial paraganglioma, Li–Fraumeni syndrome, McCune–Albright and Peutz–Jeghers.
Results: 92 thyroid ultrasound exams of 59 patients (31 male and 28 female) with median age 13 years (range 3 -18 years) were reviewed. Diagnoses of CPS included FAP (n = 11), PHTS (n = 16), DICER1 (n = 2), Li-Fraumeni (n = 8), MEN2A (n = 9), and McCune-Albright (n = 3). 9 underwent total thyroidectomy and 2 fine needle aspirations. Variable thyroid lesions detected including: a) TI-RADS4 nodules in 1/11 FAP and 2/16 PHTS, b) multinodular goiter (MNG) in 2/2 DICER1 mutations, c) ectopic intra thyroid thymus in 1/9 MEN2A, d) non-specific < 2 mm hypoechoic lesion in 1/8 LFS; e) heterogeneous gland in 2/3 McCune-Albright (1 developed MNG over time). There were two malignant thyroid nodules, one in a patient with MEN2, and the other in a patient with PHTS. Finally, there were four malignant-precursor lesions from thyroidectomies of patients with MEN2.
Conclusions: Results from this study describe the US features of benign and malignant thyroid lesions encountered in patients with CPS associated with thyroid gland pathology. The spectrum of thyroid gland lesions including thyroid carcinoma encourages early and regular surveillance in these patients.

Paper #: 146

Value of Dual-energy CT in Diagnosis of Mediastinal Tumors in Children: Initial Experience.

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Purpose or Case Report: Mediastinal tumors comprise a range of congenital, neoplastic and inflammatory tumors. While many benign and malignant lesions can be differentiated by CT appearance and attenuation values, many cannot be reliably separated. The purpose of this paper is to evaluate the feasibility of dual-energy computed tomography (DECT) in differentiating a spectrum of mediastinal tumors in children.
Methods & Materials: We retrospectively evaluated 19 patients with 20 mediastinal tumors (9 males, 11 females) with mean age of 14.6 years (1-22 years). All patients underwent a single-phase DECT using Siemens Somatom dual source scanner. CT scans were performed with dose reduction technologies. The analyses included longest tumor diameter and quantitative analyses of CT attenuation values in Hounsfield units (HU) and the iodine concentrations (mg/ml). The 80 kVp image was used to measure HUs, and the iodine map was used to measure iodine concentrations. For the quantitative analyses, a region of interest (ROI) was drawn to be as large as possible in two different areas of the tumors and the values averaged. Pathologic results were used for final diagnosis in untreated tumors and functional imaging studies including PET (n= 9) and MIBG (n= 2) scans were used in treated tumors. We used Fisher exact test for statistical analysis.
Results: Five patients had benign tumors:2 neurogenic and 3 inflammatory myoblastic tumors. Nine had untreated malignant tumors: 6 lymphomas, 2 neuroblastomas, 1 germ cell tumor. Six had treated lymphomas. The mean diameters for benign, untreated and treated tumors were 5.3 cm, 5.1cm, 4.1cm. The mean attenuation values were 47.14, 81.09 and 49.9 respectively ($p = 0.05$). The mean iodine concentration measurements in benign, untreated malignancy and treated tumors were 0.42 mg/ml, 2.06 and 0.23 respectively ($p < 0.01$). The best cut-off threshold iodine concentration for differentiating benign and treated tumors from malignant tumors was 1.1 mg/ml.
Conclusions: Results of this study show that dual-energy CT using a quantitative analytic methodology can differentiate benign, including treated tumors, from malignant tumors in

children. We believe that dual-energy CT can be a helpful complimentary tool for diagnosis in cases where standard contrast CT is inconclusive. It also has the potential to be a valuable modality to assess response to treatment.

Paper #: 147

^{18}F-FDG PET/CT Parameters are Correlated with MYCN Status in Newly Diagnosed Neuroblastoma

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Purpose or Case Report: Despite significant advances in delivering dose-intensive and myeloablative therapy with hematopoietic stem cell support, the survival for patients presenting with metastatic neuroblastoma remains poor, with a 3 year event free survival (EFS) of about 60%. Modern treatment protocols are based on risk stratification which incorporates age of diagnosis, tumor stage, tumor histology, and molecular and cytogenetics including MYCN amplification. ^{18}F-FDG PET/CT can play a role in disease staging and follow up. The purpose of this study was to report FDG PET findings in a cohort of children with neuroblastoma and assess for predictive associations with MYCN amplification status.
Methods & Materials: A single institution retrospective review was performed to identify all patients with newly diagnosed neuroblastoma for whom both pre-therapy ^{18}F-FDG PET/CT and MYCN FISH were obtained between July 2006 and July 2019. All FDG-PET examinations had been performed utilizing 0.1-0.14 mCi/kg of FDG with imaging performed approximately 1 hour after radiopharmaceutical administration. Using the PET-edge tool in MIM (MIM Software; Cleveland, OH), a single observer drew regions of interest around the primary tumor to measure SUVmax, SUVmean, tumor volume, and total lesional glycolysis (TLG, SUVmean x tumor volume). All measurements were reviewed and adjusted as needed by a board certified Radiologist. Student's t-test was used for comparisons of means.
Results: A total of 45 patients were identified. Thirteen (29%) patients had MYCN amplification. The mean age at diagnosis was 2.7 years ± 1.9 [standard deviation]. SUVmax ranged from 1.1 to 11.2 (mean 4.7 ± 2.3). Patients with MYCN amplification were older than those without MYCN amplification (3.6 ± 2.3 vs 2.4 ± 1.6 years, $p = 0.04$). Mean SUVmax (5.9 ± 2.4 vs 4.2 ± 2.1, $p = 0.028$), tumor volume (438 ± 335 mL vs 95 ± 96mL, $p<0.0001$), and TLG (1056 ± 845 vs 226 ± 329, $p<0.0001$) were significantly higher in MYCN amplified tumors versus non amplified tumors. SUVmax of the primary tumor was higher in patients with bone marrow metastases than those without (5.6 ± 2.0 vs 4.0 ± 2.3, $p = 0.017$).
Conclusions: On average, MYCN amplified neuroblastomas are larger and more metabolically active than MYCN non-amplified tumors. FDG PET may provide prognostic value in newly diagnosed neuroblastoma.

Paper #: 148

Comparing Diffusion-weighted MRI and ^{18}F-FDG PET/MRI for Staging and Restaging of Langerhans Cell Histiocytosis

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Purpose or Case Report: To compare the detection of lesions between DW-MRI and ^{18}F-FDG PET/MR for staging and restaging of Langerhans Cell Histiocytosis (LCH), using all clinical outcomes and imaging data as the reference standard. Also, this study will compare the differences between LCH chemotherapy responders and non-responders.
Methods & Materials: In a prospective clinical trial, we enrolled 11 children (2-16 years old, 4 female and 7 male) with LCH, who underwent an ^{18}F-FDG PET and DW-MRI scan on an integrated 3T PET/MR scanner at baseline (n=11) and after chemotherapy (n=7). We determined the presence or absence of tumor lesions in 5 anatomical areas per patient on ^{18}F-FDG PET and DW-MRI. We calculated sensitivities, specificities and diagnostic accuracies of the two imaging modalities, with biopsy results and follow up imaging as the reference standard. In addition, we measured the SUVratio as the maximum standardized uptake value (SUVmax) of each lesion, normalized to the SUVmean of the liver and the apparent diffusion coefficients (ADCmean) of all lesions. Quantitative data before and after chemotherapy were compared with a Mann-Whitney U test. SUVratio and ADCmean were correlated with a linear regression analysis.
Results: On baseline scans, our patients had 37 LCH lesions according to the reference standard. ^{18}F-FDG PET detected 37 of 37 lesions and DW-MRI detected 35 of 37 lesions. The sensitivity and specificity for baseline scans were 100% and 100%, respectively for ^{18}F-FDG PET and 94.59% and 100% for DW-MRI. DW-MRI missed two lesions in the head and thorax as there was no restricted diffusion of the lesion in the head and the thorax had motion artifacts. Chemotherapy responders demonstrated significant decline in SUVratio ($p=0.002$) and significant increase in ADCmean ($p<0.001$). Non-responders did not show significant changes in SUVratio ($p=0.122$) or ADCmean ($p=0.156$). The regression analysis showed that resolution of a lesion leads to a decrease in SUVratio and an increase in ADCmean.
Conclusions: Our data provides preliminary evidence that DW-MRI can be used for staging and treatment monitoring of LCH. While we found slightly lower sensitivities of DW-MRI compared to ^{18}F-FDG PET, this difference did not impact our ability to determine overall therapy response. Since patients with multifocal LCH need multiple follow-up scans throughout their lifetime, using DW-MRI could substantially decrease the radiation exposure of these young patients.

Paper #: 149

Effects of Local Cancer Therapies on Apparent Diffusion Coefficient of Paediatric Bone Marrow

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Purpose or Case Report: To measure and compare early (within 3 months) and late (beyond 3 months) changes in ADC

of the clival marrow post-photon and proton therapy.
Methods & Materials: **Photon therapy cohort:**12 children with neurological tumours who had radiotherapy between 2006 and 2017 at our institution and with pre- and post-treatment DWI were identified.Correlation with the DICOM-files of the radiotherapy plans was performed to check if the clivus was included in the field of treatment and to calculate the dose administered.**Proton therapy cohort:**Between 2012 and 2017, 112 children with neurological tumours benefitted of the Proton Overseas Programme. By applying inclusion and exclusion criteria, ten eligible patients with pre- and post-treatment DWI were selected.The DICOM-files with the pre-treatment plans were obtained from Jacksonville and Oklahoma City. The inclusion of the clivus in the field of treatment was confirmed and the dose which was administered was calculated.***Image acquisition and analysis:*** Children in both cohorts had been scanned at 1.5T including morphological sequences and DWI with b=0 and 1,000 s/mm^2.A 4-5-mm circular region-of-interest was drawn in the clivus of the b=1000 s/mm^2 DWI using in-house software Adept®. Data from the entire volume of interest (2 or 3 contiguous slices) were obtained.Aggregate values and descriptive statistics were obtained for each patient and for the entire cohort at baseline, early, and late time-points.
Results: The range of doses received with radiation therapy was much greater (39-54 Gy) with 7 patients receiving < 50 Gy. All patients in the proton beam therapy cohort received > 50 Gy, 8 of 10 received 54 Gy.The median time interval between the end of treatment and the first post-treatment MR scan was < 2 months in both cohorts and equivalent between the baseline and the second post-treatment scan.An early post-treatment rise in ADC occurred at 1-3 months in the photon therapy cohort and at 2 months after proton administration, which reduced by 3-6 and 4 months, respectively. Return to below baseline values was seen in 3 and 2 cases, respectively.
Conclusions: Longitudinal changes in ADC occur within normal skull marrow following radiotherapy and proton beam therapy to the brain as a result of acute injury to the tissue in which the energy is deposited. These changes are greater at an early time-point, but they gradually diminish. Slightly greater increases were seen early after proton therapy.

Paper #: 150

Effects of Systemic Cancer Therapies on Apparent Diffusion Coefficient of Paediatric Bone Marrow

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Purpose or Case Report: To measure early (within 3 months) and late (beyond 3 months) changes in ADC of the lumbosacral vertebral marrow following chemotherapy in children with abdomino-pelvic neoplasms and interpret them in the context of ADC measurement reproducibility.
Methods & Materials: 63 subjects aged 5-17 years with an abdominal or pelvic tumour without prior or concomitant radiotherapy to the spine, and who had MR scans pre- and post-chemotherapy including diffusion-weighted images (DWI) with at least two b values were studied. This was approved as a Service Evaluation by our institution.Patients on any other type of medication, with bony illness or artefacts on DWI were excluded. Analysable examinations were anonymised and stored on the XNAT platform.For this cohort the agents administered, the overall dose, and number of cycles was recorded.DWI was correlated with morphological axial and coronal T2-W images to identify the lumbosacral vertebrae. Circular regions of interest of approximately 8-10 mm in diameter were drawn within L3, L4, L5, and S1 on a midline slice of the highest b value DWI using the in-house software Adept®.Data from the entire volume of interest were obtained for descriptive statistical analysis performed using GraphPad Prism software.Additionally, median, mean, 10th, 25th, 75th, and 90th percentile ADC values were recorded. As data at baseline and at the first post-treatment time-point were normally distributed (Shapiro-Wilk test), the change between baseline and this time-point used a paired t-test.
Results: The 11 patients available for analysis were affected by hepatoblastoma (1), pancreatoblastoma (1), Wilms' tumour (4), immature ovarian teratoma with or without gliomatosis peritonei (2), ovarian dysgerminoma (1), pelvic fibromatosis (1), and pelvic desmoplastic round cell tumour (1).At 1-3 months after completion of chemotherapy a reduction in ADC in lumbar marrow beyond measurement variability in 70% of cases was noted with a significant reduction (p=0.04), this was sustained when measured at 4-12 months post-treatment.Only 2 cases showed an early rise in ADC, one of which then fell to below baseline values.
Conclusions: The post-chemotherapy changes in the lumbosacral marrow predominantly showed a decrease of ADC by 3 months, which was then sustained without further change beyond that time-point. The stability of the data in individual patients indicates that the findings are likely to be reliable.

Paper #: 151

Reproducibility of the Apparent Diffusion Coefficient Measurements in Clival and Lumbosacral Bone Marrow of an Off-treatment Paediatric Population

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Purpose or Case Report: To establish the reproducibility of the apparent diffusion coefficient (ADC) measurement in the bone marrow of the clivus and lumbosacral spine.
Methods & Materials: Under operational ethical permission, diffusion-weighted imaging (DWI) was run twice — before and after the morphological sequences — in 6 children having a magnetic resonance (MR) scan of the brain for clinical follow-up. In 4 children DWI was obtained on 2 separate occasions after a 1 to 4-month interval.Similarly, in 10 children having a spine MR study, the DWI acquisition was repeated. In an additional 4 subjects who had two abdomino-pelvic MR scans with DWI as part of follow-up within a 6-month period, and who had no intervening treatment in the preceding 6 months, scans done on two separate occasions were used to assess reproducibility.In both cohorts, scans including DWI with b=0 and 1,000 s/mm^2 for the brain and multiple b values ranging from 0 to 1,000 s/mm^2 in the spinal cohort were acquired at 1.5T machines; all subjects were at least 6 months off treatment.A circular region-of-interest was drawn in the clivus (diameter of 4-5-mm) and L3-S1 vertebrae (diameter of 6-8 mm) of the b=1000 s/mm^2 DWI using in-house software Adept®. Data from the entire volume of interest (2 or 3 contiguous slices) were obtained.
Results: In the brain cohort (8-16 years), 95% confidence intervals of marrow ADC measurements in the clivus ranged from -5.5 to +11%In the abdominopelvic cohort (3-16 years),

the 10 done within the same MR examination showed very similar marrow ADC values of the lumbosacral spine at the beginning and end of the examination. The ADC variability was much greater when scans acquired on different occasions (median of 10 weeks apart) were considered. Bland-Altman plots were constructed using data from all 14 patients and showed 95% confidence intervals of -23.4% to +19.3% for median ADC and -19.5% to +15.8% for mean ADC.
Conclusions: In children, it is feasible to measure ADC from the clivus with 11% variability (Limits of Agreement), whilst ADC quantitation in the lumbar spine can have a measurement variability of up to 25% (Limits of Agreement).These data will serve as a baseline to assess changes on ADC values of paediatric bone marrow induced by local and systemic oncological treatments, including potential toxicity caused by novel agents within clinical trials, and to assess engraftment in post-bone marrow transplant leukaemic patients in a non-invasive fashion, before changes in blood counts are evident.

Paper #: 152

The Correlation Between the First Order CT Features in Pre-treatment CT Texture and MYCN Amplification Status in Neuroblastoma

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Purpose or Case Report: Neuroblastoma (NBL) is the most common extracranial solid malignancy of childhood. Biological features are known to affect disease severity. Status of amplification of the MYCN proto-oncogene is among several factors that affect the prognosis. CT texture analysis of tumor provides a step from qualitative to quantitative assessment, with the added bonus of use of routinely acquired images without the need for further tests. The aim of the study is to ascertain the ability to differentiate between MYCN-amplified and non MYCN-amplified neuroblastoma on pre-treatment CT images. The hypothesis is that lesion microenvironment and heterogeneity may differ significantly between MYCN-amplified and non MYCN-amplified tumor. Such differences may be exhibited in first-order texture analysis techniques that could detect more subtle differences in tumor heterogeneity by quantifying both pixel attenuation. This retrospective study objective is to explore the correlation between the first –order CT texture analysis (CTTA) and MYCN amplification status of neuroblastoma.
Methods & Materials: A total of 43 children (23 girls, 17 boys) underwent contrast-enhanced CT of the chest abdomen and pelvis during staging of NBL between January 2009 and December 2017. We exported the pre-treatment contrast enhanced CT imaging data-set of consecutive cases of NBL; texture analysis was performed on each segmented area, computing for each lesion using first-order quantitative parameters. Statistical descriptive analysis was performed using SSPS. Fisher exact test was used to assess the accuracy of the CTTA features to differentiate MYCN amplified and non-MYCN amplified neuroblastoma. Pearson's chi-squared test was applied to categorical outcomes. Distribution of overall survival (OS) and progression-free survival (PFS) were estimated using the Kaplan-Meier method.
Results: MYCN amplification was seen in 10 patients. Among the first-order CTTA parameters, entropy, uniformity, skewness, kurtosis and standard deviation showed significant difference between MYCN- amplified and non MYCN-amplified tumors. The 3-year overall survival (OS) was 54% and 70% in MYCN-amplified and in non MYCN-amplified patients respectively.
Conclusions: In our series, we showed that first order CT texture analysis could be a potential biomarker to differentiate between MYCN-amplified and non MYCN-amplified neuroblastoma.

Paper #: 153

Monitoring Response to Tumor Micro-environment Directed Combinatorial Therapies Using Multi-modal Imaging

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Purpose or Case Report: The incidence of head and neck malignancies among children has increased substantially in the last five decades. The immunosuppressive tumor micro-environment (TME) represents a major roadblock in the treatment of head and neck tumors. We have demonstrated previously that an elevated level of myeloid derived suppressor cells (MDSC) in the tumor correlates directly with a poor prognosis, and that MDSC levels can be reduced using inhibitors of inducible nitric oxide synthase (iNOS). In this pre-clinical study, we utilized non-contrast magnetic resonance imaging (MRI) and nanoparticle contrast-enhanced computed tomography (CECT) to monitor tumor responses to TME-directed combinatorial therapies that included iNOS inhibition, immunomodulation, checkpoint inhibition, and radiation.
Methods & Materials: *In vivo* studies were performed in syngeneic mouse models of HPV- and HPV+ squamous cell carcinoma. Animals were treated with CRT (cyclophosphamide + fractionated radiation), an immune checkpoint inhibitor (anti-PD1), and TME modulating nitric oxide synthase (NOS) inhibitors. Non-contrast T2-weighted (T2w) MRI was performed for longitudinal monitoring of disease progression. High-resolution CT angiography and delayed CECT was performed using a blood-pool nanoparticle contrast agent to image tumor vasculature, vessel leakiness, tumor vessel cooption and distant metastatic spread. Treatment response was evaluated using RECIST criteria.
Results: Non-contrast MRI enabled quantitative 3D analysis of changes in primary tumor volume. Nanoparticle delivery of the broad spectrum NOS inhibitor L-NAME resulted in the best treatment outcome [29% complete response (CR), 57% partial response (PR), 0% stable disease (SD) and 14% progressive disease (PD)] compared to control treatments [0% CR, 64% PR, 7% SD and 29% PD] in HPV+ tumors. HPV+ tumors demonstrated better treatment outcomes compared to HPV- tumors. Whole-body multi-modal imaging (MRI and CECT) enabled spatio-temporal quantitative analysis of metastatic disease progression to draining and distant lymph nodes. Metastatic spread to lungs and abdominal region was also observed.
Conclusions: Our work highlights the utility of advanced imaging for *in vivo* whole-body longitudinal monitoring of treatment response to multimodal TME-directed therapies in pre-clinical testing. Nanoparticle delivered broad-spectrum NOS inhibition provides the best TME modulation treatment on a background of CRT + anti-PD1.

Paper #: 154

Non-invasive Imaging of Ferumoxytol Labeled Chimeric Antigen Receptor (CAR) T-cells Trafficking to Osteosarcoma

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Purpose or Case Report: Metastasized osteosarcoma has a poor prognosis with a two-year event free survival rate of 15-20%, highlighting the need for the advancement of efficacious therapeutics. Chimeric antigen receptor (CAR) T-cell therapy is emerging as a potent strategy for eliminating tumors by harnessing the immune system. Despite this, trials encounter challenges due to varied responses and failing therapy in patients. Development of translatable cell imaging methods would provide invaluable information regarding the biological fate of T-cells. This work aims to evaluate a new approach for CAR T-cell labeling with ferumoxytol, which enables non-invasive cell tracking with magnetic resonance imaging (MRI) and a new imaging technique, magnetic particle imaging (MPI).
Methods & Materials: *In vitro characterization:* We isolated human T-cells from donors, expressed the CAR gene and stimulated for expansion. A new microfluidics device was used to label T-cells with ferumoxytol nanoparticles (Feraheme) through cell volume exchange for connective transfer. The iron content of labeled T-cells and unlabeled controls was analyzed by prussian blue histology and inductively coupled plasma optical emission spectrometry. To determine the sensitivity, varying numbers (10^3-10^6) of labeled T-cells and controls were imaged using MRI or MPI. *In vivo imaging:* Labeled or unlabeled T-cells were intravenously administered in osteosarcoma bearing NOD SCID mice and animals were imaged using MRI and MPI. The MPI signal intensity and T2 relaxation times of different groups were compared using an analysis of variance (ANOVA) and a linear regression analysis.
Results: *In vitro characterization:* Retention of ferumoxytol was significantly ($p<0.01$) greater in labeled T-cells (0.39 ± 0.003 pg/cell) than controls (0.06 ± 0.006 pg/cell). 10^4 ferumoxytol labeled T-cells were visually detected using MPI and MRI. T2 relaxation times of labeled T-cells were significantly shorter compared to unlabeled for cell numbers $\geq 10^4$. The ferumoxytol MPI signal showed a linear correlation with the T-cell number. *In vivo imaging:* MPI demonstrated homing of T-cells to osteosarcoma in animals administered with labeled T-cells, whilst T-cells were not visualized in animals infused with unlabeled cells.
Conclusions: This study demonstrates the first successful labeling of CAR T-cells with ferumoxytol. The labeled cells could be detected *in vitro* and *in vivo,* using MRI and MPI, thereby paving the way for *in vivo* monitoring of CAR T cell trafficking to osteosarcomas.

Paper #: 155

Noninvasive Tracking of Disease Progression in TH-MYCN Mouse Models of Neuroblastoma Using Multi-modal Imaging

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Purpose or Case Report: Neuroblastoma (NB) is the most common non-cranial solid tumor in childhood. The MYCN oncogene plays a crucial role in tumorigenesis and angiogenesis in NB and is a strong indicator of poor prognosis. The tyrosine hydroxylase (TH)-MYCN transgenic mouse model of NB is extensively utilized; however, little is known about disease progression in this model. In this work, we use multi-modal imaging to study tumor progression and vascular architecture in TH-MYCN transgenic, allograft, and syngeneic mouse models of NB.
Methods & Materials: Longitudinal *in vivo* studies were performed in TH-MYCN transgenic, allograft, and syngeneic mice (n=9 each). Tumors harvested from TH-MYCN transgenic mice were surgically implanted in the left renal capsule in nude mice (NCr) and wild-type littermates of TH-MYCN mice to generate allograft and syngeneic tumors, respectively. Disease progression was studied using T2w-MRI in transgenic (2-7 weeks of age) and allograft and syngeneic mice (weeks 2- 5 post tumor implantation). High resolution CT angiograms (CTA) were captured to image tumor vascular architecture and estimate tumor fractional blood volume (FBV). Histopathology was performed to compare tumor morphology and microvessel density among NB models.
Results: Tumors in TH-MYCN mice became evident in the dorsal retroperitoneal region at week 4 (~ 1.5 mm diameter) and grew rapidly between weeks 4-7 [10 mm^3 – 1160 mm^3]. TH-MYCN mice also demonstrated a delayed paraspinal growth along thoracic vertebrae visible at week 5. In contrast, allograft and syngeneic mice demonstrated tumor growth restricted to the peritoneal cavity [allograft: 40 mm^3 -2420 mm^3 ; syngeneic: 20 mm^3 – 1730 mm^3]. CTA demonstrated TH-MYCN tumors developed a microvascular network with large, superficial blood vessels and tumor FBV of 0.12 ± 0.04. Tumors in allograft and syngeneic mice exhibited similar vasculature patterns to transgenic mice [allograft FBV: 0.14 ± 0.02; syngeneic FBV: 0.12 ± 0.03]. Histological analysis demonstrated similarity in tumor architecture and microvessel density between TH-MYCN and implanted tumors.
Conclusions: The TH-MYCN transgenic NB model demonstrated aggressive disease progression originating in the retroperitoneal cavity and a delayed growth along the paraspinal thoracic tract. In comparison, allograft and syngeneic renally-implanted models demonstrated single-mass tumor growth in the peritoneal cavity. Other than the secondary findings, TH-MYCN and implanted models demonstrated similar vasculature and tumor morphology.

Paper #: 156

Prediction of the MYCN status in Neuroblastoma Using MR-based Radiomics

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Purpose or Case Report: Neuroblastoma is a clinically heterogeneous pediatric malignancy, varying in location, histopathologic appearance, and biologic characteristics. Genetics plays an important role in the prognosis. Amplification

of the MYC family member, MYCN, is found in 25% of cases and correlates with high-risk disease and poor prognosis. However, genetic information can only be obtained via surgery or biopsy with concurrent morbidity and sampling variability associated with biopsy. The ability to detect MYCN amplification from routine pre-operative imaging can stratify neuroblastoma risk groups and affect clinical decision making. The purpose of this study was to predict the patient's MYCN status based on radiomics analysis of the magnetic resonance imaging (MRI) characteristics in patients with neuroblastoma.
Methods & Materials: In this study, a cohort of 130 patients (72 females and 58 males) diagnosed with neuroblastoma from the Children's Hospital of Philadelphia was included and divided into two groups ("Train" and "Test") randomly in a 7:3 split. Of these, 27 were MYCN amplified and 103 were MYCN non-amplified. The average age of patients was 3 years and 8 months. Their pre-operative images were manually segmented using 3D Slicer software. An automatic machine learning Tree-Based Pipeline Optimization Tool (TPOT) was run on the dataset and tested on the "Test" group.
Results: The automatic TPOT exported pipeline[RandomForestClassifier(bootstrap = True, criterion = "entropy", max_features = 0.35000000000000003, min_samples_leaf = 15, min_samples_split = 12, n_estimators = 100)] based on the T2WI "Train" group (84 cases) achieved an accuracy of 75.7% (AUC = 0.78) in the T2WI "Test" group (37 cases) with 75.0% specificity and 80.0% sensitivity in predicting the presence of MYCN amplification. The accuracy of the prediction for T1C "Test" group (31 cases) based on T1C "Train" group (70 cases) was 87.1% (AUC = 0.78) with 89.3% specificity and 66.7% sensitivity. Finally, the images of T1C and T2WI were combined and divided into "Train" (70 cases) and "Test" (30 cases) groups, on which the accuracy of the prediction for "Test" group was 76.7% (AUC = 0.76) with 76.9% specificity and 75.0% sensitivity.
Conclusions: MRI radiomics can predict the MYCN status of neuroblastoma with good accuracy, which assist oncologists stratifying neuroblastoma risk groups and guiding clinical decision making.

Paper #: 157

Radiogenomics of Neuroblastoma: Quantitative MRI and Genetic Data Analysis

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Purpose or Case Report: Radiogenomics refers to the correlation of imaging and genomic data of tumors in cancer patients. This study attempts to make correlations between biomarkers in NGS Comprehensive Solid Tumor Panel reports and MRI imaging findings in neuroblastoma patients.
Methods & Materials: Patients aged 0-7 yrs who had NGS Solid Tumor Panel testing and desired imaging sequences were compiled into a database (N=25). Primary tumor data from axial fluid sensitive sequences; T2 fse fat sat (23), Haste (1), and STIR (1) from PACS were processed using the tumor segmentation feature in the pMRI software package. Tumors were segmented by hand and segmentation was guided/approved by a radiologist with 20+ years of experience. Volume and signal intensity values were collected using pMRI. Signal intensity/heterogeneity is defined by standard deviation, kurtosis, or skew. Genetic data were collected from Solid Tumor Panel reports in EPIC.
Results: 48% (n=12) of patients were male and 52% (n=13) were female. Tumor volumes (V) ranged from 2.85-521.97 cm^3. Mean age was 2.6 yrs. Independent samples T tests and two-way ANOVAs were run to correlate statistically significant findings.Analyses showed 2p addition tumors were larger than those without: Yes; n=7, volume=333.86 cm^3. No; n=18, volume=83.42 cm^3, p=.009. 11q deletion tumors were larger than those without: Yes; n=5, V=305.26 cm^3. No; n=20, V=115.625 cm^3, p=.017.11q deletion + 2p addition (n=3) tumors were larger than 2p addition but no 11q deletion tumors (n=4). ηp^2=.29. $F(1, 21)$=8.792, p=.007.MYCN amplification indicated larger tumors: Yes; n=6, V=307.5 cm^3. No; n=19, V=104.9 cm^3, p=.046. 1p deletions indicated larger tumors: Yes; n=6, V=203.005 cm^3. No; n=19, V=103.67 cm^3, p=.001.1p deletion but no MYCN amplification (n=1) indicated larger tumors than having neither mutation (n=18). MYCN amplification but no 1p deletion (n=5) indicated larger tumors than having neither (n=18). ηp^2=.25. $F(1,21)$=6.99, p=.015.Heterogeneity, kurtosis, and skew of signal intensity did not meet significance.
Conclusions: Tumor volume is significant in poor prognosis genes. Collecting/analyzing these data provides detailed tumor profiles and useful information for targeted therapy development. Correlating imaging findings and genetics provides less invasive analyses and prognosis indicators. Other trends were noticed but did not meet significance. With a larger dataset, these could be proven and clinically applied. This is a future goal of this study.

Paper #: 158

Significance of New Hemispheric Hypometabolism on PET-CT Following Single Stage Complete Corpus Callosotomy

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Purpose or Case Report: Single stage corpus callosotomy is a surgery utilized in patients with intractable epilepsy that prevents the spread of seizure impulses to the contralateral hemisphere. This study aimed to evaluate post corpus callosotomy findings on fluorodeoxyglucose (FDG) positron emission tomography (PET)-computed tomography (CT), specifically a finding noted in which a cerebral hemisphere demonstrated new (compared to baseline PET-CT) hypometabolism without corresponding magnetic resonance imaging (MRI) lesion. Our aim was to determine if this finding had clinical relevance in predicting post procedure seizure rates.
Methods & Materials: A retrospective chart review was completed including 17 patients at our institution who had corpus callosotomy with both pre and post-surgical PET-CT. The medical records were reviewed for pre and post-operative seizure symptoms, in addition to findings on electroencephalogram (EEG), MRI, PET-CT, and single-photon-emission CT (SPECT). Surgical outcomes were evaluated using an institutionally implemented seizure reduction classification scale. Additionally, criteria from the International League Against Epilepsy (ILAE) classification system for epilepsy surgery outcomes were utilized for assessment.
Results: Of the initial seventeen patients undergoing corpus callosotomy, 6 (35%) demonstrated new diffuse hemispheric hypometabolism on PET-CT without associated MR lesion. Of the 6 patients with hemispheric hypometabolism, 1 was lost to follow-up. All (100%) of the remaining 5 had greater than 90% seizure reduction. Of the 9 patients without hemispheric

hypometabolism, 4 (44%) showed greater than 90% seizure reduction. Three out of 5 with hemispheric hypometabolism (60%) were categorized as ILAE class 1 (i.e. completely seizure free). Two out of 9 without cerebral hypometabolism (22%) were categorized as ILAE class 1.
Conclusions: New diffuse hemispheric hypometabolism is frequently seen on PET-CT after corpus callosotomy. In our review, this finding is associated with a higher likelihood of having greater than 90% seizure reduction rate and a higher rate of seizure free status as compared to patients without diffuse cerebral hemispheric hypometabolism. Further studies are needed given the low number of patients in this cohort.

Paper #: 159

Accuracy of Cervical Spine CT for Detection of Craniocervical Junction Ligamentous Injury

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Purpose or Case Report: Cervical spine trauma, particularly at the craniocervical junction, can produce significant morbidity and mortality in the pediatric population. Although normative pediatric cervical spine CT measurements have been reported, the accuracy of these measurements for predicting ligamentous injury remains unknown. The purpose of this study is to evaluate the sensitivity and specificity of normative pediatric CT measurements for prediction of traumatic ligamentous injury at the craniocervical junction, using MRI as gold standard.
Methods & Materials: Following IRB approval, a retrospective review of 64 pediatric (age <=21 years) trauma patients who underwent cervical spine CT and gold standard cervical spine MRI was performed. Craniocervical junction measurements were obtained from the CT cervical spine including: basion-dens interval (BDI), anterior atlanto-dental interval (AADI), lateral atlanto-dental interval (LADI), prevertebral thickness at C2, atlanto-occipital interval (AOI), lateral atlantoaxial interval (LAAI), and Powers ratio. Cervical spine MRIs were retrospectively reviewed to identify ligamentous injury to the craniocervical junction. Thresholds for normal and abnormal CT measurements were established from normative pediatric cervical spine CT measurements and compared to the MRI cervical spine to determine the sensitivity and specificity of individual measurements, any single abnormal measurement, and combinations of abnormal measurements for detection of ligamentous injury.
Results: Sensitivity and specificity of individual measurements were as follows: BDI 0.28/1.0, AADI 0.44/0.58, LADI 0.17/0.77, prevertebral thickness 0.28/0.7, AOI 0.67/0.81, LAAI 0.86/0.31, Powers ratio 0.22/0.98. Sensitivity and specificity of one or more of the described measurements being abnormal is 1/0.12, two or more 0.94/0.19, three or more 0.89/0.42, four or more 0.72/07, five or more 0.67/0.84, six or more 0.33/0.93 and seven or more 0.28/0.95.
Conclusions: Sensitivity and specificity of CT criteria for prediction of traumatic ligamentous injury at the craniocervical junction are generally nonspecific in isolation but improve in validity when five or more criteria are met as abnormal.

Paper #: 160

Apparent Diffusion Coefficient Histogram Radiomic Metrics for Classification of Intraventricular Pediatric Brain Tumors

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Purpose or Case Report: Accurate preoperative imaging diagnosis of supratentorial pediatric intraventricular tumors is not always straightforward. Conventional MRI features such as T1- and T2-weighted signal and contrast enhancement may overlap among various choroid plexus tumors and embryonal tumors. This study aimed to perform apparent diffusion coefficient (ADC) histogram analysis, assessing various metrics in different intraventricular for histological classification.
Methods & Materials: Twenty-three intraventricular pediatric tumors were retrospectively evaluated. There were 12 choroid plexus papillomas (CPP), six choroid plexus carcinomas (CPC), three ATRTs, one PNET, and one medulloepithelioma. The ATRT, PNET, and medulloepithelioma cases were bundled in a single group of embryonal tumors according to the 2016 WHO classification of brain tumors. All tumors were investigated by MRI by using diffusion-weighted imaging. All tumors were manually segmented using an in-house developed parametric (pMRI) software and diffusivity metrics were automatically calculated on a pixel-by-pixel basis. Only the solid components of the lesions were included in the analysis. The following first-order histogram radiomic metrics were calculated: mean ADC_{mean}, $ADC_{Kurtosis}$, $ADC_{skewness}$, $ADC_{Variance,}$ and Shannon index of entropy. Differences in the whole tumor metrics were assessed using the Kruskal-Wallis test with post hoc comparison.
Results: There were significant differences in ADC_{mean} (1744±101 vs 1215±136 vs 971±150 10-3mm/s^2, $p<0.002$) $ADC_{Kurtosis}$ (1.01±0.54 vs 2.191±0.739 vs 4.635±0.809, $p<0.022$) among choroid plexus papilloma, choroid plexus carcinoma, and intraventricular embryonal tumors, respectively. In *post hoc* analysis, the ADC_{mean} of CPP was significantly higher than CPC and embryonal tumors, and on the other hand, the $ADC_{kurtosis}$ of embryonal tumors was significantly higher from both types of choroid plexus tumors.
Conclusions: Embryonal tumors had significantly lower ADC_{mean} values as compared with choroid plexus tumors. CPC had significantly lower ADC_{mean} values as compared with CPP. ADC histograms of embryonal tumors were significantly more leptokurtic than choroid plexus tumors. ADC histograms of CPPs were significantly more platykurtic than CPPs. ADC_{mean} of the whole tumor and the shape of the ADC histograms may be useful metrics for the preoperative histological diagnosis of pediatric supratentorial tumors.

Paper #: 161

Quantitative Evaluation of the Brain Echogenicity in Hypoxic-ischemic Encephalopathy Compared with Controls

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Purpose or Case Report: Ultrasound (US) is a powerful imaging tool in the evaluation of neonates with suspected hypoxic-ischemic encephalopathy (HIE). US evaluation of the neonatal brain has been mainly performed qualitatively, comparing intracranial structures with different echotextures. Qualitative US analysis of the neonatal HIE brain may vary according to technical variations, the severity of the injury and the presence of coexistent complications. Quantitative analysis of the neonatal brain echotexture has been seldom attempted. Our aim was to compare the echotextures of specific brain regions between HIE patients and controls.

Methods & Materials: Brain ultrasound of twenty term neonates with HIE with abnormal MRI findings and twenty term neonates with no clinical or MRI evidence of HIE were retrospectively evaluated. US imaging obtained in the coronal plane with slow anterior to posterior swipe technique was post-processed by an in-house parametric software. The six brain regions evaluated were the anterior, intermediate and posterior white matter (WM), the basal ganglia (BG), thalami and the perirolandic subcortical WM. One circular region of interest (ROI) was placed in each given brain region in both hemispheres. The sum of pixels of the two ROIs ranged between 2000 and 2050 pixels. The echotexture measurements were normalized to the echotexture of the choroid plexus (CP) in each given individual. The CP in the atria of the lateral ventricle (CP glomus) was chosen for normalization with circular ROIs. The number of ROIs of the CP also ranged from 2000 to 2050 pixels. Permutation test was used to compare differences in means between HIE patients and normal controls.

Results: The normalized echotexture of the brain regions in HIE patients vs control individuals were: anterior WM (0.76 vs 0.59, $p<0.001$), intermediate WM (0.75 vs 0.60, $p=0.02$), posterior WM (0.68 vs 0.54, $p<0.001$), BG (0.65 vs 0.53, $p=0.006$), thalami (0.78, vs 0.61 $p<0.001$) and perirolandic subcortical WM (0.77 vs 0.54, $p<0.001$).

Conclusions: Quantification of brain echotexture is a feasible method to differentiate HIE from control neonates in cases equivocal for qualitative diagnosis. Further work can also reveal whether a quantitative approach can also discern varying types and severity of HIE.

Paper #: 162

Quantitative Proton Magnetic Resonance Spectroscopy in Primary Mitochondrial Disorders

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Purpose or Case Report: Proton MRS (1H-MRS) is a technique to non-invasively study brain metabolites in vivo. 1H-MRS has been shown to detect abnormal brain accumulation of lactate in primary mitochondrial disorders (PMDs). However, differences in lactate concentration among the different PMDs have not been explored. We aimed to explore differences in quantitative 1H-MRS derived metabolite concentrations, particularly of lactate, and their ratios, in PMDs. We analyzed quantitative 1H-MRS data of the brain in pediatric patients with different types of genetically confirmed PMDs to evaluate differences in metabolite concentration and ratios.

Methods & Materials: Forty-six PMDs patients were evaluated with quantitative 1H-MRS using LCModel. Thirty-two patients were scanned in a 3T (TR/TE, 1700/20ms with 192 averages) and fourteen in a 1.5T scanner (TR/TE, 1500/20ms with 256 averages). Single voxel 1H-MRS spectra were obtained from the right basal ganglia of all the patients. According to the type of DNA mutation, there were twenty-six patients with nuclear (nDNA) and twenty with mitochondrial DNA (mtDNA) mutations. According to phenotypes, there were fifteen patients with Leigh syndrome (LS), seven patients with POLG related disorders (POLGRD), and five patients with mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS). The rest of the patients had Cockayne, Pearson, Kearns-Sayre syndrome, complex IV deficiency, COQ4, CPEO-plus, pyruvate deficiency, MT-ATP6, SCA28, MPV17 or LHON. The remaining eight patients had no defined specific phenotype. For group comparison, t-tests and Wilcoxon rank-sum tests were applied.

Results: There was no statistically significant difference between lactate concentrations, lactate ratios, or other metabolite concentrations in PMDs with mtDNA compared to those with nDNA mutations (1.67 ± 0.24 vs 1.155 ± 0.205, $p=0.132$). There was a statistically significant difference between lactate concentrations in LS vs POLGRDs (1.776 ± 0.25 vs 0.97 ± 0.353, $p<0.039$). The lactate/Creatine ratio was higher in LS than the others combined ($p<0.045$), which may be explained by a significant lower creatine concentration in LS (3.542 ± 0.259 vs 4.267 ± 0.186, $p<0.029$). Myo-Inositol/Creatine ratio was also higher in LS (0.52 ± 0.074 vs 0.325 ± 0.053, $p<0.03$).

Conclusions: Lactate/Creatine and Myo-Inositol/Creatine ratios were significantly higher in LS patients than other PMDs combined, along with lower creatine. LS patients also had significantly higher lactate concentration compared to POLGRDs patients.

Paper #: 163 - *Withdrawn*

Paper #: 164

Differentiating Pediatric Multiple Sclerosis from ADEM at Initial Presentation on MR Imaging

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Purpose or Case Report: Pediatric multiple sclerosis (MS) is difficult to diagnose at presentation, and the clinical features often overlap those of acute disseminated encephalomyelitis (ADEM), neuromyelitis optica or clinically isolated syndrome. Established criteria for diagnosing MS are less reliable in pre-pubescent children. We seek to qualitatively and quantitatively define the MRI features of pediatric MS compared to ADEM at initial presentation.

Methods & Materials: A retrospective analysis of MRI scans obtained at first attack from 23 children diagnosed with MS and 15 children with ADEM was performed. T2/FLAIR

hyperintense lesions were quantified and categorized according to location and size: distribution (periventricular, juxtacortical, scattered cerebral, scattered, brainstem) and size (S <1 x 1.5 cm; M < 2 x 2.5 cm and L > 2.5 cm.) The largest lesion was diametrically and volumetrically evaluated (Olea Sphere, Olea Medical, La Ciotat, France.) T1W post-contrast images were evaluated for different enhancement patterns: hetero/homogeneous, complete ring, incomplete ring. The presence/absence of "central vein sign" on GRE/SWI images was evaluated.
Results: The median age of the MS patients was 15 years (F: 16, M: 7) and the median age for ADEM patients was 4.5 years (F:8, M:7), with a p value of 0.0. The MS patients had a larger total number of lesions (p = .006), smaller lesion size (p = .002) and more often a periventricular distribution of lesions (p = 0.04) compared to ADEM. The MS lesions showed enhancement more often than ADEM lesions (p = 0.012), however the central veins sign did now show statistical significance, although encountered more often in MS patients (30% vs 13%). No statistical significance was demonstrated between the axial diameter measurements or volumetric quantification of the largest lesion in each group. Comparisons between total lesion volume counts are pending.
Conclusions: Our study suggests that a pediatric patient presenting with neurological symptoms and cerebral white matter lesions is more likely to be diagnosed with MS if it is an older child, there are a large number of lesions, majority of the lesions are less than 1cm, are mainly periventricular in location, and many display contrast enhancement. Conversely, a patient is more likely to be diagnosed with ADEM if it is a younger child, there are overall a smaller number of lesions, many of the lesions are larger than 1cm, are not primarily periventricular and don't exhibit contrast enhancement.

Paper #: 165

Dual Energy CT with Automated Bone Removal For Detection of Acute Intracranial Hemorrhage in Pediatrics

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Purpose or Case Report: Head trauma is a significant cause of morbidity and mortality in pediatrics. Non-contrast Head CT is the accepted gold standard imaging study to evaluate for suspected acute intracranial hemorrhage (ICH), however small acute extra-axial hemorrhage may be easily missed due to size and similar density to the bony calvarium. In Dual Energy CT (DECT), materials within the body such as bone/calcium and hemorrhage can be more easily discriminated based on differential attenuation at high and low peak voltage image acquisitions. This allows for advanced post-processing including automated bone removal which has been shown to improved visualization of acute ICH in the adult radiology literature, but has not yet been described in pediatrics. We report a retrospective review of DECT with automated bone removal for detection of acute ICH in the pediatric population.
Methods & Materials: Non-contrast head CTs ordered for "trauma" from the ED between 8/1/2018-8/1/2019 performed with DECT technique with final interpretation of "positive intracranial hemorrhage" were identified from the radiology information system (RIS). All CT exams were performed on a dual-source dual energy CT scanner (SOMATOM Force; Siemens Healthcare). Images available for review in PACS by interpreting radiologists included original DE datasets (80kV and Sn150 kV), mixed data set at a simulated 120 kV, and automated bone removal reconstructions (Dual Energy Bone Removal Application on syngo.via VA30A, Siemens Healthcare). CT images and both preliminary and final interpretations were reviewed retrospectively.
Results: A total of 114 intracranial hemorrhages are included in our study including 10 epidural hematomas (9%), 65 subdural hematomas (57%), 28 subarachnoid hemorrhages (25%), and 11 "extra-axial hemorrhage NOS" (10%). Of these, 57% (65/114) occurred after hours and had a formally documented preliminary interpretation by a radiology trainee, either 2nd year radiology resident or fellow. Detection of epidural and subdural hemorrhages was improved on DECT with automated bone removal. Overall rate of trainee discrepancy was similar to that reported in prior literature; however rate of discrepancy for subdural and epidural hemorrhages was improved.
Conclusions: This retrospective review highlights utility of DECT with additional automated bone removal for increasing conspicuity and detection of acute ICH in the pediatric population. To the best of our knowledge, this is the first report of this application in pediatrics.

Paper #: 166

Expected Ranges of Metabolite Ratios on Multivoxel MRS at 3T MRI as a Function of Age, in Children With and Without Developmental Delay

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Purpose or Case Report: Isolated developmental delay (IDD) is commonly encountered in daily practice and the cause is frequently unknown. Conventional MR Imaging usually fails to reveal an abnormality.MR Spectroscopy (MRS) can assess variations in metabolite ratios and correlate this with abnormalities in brain structure such as disorders of myelination. However, the normal ranges of these metabolites is not well established in children and vary by age. We sought to use the data from multivoxel 3T MRS to characterize the metabolite ratios in different parts of the brain as a function of age in children with IDD vs age-matched controls.
Methods & Materials: All MRI with MRS done on 3T for children with IDD between Jan to Oct 2018 at a tertiary pediatric hospital were reviewed after excluding patients with prematurity, metabolic disorders, trauma, syndromes or genetic abnormalities. (n=103, mean age 79m, range 7 to 214m)MRI of age-matched controls with no delay who had MRI performed for other reasons and reported as normal were reviewed (n=52, mean age 83m, range 12 to 180m). There were a total of 39 pts <3 yr vs 116 >3 yr (98 M, 57 F).NAA/Cho, NAA/Cr, Cho/Cr ratios from basal ganglia and thalami for right and left sides were recorded. ANOVA was performed to test for statistically significant ($p<0.05$) differences in metabolite ratios between children with IDD and controls and between children younger and older than 3 years.
Results: There was no statistically significant difference in metabolite ratios between the two groups. The NAA/ Cr and NAA/ Cho ratios showed a significant increase with age. There was significant regional variation, with higher metabolite ratios containing NAA in the thalami than basal ganglia. Cho/Cr ratios across all ages and locations had average values 1.08-1.23, and 95% CI upper bound 1.30-1.52. This did not vary significantly by age or between normal/dev delay. During this period MRS

identified three patients with creatine deficiency.
Conclusions: Metabolite ratios at 3T multivoxel brain MR spectroscopy of children show typical changes, primarily an increase in NAA, with increasing age, in keeping with progressive brain maturation.Cho/Cr ratios up to 1.5 were normal, unaffected by age or presence of developmental delay. The developmental delay cohort had MRS profiles nearly indistinguishable from normal subjects of the same age. Overall, brain MR spectroscopy findings in young children should be interpreted cautiously, with an awareness of age-related normal variation.

Paper #: 167

Imaging Phenotype of Primary Mitochondrial Disorders in Neonates

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Purpose or Case Report: Primary mitochondrial disorders (PMD) in newborns can be misdiagnosed as hypoxic-ischemic encephalopathy (HIE), clinically and radiologically. The purpose of this study is to describe the frequency and patterns of brain MRI findings in children with PMD diagnosed during the neonatal period.
Methods & Materials: In this retrospective IRB approved study, the MRI database was queried for subjects with PMD from 2000 to 2018. Patients with the genetic diagnosis of PMD before 30 days of life and available brain MRI were included. DNA etiology distribution (mitochondrial or nuclear), specific gene mutation, and patterns of MRI findings were described.
Results: Fourteen (11.8%) patients were included with a median age at MRI of 56 days (IQR 9-518) (8 males). Thirteen (93%) subjects had nuclear gene etiology, including three *FBXL4*, two *TRMU*, one *SLC25A46*, one *SLC25A3*, one *FARS2*, one *LPIN1*, two *MRPL3*, and two RRM2B. The only one newborn with mitochondrial etiology was a single large-scale deletion, clinically classifiable as Pearson syndrome. Two cases were diagnosed as Leigh Syndrome, the remaining 11(78.6%) were not phenotypically classifiable. Seven subjects (50%) died (median 101 days;IQR 52-183). Ten newborns had MR spectroscopy, all showing an abnormal lactate peak and in four cases this was the only MRI finding. The most common location of lesions was the deep white matter (n=6,42.9%). White matter cavitation was noted in two subjects, both with periventricular distribution and associated with hemorrhagic component. Hemorrhagic foci were also noted with periventricular distribution in another patient. Another common finding was involvement of the cerebellar dentate nuclei in 5 (35.7%), and ventriculomegaly in 4 subjects (28.6%). Basal ganglia and brainstem lesions were noted in 2 (14.3%) and 3 cases (21,4%), respectively. One subject, *FARS2* mutation, had imaging findings consistent with stroke-like lesions compromising both occipitoparietal lobes, and the splenium of the corpus callosum, mimicking/overlapping findings of neonatal hypoglycemia.
Conclusions: Disease onset of PMD is not uncommon in newborns. Of note, these subjects have demonstrated a high frequency of nuclear gene mutation, rather than mitochondrial DNA. Lactate peak on spectroscopy can be the only imaging abnormality. White matter lesion was the most frequent finding, commonly associated with hemorrhage and cavitation. Basal ganglia and brainstem involvement, commonly observed in other PMD age groups and HIE patients, were uncommon.

Paper #: 168

Increasing the Use of Ultrasound in the Diagnosis of Appendicitis in Children in a Community Hospital Emergency Department

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Purpose or Case Report: General Emergency Departments (ED) continue to have a high usage of CT for the diagnosis of appendicitis in children. Purpose of this project was to see if an interdisciplinary approach in a small community ED could increase the usage of US for the evaluation of appendicitis in children.
Methods & Materials: A community hospital only using CT to assess for pediatric appendicitis brought pediatrics,ED, radiology, surgery together to work on ways to increase US usage. The initial intervention included webinar sessions by a pediatric radiologist situated 3 hours away to teach technique and guide protocol planning and interpretations. A protocol to first order US, with CT to follow as needed was implemented. A second intervention provided 24 hour/ 7 day US coverage. Chart review of children 2-17 years of age evaluated for appendicitis prior and after each intervention was performed . Data - date, age, weight, US result, CT result, path report, disposition and return to ED within 7 days with appendicitis.
Results: 470 children met study criteria, 72 preintervention and 398 postintervention (1st intervention following training/ protocol initiation, 2nd intervention following 24/7 US availability) . CT utilization decreased from 97% to 55% (P<0.001). US increased 7% to 73% (P<0.001). Offering 24/7 US had the greatest affect: group 1, n=72 (preintervention), group 2, n=61 (post 1st intervention before 24/7 US availability) and group 3, n=337 (post 2nd intervention after 24/7 US availability). US increased from 7%-group 1, to 38%-group 2, to 79%-group 3. The proportions b/w group 1 & 2, b/w group 1 & 3 and b/w group 2 & 3 were statistically different (p<0.001). CT decreased from 97% group 1; to 85% group 2; to 50% group 3. Proportions b/w group 1 & 2 were not stat diff (p value 0.15) but proportions b/w group 1 & 3 and groups 2 & 3 were stat diff (p<0.001). Negative appendectomy rate before interventions 0% ; after interventions 3% - missed appendicitis before interventions 0%; after interventions 0.3% not statistically significant.
Conclusions: Utilization of US for pediatric assessment of appendicitis in a community hospital was significantly increased following interventions including webinar training by a pediatric radiologist, interdisciplinary buy in to implement a 2-tier imaging approach and most critically 24/7 US availability. This led to a significant decrease in ED use of CT scans in children.

Paper #: 169

Effectiveness of a New Curriculum Designed to Teach Residents and Fellows the use of Ultrasound in the Diagnosis of Midgut Volvulus

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Purpose or Case Report: Midgut volvulus (MV) is a surgical emergency conventionally diagnosed with fluoroscopy. Ultrasonography (US) is an alternate method to expedite diagnosis when a radiologist is not on-site, but can be limited by interpreter and sonographer familiarity with the key findings needed to make the diagnosis. The primary objective of this study was to see if a newly-designed curriculum improved trainee knowledge of US for midgut volvulus.
Methods & Materials: Study was HIPAA compliant and IRB exempt. Curriculum consisted of a self-directed online PowerPoint presentation and an in-person session where midgut volvulus US technique was demonstrated and the self-directed didactic presentation was discussed in small groups. All local radiology residents and pediatric radiology fellows were invited to participate. Participation was optional, but participants were asked to complete pre and post tests. Both on-line tests have 7 questions to assess knowledge, 3 unknown cases (cine clips, one each of MV, normal, and malrotation), and 2 self-graded comfort with US questions. The posttest has 2 added questions of the trainees' perceived usefulness of the training. The change in test scores was plotted for each trainee, and the Wilcoxon signed-rank test was used to compare test scores pre and post training. Training level of volunteers was summarized using frequency with percentage.
Results: 16 trainees completed all modules: PGY6 or 7 (n=4, 25%), PGY5 (n=2, 13%), PGY4 (n=3, 19%), PGY3 (n=2, 13%), PGY2 (n=5, 31%). 6 trainees completed only pre or post tests, and were not included in the analysis. There was an improvement in knowledge question scores following training (p<0.002): pre vs post median 7.0 vs 10.5, min 2.0 vs 6.0, max 12.0 vs 12.0. For both self-graded ability to interpret MV US (pre vs post median 5.5 vs 9.0, min 1.0 vs 5.0, max 10.0 vs 10.0) and how to troubleshoot MV US with the sonographer (pre vs post median 3.5 vs 8.0, min 1.0 vs 4.0, max 10.0 vs 10.0), there was improvement following training (p<0.001 for both). Trainees indicated the in-person training helped their understanding of MV (mean 9.1/10). Trainees did not agree that the self-directed module was good enough, and the hands-on session was unnecessary (mean 3.9/10).
Conclusions: The tested curriculum improved trainees' knowledge of US for midgut volvulus. Trainees found the in-person session helpful. Success in future educational efforts may be facilitated with in-person sonographic demonstrations and discussion of any self-directed module.

Paper #: 170

Implementation of a Software Solution to Balance Workload Responsibilities in an Academic Pediatric Radiology Department

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Purpose or Case Report: In our pediatric radiology department, radiographs (XR) are the shared responsibility of body radiologists, expected to be read in addition to daily modality-based or site-specific assignments. Due to concerns that the increasing XR volume was unevenly shared amongst colleagues, a software intervention was developed to improve weekday 7am-5pm workload balance by auto-distributing exams at 10-minute intervals during peak hours to rotation worklists within PACS; a cap of 20 distributed exams to each target worklist was set. Metrics to evaluate the intervention's effectiveness were assessed. Additionally, as there was concern that assigning exams may result in slower turnaround times (TATs) and increased errors, TATs and error rates were evaluated.
Methods & Materials: This study was HIPAA compliant and exempt from IRB approval. Data were retrieved from the electronic health record, scheduling software, and peer learning database. Daily mean XR volume was determined. Data from 12 months pre and 6 months post intervention on weekdays were compared, metrics included: number of studies read by each radiologist on target rotations, variance of daily XR count per target rotation, frequencies of reading 5 or fewer XR exams on target rotations, daily median TATs and variance, and frequency of errors. Levene's test for equality of variance was used to determine significance of variance differences. Fisher's exact test was used for frequency differences.
Results: Post intervention, the variance of the daily XR counts read on target rotations decreased by 33% (p<0.0001). Mean daily XR volume on target rotations increased by 9% (p=0.0063). Mean daily institutional XR volume increased by 6%. Following intervention, the percentage of days where a body radiologist read fewer than 5 XR decreased from 18.5% to 0.9% (p<0.0001). Mean of daily median XR TAT decreased by 11% from 31.1 min pre to 27.7 min post, with decreased variance of median daily TATs from 418.1 to 114.3 (p<0.0022). There was no statistically significant difference in error frequency reported in the peer learning database (2.65% pre, 2.62% post, p=1).
Conclusions: Utilizing a novel software intervention, there was improved workload balance with more equitable radiologist contribution and decreased variability. Despite increased volumes, there was an improvement in median daily TAT, with decreased variance. There was no effect on error frequency reported in the peer learning database.

Paper #: 171

Feedback Fridays: An Innovative Intervention to Structure Serial Resident Feedback and Assess Resident Interest in Subspecialty Training

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Purpose or Case Report: Demonstrate how the Pediatric Radiology Department at a single institution structures short-interval feedback to residents. Describe how the department collects short-interval feedback from residents regarding their experiences. Demonstrate resident responses to this pilot program of instituting standardized weekly feedback
Methods & Materials: At our academic institution, residents were traditionally evaluated at the end of the rotations online and with informal one-sided feedback from faculty to residents. A majority of the residents indicated that end-of-rotation feedback was insufficient to accurately assess growth during

their rotations and that there was no regular opportunity to give resident feedback about the rotation. In January 2019, our division piloted a program in which a designated faculty member collected feedback from other faculty who worked with the resident throughout the week.This "feedback faculty" member would then summarize the most salient points from collected data and have a face-to-face discussion with the resident every Friday afternoon.The residents were then given a weekly anonymized online form to evaluate the following: overall experience over the week, aspects of the rotation that they felt were valuable (ie: case mix, case volume, teaching experience, duty hours), change in interest in pursuing a pediatric radiology fellowship, and whether the resident would like more time in their training in pediatric radiology.
Results: To assess the effectiveness of this program for the residents we collected data from January 2019 to September 2019. Anonymized online surveys yielded 46 responses. Over 90% of the responses reported case variety and teaching experience as the most valuable areas of resident education. 50% reported an increase in the likelihood of pursuing a pediatric radiology fellowship following the week's experience. 80% reported a request for more allotted residency training to pediatric radiology. Using the resident feedback, the division was able to facilitate changes to the rotation in order to better meet the educational needs of the residents. Changes included working with the radiology residency program to increase pediatric radiology exposure and establishing a resident interest group with quarterly social events to continue fostering interest in pursuing pediatric radiology as a subspecialty.
Conclusions: Formalized feedback in the form of weekly "Feedback Fridays" is an effective tool in incorporating real-time responses into resident education.

Paper #: 172

Families' Perceptions on Communication and Patient Engagement in Pediatric Radiology: A Focus Group Study

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Purpose or Case Report: One of the pillars of the American College of Radiology initiative Imaging 3.0 is patient engagement. However, there are no specific guidelines into which interventions should be prioritize in order to maximize the benefits while acknowledging finite resources. We conducted this study to understand families' preferences for communication before, during, and after receiving pediatric radiology services.
Methods & Materials: A focus group study was conducted with families with prior visits to our department using a semi-structured moderator guided interview in order to understand their preferences and priorities in terms of: a) preparation for the study; b) communication during the study; and c) communication of results. The focus groups were audio recorded and transcribed. We employed direct content analysis to identify areas of improvement with regards to families experience with radiology services.
Results: 13 family members participated in 3 focus group discussions. Overall, families described their radiology experience positively. Participants described need for better education of imaging that is specific to their studies and curated/endorsed by the department, succinct pre-study instructions beyond a courtesy call, and improved knowledge on the options to receive results including immediate communication with the radiologist, patients' portal, and direct phone access to radiologist when questions about the results arise. If results are delivered in person, participants expressed a desire for more privacy and confidentiality in the waiting room setting.
Conclusions: While educational materials and communication avenues exist, most families are unaware of important details, therefore better dissemination strategies on the options for engagement with the radiology department are needed. In response to the families' preferences for increased communication, we plan to give priority to enhanced patient-specific material available online during appointment scheduling and to deploy a text based appointment reminder that incorporates imaging education and follow-up identification of radiologists associated with the reading.

Paper #: 173

Mommy, My Tummy Hurts: Ultrasound Diagnosis of Pediatric Gastrointestinal Emergencies - A Simulation Study

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Purpose or Case Report: The purpose of this study is to identify how well radiology residents are able to diagnose gastrointestinal emergencies on ultrasound using a simulated emergency radiology call shift.
Methods & Materials: The Wisdom in Diagnostic Imaging SIMulation (WIDI SIM) is a computer aided simulation of an emergency imaging shift that has been rigorously tested and proven to be a reliable means for assessing resident preparedness to competently cover radiology call.The residents are provided with a total of 65 cases of varying difficulty, across modalities, including normal studies which they interpret over 8 hours. The residents respond with free text, which is then scored using a robust grading rubric with a 10 -point scale. A score below a 5 equates to inability to diagnose a case. Over the past 6 years, the residents have been given pediatric ultrasound cases of hypertrophic pyloric stenosis (HPS), intussusception, acute appendicitis and portovenous gas.
Results: Over 1000 residents have participated in the SIM program since its inception in 2014. Resident participants include all years of radiology residency.Ultrasound is the preferred imaging modality for evaluation of acute abdominal pain in the pediatric emergency room (ER). Commonly seen diagnoses include acute appendicitis, HPS, and intussusception. Portovenous gas on ultrasound, although a critical diagnosis is less often seen, but must be recognized by the on-call radiology resident.Given the frequency of evaluation for appendicitis requested from the pediatric ER this concept was tested twice. A total of 383 resident test-takers were given a case of acute appendicitis on ultrasound. Almost 40% of resident test-taker underperformed with scores below 5. Only 17% of resident test-takers from a total of 201 residents underperformed in their interpretation of hypertrophic pyloric stenosis. Intussusception was also tested on this cohort of 201 resident test-takers with 14% unable to diagnose. Finally, the most difficult case – of portovenous gas was given to 351 resident-test takers of which 27% were able to recognize and elicit a work up for mesenteric ischemia.
Conclusions: Ultrasound diagnosis of pediatric gastrointestinal emergencies is of the upmost importance for the overnight

radiology resident. 40% of radiology residents failed to diagnose acute appendicitis on ultrasound. This raises a concern for the potential of children coming to the ER overnight to be exposed to unnecessary radiation as computed tomography is often the next-step in diagnosis.

Paper #: 174

A Needs Assessment of Pediatric Neuroradiology Training: Survey of Practicing Pediatric Radiologists

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Purpose or Case Report: Both neuroradiologists and pediatric radiologists require unique skills to confidently manage pediatric neuroradiology cases either in a community setting, or in a specialized pediatric tertiary care hospital. We conducted a needs assessment of pediatric radiologists to define their neuroradiology subspecialty training experience and identify perceived skills and knowledge gaps as well as their attitudes toward a customized pediatric neuroradiology curriculum.
Methods & Materials: A comprehensive anonymous needs assessment survey was developed and distributed electronically in July 2019 to 175 SPR members who were current fellows or recent graduates from programs from 2014 to 2019. Members were given approximately 1.5 months to respond and two reminders were electronically delivered prior to survey closing. Eight questions addressed demographics, percent time interpreting neuroradiology and value of training in preparing them for neuroradiology practice. A qualitative description included percentages for both categorical and continuous variables.
Results: 57 pediatric radiologists (1 fellow and 56 attendings) responded to the survey (33%). Sixty-three percent were fellowship trained only in general pediatrics, and 16% were trained in both peds and neuroradiology. Seventy-five percent performed some pediatric neuroradiology. For all practice types, 22% spent greater than 50% of their time reporting pediatric neuroradiology studies. During residency, the majority (71.4%) reported 4 weeks or less of pediatric neuroimaging, whereas 21.4% reported >10 weeks. During fellowship 30.4% reported 4 weeks or less while 32% reported >10 weeks training. Respondents reported adequate training in general image interpretation including emergency pediatric neuroimaging (75%), pediatric neuropathology on CT (73%), and imaging specifically related to nonaccidental trauma in pediatric neuroimaging (68%). Fifty percent or greater reported limited or no instruction in 5 areas of image interpretation (fetal, ENT, oncology, embryology, spectroscopy); 4 technical skills (image quality, reducing imaging time, choice of contrast agents, sedation) and understanding clinical management pathways.
Conclusions: Most pediatric radiologists will need interpretation and technical skills in pediatric neuroimaging. Training programs vary widely in the dedicated time and content offered in pediatric neuroimaging rotations. A standardized pediatric neuroradiology fellowship curriculum is warranted to fully prepare graduates for practice.

Paper #: 175

Geographic and Income Disparities in Pediatric Utilization of Advanced Imaging

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Purpose or Case Report: To analyze regional disparities in imaging utilization over an 8-year period in one of the largest pediatric Accountable Care Organizations (ACO) in the US covering over 300,000 children.
Methods & Materials: Claims data for each year from 2010-2017 were reviewed to obtain MRI, CT, and US utilization from emergency department (ED) and outpatient (OP) encounters. The county name for each child's residency was recorded, and the total number of children covered in each county was obtained. Median family income and for these counties were obtained from 2010 US Census. Utilization rate (UR, defined as number of advanced imaging procedures per 100 enrolled children per year) was calculated for each county. Linear trend analysis were undertaken using Pearson's correlation.
Results: Children from 34 different counties presented for a total of 95,326 ED procedures and 154,255 OP procedures over the 8-year period. Through the ED, there was significant differences in UR across counties, with median global UR of 3.8 (min= 2.1; max=6.1), median UR for CT of 3.1 (min=1.0; max=4.8), median UR for US of 0.8 (min=0.4; max=1.6), and median UR for MRI of 0.04 (min=0.02; max=0.09). Comparing median family income to UR in the ED, there was a moderate negative correlation for global usage (Pearson's r=-0.4) and CT usage (r=-0.54). US usage in the ED had a marginal positive correlation with increasing family income (r=0.29). In the OP setting, significant differences in UR were again noticed across counties, with median global UR noted as 5.8 (min= 4.0; max=8.0), median UR for CT of 1.1 (min=0.6, max=2.1), median UR for US of 3.0 (min=2.3, max=4.0), and median UR for MRI of 1.6 (min=1.1; max = 2.0). Comparing median family income to UR in the OP setting, there was a moderate negative correlation for all usages: global usage (Pearson's r=-0.47), CT usage (r=-0.44), US usage (r=-0.32), and MRI usage (r=-0.50).
Conclusions: This is one of the few studies examining geographic disparities in pediatric imaging utilization. There is significant variation in utilization by patients from 34 counties with more pronounced difference in the ED vs. OP setting. In addition, there is a moderate negative correlation between advanced imaging utilization and median family income of the county. Knowing regional disparities in pediatric imaging utilization may help explain some differences in health outcomes for disease-specific pathways and help develop targeted interventions and allocate future resources appropriately.

Paper #: 176

Utilization of a Critical Alert System at a Tertiary Care Children's Hospital

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Purpose or Case Report: Critical alert systems have been implemented to assist radiologists in contacting clinicians and documenting critical findings on imaging. These systems serve as a safety net for patients, facilitating timely, accurate communication of findings. The purpose of this study was to review the critical findings sent through the messaging system at a children's hospital to determine utilization by radiologists and providers.
Methods & Materials: The usage of the critical alert system at a children's hospital from 2016 to 2019 was reviewed. When the severity of a finding was discordant with the institution's standard classification system, the author of the message was blinded and the discrepancy reviewed by the department quality and safety officer. Incidental findings and recommendations for further imaging in the alerts were also reviewed.
Results: 1,846 alerts were sent in regards to 1,777 critical findings in patients age 16 and younger. The most common exams were chest radiographs, followed by computed tomography (CT) of the head, and abdominal ultrasound (US). The severity of 16% of alerts was reclassified. Following reclassification, 30% of findings were yellow (compliance goal of 24 hours), 45% orange (compliance goal of 12 hours), and 25% red (compliance goal of 1 hour). The findings were communicated directly to providers in 83% of cases, with the automated messaging system used in 17% of cases.Overall, 51% of alerts were sent by residents and 49% by staff; however, a trend towards an increase in resident usage was noted, with 64% of alerts sent by residents in 2019. The most common department contacted was the emergency department, which received 45% of alerts, followed by the neonatal intensive care unit (ICU) and pediatric ICU. 5% of alerts were sent to outreach hospitals and clinics.Incidental findings were found on 7% of examinations. Recommendations for follow-up imaging was made in 23% of cases and specialty consultation was recommended in 3% of cases.
Conclusions: Utilization of the critical alert system was most common in critically-ill patients in the emergency department and ICU. The preferred method of communication is direct contact with providers with the alert system used to document and reinforce findings; however, the message system was needed to contact providers.While incidental findings are uncommon in the pediatric population, follow-up imaging is often recommended. Documentation of these recommendations through the alert system may facilitate follow-up.

Paper #: 177

Resident Familiarity with ACR Appropriateness Criteria for Pediatric Patients

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Purpose or Case Report: Familiarity with the American College of Radiology appropriateness criteria (ACR AC) is important to properly counsel clinicians and ensure patients receive optimal imaging evaluation. While clinicians have become increasingly aware of the ACR appropriateness criteria (AC), residents may not, often becoming involved in a case following the decision on what imaging study to perform. The purpose of this study was to assess resident knowledge of ACR AC regarding pediatric patients at a residency with training at a tertiary care children's hospital.
Methods & Materials: Residents at a single program were given a survey with clinical narratives from ACR AC pediatric topics. Residents were asked to name the single best imaging study they would recommend for a given clinical scenario. If multiple imaging studies were indicated, residents were asked to name the highest ranked imaging study. 15 clinical narratives from 15 pediatric topics were selected.
Results: A total of 24 residents were surveyed, representing the entirety of the residency excluding a co-author. The number of correct responses was similar across all years. On average, the R1, R3, and R4 class selected the correct imaging study for 8 of 15 narratives, and the R2 class 9 of 15 narratives. 100% of residents correctly selected noncontrast computed tomography (NCCT) of the sinuses for persistent sinusitis. 100% of residents chose NCCT or magnetic resonance imaging for subacute head injury, both rated usually appropriate per the head trauma ACR AC. The work-up of fever of unknown origin, appendicitis, and scoliosis was also frequently selected correctly: 83%, 88% and 100% respectively. Only 17% of residents chose radiographs (XR) for the initial imaging of acute cervical spine trauma with at least one risk factor and reliable clinical examination and for an acute limp with nonlocalized symptoms and no concern for infection. 21% of residents selected ultrasound as the first-line imaging modality for neonatal seizures.
Conclusions: Residents may not be familiar with certain ACR AC regarding pediatric patients, even in advanced years of residency. An effort to integrate education on the ACR AC into residencies should be made, as increasing resident exposure to the ACR AC can improve the ability of residents to advise providers in clinical decision making.

ALTERNATE PAPERS

Alt #: 001

Ultrasound Two-dimensional Shear Wave Elastography for Identifying Liver Fibrosis in Pediatric Patients: A Clinical Effectiveness Study

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Purpose or Case Report: Ultrasound shear wave elastography (US SWE) can be used to noninvasively measure liver stiffness. US SWE is a potentially useful technique for diagnosing and monitoring liver fibrosis, obviating the need for liver biopsy in some patients. When compared to MR elastography (MRE), US SWE is lower cost, portable, and does not need sedation/anesthesia. US SWE measurements can vary by method (point vs. 2D) and vendor. Few studies have defined cut-off values for detecting fibrosis in pediatric patients using US 2D SWE. This study aims to evaluate the diagnostic performance and define cut-off values of US 2D SWE for the detection of liver fibrosis in pediatric patients, using Toshiba (Canon) Aplio 500 and Aplio i800 systems.
Methods & Materials: This was an IRB-approved, retrospective study. We searched electronic medical records to identify patients (<20 years-old) that had undergone both liver

US 2D SWE and percutaneous biopsy within a 6-month interval. Liver biopsies were histologically assessed using the METAVIR (fibrosis) and NASH Clinical Research Network (steatosis) scoring systems. Continuous data were compared using the Mann-Whitney U test. Receiver operating characteristic (ROC) curve analysis was used to evaluate diagnostic performance.
Results: 48 patients were included in our study, with a median age of 12.5 years (interquartile range, 8.0-15.8 years). 25 patients were male (52.1%). There were 29 patients with METAVIR fibrosis score of F0-1 and 19 patients with a score of F2-4. Median liver shear wave speed (SWS) was significantly lower in patients with stage F0-1 fibrosis compared to patients with stage F2-4 fibrosis (1.64 vs. 2.11 m/s; p=0.003). For differentiating METAVIR stages 0-1 from stage 2 or higher fibrosis based on SWS, the AUC was 0.75 (95% CI: 0.61-0.86). A cut-off of >1.88 m/s yielded sensitivity of 73.7% (95% CI: 48.8-90.9) and specificity of 79.3% (95% CI: 60.3.7-92.0). For the subpopulation of patients without significant hepatic steatosis on histology (n=35), the AUC was 0.86 (95% CI: 0.70-0.95) for the same distinction. In this subpopulation, a cut-off of >1.88 m/s yielded a sensitivity of 80.0% (95% CI: 51.9-95.7) and specificity of 95.0% (95% CI 75.1-99.9).
Conclusions: US 2D SWE distinguishes patients with no/mild fibrosis from those with moderate/severe fibrosis with good sensitivity and specificity. Diagnostic performance is comparable to that published for MRE and is likely adversely impacted by the presence of steatosis.

Alt #: 002 - ***Withdrawn***

Alt #: 003

Osteoid Osteomas of the Small Tubular Bones of the Hands and Feet: Imaging Features with Clinical Correlation

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Methods & Materials: A retrospective review of suspected osteoid osteoma was performed from May 2, 2006 to September 11, 2019, which yielded 1,157 patients from whom 8 patients had diagnosed osteoid osteoma involving the tubular bones of the hands and feet (6 girls and 2 boys, mean age of 12 years, range from 8 to 16 years). Picture archiving and communication system and electronic medical records were reviewed.

Results: A total of 8 patients were included in the analysis: 5 had histologically proven osteoid osteoma and 3 had indeterminate pathology results, but had a presumed diagnosis based on imaging findings, clinical history, and response to radiofrequency ablation/surgical excision of the lesion. A combination of radiography (n = 7), CT (n = 4), and MRI (n = 7) were used for diagnosis. Four (50%) osteoid osteomas occurred in the hand, involving the 5th metacarpal, thumb metacarpal, 4th proximal phalanx, and 4th middle phalanx. Four (50%) occurred in the foot, involving the 3rd metatarsal, 2nd metatarsal, 1st proximal phalanx, and second proximal phalanx. With the exception of 1 patient who had no recorded symptom duration, the delay between onset of symptoms and treatment averaged 21 months (range 8 to 61 months). A history of trauma to the area of the lesion at the onset of symptoms was noted for 3 patients (38%). Two patients (25%) with lower extremity lesions were athletes and had a history of either ipsilateral stress injury or contralateral fracture. On pre-intervention radiographs, available for 7 cases, six (86%) had widening of the shaft of the affected bone, 3 (43%) had cortical thickening, and 5 (71%) had a focal lucency within an area of sclerosis, suggesting a nidus. All 7 cases with MRI had a focal ovoid lesion surrounded by diffuse bone marrow edema in the affected bone with 2 of the 7 having the classic “target” lesion.

Conclusions: Noncontrast MRI can aid in the diagnosis of osteoid osteoma in the hands and feet with identification of a focal ovoid lesion and diffuse bone marrow edema in the affected bone, particularly if a targetoid lesion is identified. A full diagnostic work-up is essential to prevent delay in diagnosis and treatment, particularly in cases of confounding history.

SCIENTIFIC PAPERS CONVERTED TO POSTERS – SLARP

(S) Indicates a La Sociedad Latino Americana de Radiología Pediátrica (SLARP) program submission. Authors are listed in the order provided. An author listed in bold identifies the presenting author.

Paper #: 001 (S)

Anillos Vasculares: Serie de Casos y Aproximación para el Reporte Radiológico

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Purpose or Case Report: Describir los hallazgos más frecuentes en tomografía computarizada del anillo vascular en un centro de referencia nacional y proponer un algoritmo lógico de diagnóstico para ayudar a los informes del radiólogo pediátrico.
Methods & Materials: Analizamos retrospectivamente los hallazgos de imágenes de 18 pacientes pediátricos remitidos a nuestro centro de referencia nacional cardiovascular pediátrico en el periodo del 2013 al 2019 , con angiografía por tomografía computarizada para la evaluación del anillo vascular conocido o clínicamente sospechoso. Identificamos y registramos los anillos vasculares y sus variantes anatómicas.
Results: Se incluyeron 18 pacientes, el rango de edad fue de 0,5 meses a 14 años (el 88% eran lactantes), 9 mujeres, 9 hombres. Encontramos siete casos con doble arco aórtico, dos de ellos clasificados como doble arco aórtico con segmento atrésico. Seis pacientes con arco aórtico derecho con arteria subclavia izquierda retroesofágica y divertículo de Kommerell, y cinco pacientes con arco aórtico derecho retroesofágico circunflejo. Dos pacientes de la última categoría presentaron anatomía atípica. La malformación cardíaca más común asociada fue la comunicación interauricular en cinco pacientes. La comunicación interventricular y la tetralogía de Fallot se encontraron en dos pacientes. Cinco de los 7 pacientes con doble arco aórtico tienen otra malformación cardiovascular asociada, los más comunes fueron comunicación interauricular (4 de 5 pacientes) y ductus arterioso persistente (2 de 5 pacientes).
Conclusions: Todos nuestros casos se dividen en tres categorías principales: doble arco aórtico, arco aórtico derecho con arteria subclavia izquierda retroesofágica con divertículo de Kommerell y arco aórtico derecho retroesofágico circunflejo. Se propone un algoritmo basado en las tres categorías principales y las variaciones principales. La descripción de los anillos vasculares en el informe radiológico debe estandarizarse para guiar la planificación quirúrgica.

Paper #: 002 (S)

Can Pigtail or Narrow Curve Morphology be an Additional Finding Used to Exclude Appendicitis in Questionable Case?

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Purpose or Case Report: In the diagnosis of acute appendicitis, unenhanced MRI provides an efficient and comprehensive evaluation of the appendix. However, on the daily clinical basis, there are cases that generate a diagnostic dilemma with subtle/indeterminate inflammatory changes. For these questionable cases, the morphology of the appendix could play a role as an aid for the radiologist to increase the confidence diagnosing or ruling out acute appendicitis. The aim of this study is to evaluate the morphology of the appendix as an additional tool for the diagnosis of appendicitis.
Methods & Materials: We conducted a retrospective search in the last 2 years. All children with MRI with appendix protocol were included. Exclusion criteria were: frank appendiceal perforation, periappendiceal abscess, partial or no visualization of the appendix and diameter of the appendix larger than 12 mm. Morphology of the appendix was evaluated on the axial, sagittal and coronal T2 HASTE non-fat-sat sequences. Diffusion images and T2 fat-sat sequences were not evaluated to avoid selection bias. Maximal diameter of the appendix was recorded. Morphology was classified in 2 groups: Straight/Open curve and Pigtail/Narrow curve. Interobserver reliability test of the morphology was performed with 40 randomly selected cases.
Results: We included 95 children, 51 girls, mean age 11yrs (3-17 yrs) and 33 (35%) with surgically proven acute uncomplicated appendicitis. As expected, children without appendicitis had smaller appendiceal diameters (median of 6mm (4-7mm)) in comparison to children with acute appendicitis (median of 8 mm (6-12 mm)) ($p<0.01$). Children with and without appendicitis demonstrated a significant difference in appendiceal morphology ($p=0.19$), as 65% (40/62) of the cases without appendicitis exhibited a Pigtail/Narrow curve morphology; whereas 60% (20/33) of the cases with acute appendicitis had a Straight/open curve morphology. Interobserver reliability in the morphology evaluation was 0.66.
Conclusions: Normal appendices usually demonstrate narrow curves or Pig-tail morphology. In cases where the MRI diagnosis of appendicitis is not straightforward, the morphology of the appendix could play a role as an additional diagnostic tool. Although normal appendices can be straight in morphology; the lower incidence of narrow curves or Pig-tail morphology in cases of acute appendicitis could be related to increase in intra-appendiceal pressure, resulting in straightening of the appendix.

Paper #: 003 (S)

CT Imaging Findings of E-Cigarette/Vaping-Associated Lung Injury in Children

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Purpose or Case Report: E-cigarette/vaping-associated lung injury (EVALI) has been recently reported in the radiology literature and has become an urgent public health matter as stated by the Center for Disease Control and Prevention. As of October 22, 2019, there have been 1,604 cases in the United States territory with 34 confirmed deaths. Patients <20 years represent 36% of EVALI cases. Moreover, the use of vaping among adolescents and teenagers has progressively increased in recent years. Although the exact cause and mechanism of injury remain a subject of investigation, clinical suspicion along with imaging findings and in some cases, bronchoscopic results, remain the mainstay in the diagnosis of EVALI, after excluding

infection. Reported imaging patterns of EVALI include hypersensitivity pneumonitis, diffuse alveolar hemorrhage, acute eosinophilic pneumonia, diffuse alveolar damage, lipoid pneumonia, and giant cell interstitial pneumonia. We describe computed tomography (CT) findings of EVALI patients from our institution
Methods & Materials: This is a HIPAA-compliant retrospective study of symptomatic patients with history of vaping that were evaluated by Pulmonology from December 2018 to October 2019. Demographic and clinical data that included vaping use, symptoms, laboratory results, imaging and bronchoscopy findings, and treatment were documented
Results: We found 12 cases, 6 females and 6 males, with age range 13-18 years (mean 15.9). Ten patients had vaped for at least 2 months while two had for "several weeks". All, except one that only used nicotine, reported the use of tetrahydrocannabinol (THC). All patients had respiratory symptoms, ten had gastrointestinal symptoms and eight had fever. Eight cases had elevated inflammatory markers. On CT, all cases showed a continuum of ground-glass opacities. Interlobular septal thickening (7), subpleural sparing (5), nodules (3), crazy-paving (1), pneumomediastinum (1) and bilateral pleural effusions (1) were also found. Of a total of five bronchoalveolar lavages (BALs), few lipid-laden macrophages (instead of >25%, as recently reported), eosinophilia or neutrophilia, were each found in two. Notably, one patient required ECMO for 1.5 months
Conclusions: Radiologists should be knowledgeable of the spectrum of CT imaging manifestations of EVALI because we may be the first to raise the specific concern for this entity and prompt vaping cessation, especially, in the presence of respiratory and gastrointestinal symptoms along with fever and elevated inflammatory markers

Paper #: 004 (S)

Implementación de un Modelo de Informe Estandarizado de la Radiografía de Pelvis AP Usada en el Tamizaje de la Displasia de Caderas: HIRADS

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Purpose or Case Report: Se realiza en Chile tamizaje universal de displasia de cadera (DDC) con radiografía de pelvis AP (Rx Pelvis) a los 3 meses de edad, sin embargo no hay una estandarización del informe radiológico para una correcta y óptima derivación al especialista.Objetivo: Estandarizar y validar el informe de la Rx pelvis usada en el tamizaje de la DDC.
Methods & Materials: Se llevó a cabo un estudio de cohorte histórico en dos fases entre los años 2014 y 2018.En la primera fase, de acuerdo a 4 criterios radiológicos (ángulo acetabular, ubicación de la foseta acetabular, osificación de la ceja cotiloidea y alineamiento femoral) se definieron en consenso 5 tipos de pelvis morfológicas: normal, inmadura, displasia acetabular, displasia alineada y displasia con sub/luxación. De acuerdo a los tipos de pelvis se definieron 4 conductas que llamamos HIRADS (Hip Imaging Reporting and Data System), HIRADS 1 continua en control sano con el Pediatra, 2 control radiológico en 6 semanas, 3 y 4 se derivan al Traumatólogo. Se estructuró un informe con la descripción de los 4 criterios y en la conclusión el tipo de pelvis y el HIRADS. Dos Radiólogos en forma ciega aplicaron el informe estandarizado en una muestra de 100 Rx Pelvis y se calculó índice de concordancia interobservador Kappa de Cohen.En la segunda fase se siguieron hasta 1 año de edad a todos los niños cuya Rx de pelvis se informó usando el informe estandarizado. Para validar el informe se correlacionó el HIRADS con el diagnóstico de DDC, en dos momentos: inmediatamente posterior a la Rx Pelvis de tamizaje y a 1 año de edad.
Results: En la primera fase se obtuvo un índice de concordancia interobservador Kappa de Cohen de 0,71 para el tipo de pelvis, lo cual corresponde a acuerdo sustancial. En la segunda fase se revisaron1080 casos. 46,4% fueron HIRADS 1, 33,9% 2, 14,9% 3 y 4,8% 4.Al año de edad el diagnostico de DDC según HIRADS fue, 0,012 % en HIRADS 1, 15,7% en 2, 44% en 3 y 75% en 4.El riesgo calculado de tener DDC según HIRADS es 2,78 veces en 3 (p=0.023) y 4.75 veces en 4 (p=0.003) comparando con HIRADS 2 ya que 1 fue 0.La capacidad de discriminación de DDC de HIRADS según curva ROC es mayor de 0,7.
Conclusions: Es posible informar la Rx Pelvis en el contexto de tamizaje DDC en forma estandarizada con una buena concordancia interobservador. El informe estandarizado y categorización que proponemos es válido porque la capacidad de discriminación del HIRADS es buena.

Paper #: 005 (S)

Success Rate of Non-sedated MRI in Children 1 to 7 years of Age

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Purpose or Case Report: To report the success rate of non-sedate MRI studies in children 1-7 years of age and to evaluate clinical factors predictive of success.
Methods & Materials: This was a HIPAA compliant IRB approved retrospective study. We created a multidisciplinary program to decrease sedation called try-without (TWO) sedation/anesthesia. The approach includes age-appropriate ambient optimization, support from the MRI technologist, child-life (CL) specialist, and protocol optimization by radiologists. In the TWO program, children book two appointments at the time of the scheduling, a) a non-sedated MRI (usually within days of request) and b) a sedated/GA slot (usually days to weeks based on availability). If the TWO exam is successful, the subsequent sedation slot is cancelled; conversely, if the TWO is non-diagnostic, the sedation slot is maintained. Criteria for inclusion were: a) referral for TWO exam between 6/1/2018 and 5/30/2019, b) age 1-7 yrs. For study purposes, success was defined by reviewing the medical record: if the interpretation of the MRI deemed the exam satisfactory for the clinical query. For each case we recorded the age and sex of the child, type of exam (brain, spine, brain and spine, craniofacial, musculoskeletal [MSK], body [abdomen, chest]), intended duration of the protocol, and use of contrast. Descriptive statistics and means of central tendency were used to analyze demographics and clinical data. A multiple logistic regression was used to evaluate predictors of success.
Results: We analyzed data from 273 subjects (144 male,129 female) with a mean age of 4.75 years (SD 1.6). The studies were 186 (68.1%) brain, 34 (12.4%) spine, 20 (7.3%) MSK, 15 (5.4%) brain and spine, 10 craniofacial (3.6%), 6 (2.5%) body. The overall success rate was 84.6%. Success rate was 100% for

MSK studies, 91% for spine, 83% for brain, 80% for craniofacial, 71% for body, and 53% for combined brain and spine. The logistic regression showed that age had a significant association with success on TWO MRI (p=0.001). Sex, duration of protocol, and use of contrast were not significant predictors of success (p>0.1). All studies performed with contrast (n=30) had successful TWO exams.
Conclusions: A multidisciplinary approach enables high success rate of non-sedated MRI in children 1-7 years of age, exceeding 80%. Success rate significantly increases with age.

**Work supported by the SPR Research and Education Foundation*

Paper #: 006 (S)

Medidas Normales de la Laringe y Tráquea en Etapa Fetal por RM

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Purpose or Case Report: Determinar los diámetros promedio de la laringe y la tráquea fetal por resonancia magnética.
Methods & Materials: Estudio observacional retrospectivo. Se evaluaron todas las resonancias magnéticas fetales sin patología de la vía respiratoria en un periodo de 3 años.
Results: Se evaluaron un total de 73 resonancia magnéticas fetales. 36 (49%) fetos fueron de sexo femenino y 37 (51%) de sexo masculino con edad gestacional entre 18 y 40 semanas por biometría fetal. En el grupo de edad gestacional entre 18-24 semanas el promedio del diámetro anteroposterior de la laringe fue de 2.47 mm y de la tráquea de 2.5 mm, en el grupo de 25-30 semanas de edad gestacional el diámetro anteroposterior promedio de la laringe fue de 3.09 mm y de la tráquea fue de 3.05 mm, en el grupo de 31-35 semanas de edad gestacional el diámetro de la laringe fue de 3.12 mm y de la tráquea fue de 3.27 mm y en el grupo de 36-40 semanas de edad gestacional el diámetro promedio de la laringe fue de 3.2 mm y de la tráquea fue de 3.22 mm.
Conclusions: La resonancia magnética fetal es un método diagnóstico no invasivo útil en la evaluación de la anatomía normal de la vía aérea. El conocimiento de los valores normales de la laringe y la tráquea en estudios de resonancia magnética fetal permite a los médicos radiólogos determinar la presencia o no de la dilatación de la vía aérea, siendo mayor su utilidad en pacientes con tumoraciones cervicales o de macizo facial que pueden asociar obstrucción de la vía aérea superior con dilatación secundaria de la laringe o tráquea.

Paper #: 007 (S)

Patrones Normales de la Médula Ósea de los Pies y Tobillos en la Población Pediátrica

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Purpose or Case Report: Describir los patrones de intensidad de señal de la médula ósea del tobillo y pie en los estudios de resonancia magnética (RM) en la población pediátrica.
Methods & Materials: Estudio observacional retrospectivo. Se evaluaron todas las resonancias magnéticas de pies y tobillos asintomáticos realizadas en pacientes menores de 14 años en un periodo de 3 años y se categorizaron los patrones de médula ósea en homogéneo y heterogéneo dividiendo los hallazgos por grupos etáreos entre 3 y 9 años y entre 10 y 13 años.
Results: Se evaluaron un total de 171 resonancias de pies y tobillos asintomáticos en niños menores de 14 años. 101 pacientes fueron mujeres y 70 varones. La edad promedio fue de 10.2 años entre 3 y 13 años de edad. En las mujeres entre 3 y 9 años (41 pacientes), el 63% presentó un patrón heterogéneo; y en el grupo entre 10 y 13 años (60 pacientes), el 57 % presentó un patrón homogéneo. En los varones en el grupo entre 3 y 9 años (28 pacientes), el 82 % presentó un patrón heterogéno; y en el grupo entre 10 y 13 años (42 pacientes), el 57% presentó un patrón heterogéneo. Del total de niños estudiados se encontró que el 58 % presentó patrón heterogéneo y el 42.9% presentó patrón homogéneo de la médula ósea de los pies y tobillos en los estudios de resonancia magnética.
Conclusions: La intensidad de señal de la médula ósea de los pies y tobillos en pacientes pediátricos pueden mostrar un patrón homogéneo o heterogéneo, siendo más frecuente el patrón heterogéneo en los niños menores de 10 años. Es importante para el médico radiólogo conocer los patrones de intensidad de señal de médula ósea en la población pediátrica para no confundir un patrón heterogéneo con lesiones de estrés o fracturas ocultas.

Paper #: 008 (S)

Normal Age-related Quantitative CT Values in the Pediatric Lung: From the First Breath to Adulthood

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Purpose or Case Report: To describe the normal progression of quantitative CT chest parameters in children
Methods & Materials: All patients with an available normal non-contrast enhanced chest CT from 2008 to 2019 were included. Patients with any abnormality in the lung parenchyma, thoracic cage deformity/malformation, acute/chronic respiratory symptoms, or incomplete field of view were excluded. Lung parenchyma was segmented with a semi-automated technique using an open source software. Percentage of low attenuation areas ≤ -900 HU (LAA), high attenuation areas ≥ -700 HU (HAA), mean lung density (MLD), kurtosis, skewness, lung mass, and volume were obtained. Kurtosis describes the sharpness of a histogram's peak, whereas skewness shows the degree of asymmetry. Descriptive data were presented as mean ± standard deviation. Linear regression models were used to evaluate the relationship between quantitative CT parameters with age (years). Reference equations were obtained using the intercepts and slopes. P-values < 0.05 were considered significant.
Results: 220 children (111 girls) were included. The mean age was 9.5 ± 5.9 years. The most common CT indication was "staging/restaging lung metastasis" (n = 185), followed by "suspected pulmonary blebs" (n = 9) and "suspected thoracic mass" (n = 8). LAA showed a weak correlation with age ($r = 0.26$, $R^2 = 0.70$, $p < 0.001$). HAA displayed a strong negative

correlation with age (r = -0.84, R^2 = 0.71, $p < 0.001$). The MLD had a strong negative correlation with age (r = -0.83, R^2 = 0.71, $p = < 0.001$). Kurtosis (r = 0.75, R2 = 0.57, $p < 0.001$) and skewness (r = 0.82, R^2 = 0.68, $p < 0.001$) showed a strong positive correlation with age. Finally, mass (r = 0.92, R^2 = 0.85, $p < 0.001$) and volume (r = 0.86, R^2 = 0.75, $p < 0.001$) showed a strong positive correlation with age. Reference equations for calculating expected values by age (years) are as follows: LAA (%) = 0.028 – (0.009 x Age), HAA (%) = 84.2 – (4.7 x Age), MLD (HU) = 572 + (14.7 x Age), kurtosis = 4 + (0.9 x Age), skewness = 1.7 + (1.3 x Age), mass (g) = 86.2 + (44.4 x Age), and volume (L) = 0.2 – (0.2 x Age).
Conclusions: Quantitative CT analysis shows that as children grow, the lung parenchyma attenuation decreases linearly and becomes more homogenous. Age is a moderate to strong predictor of the different quantitative CT parameters, except for low attenuation areas.

Paper #: 009 (S)

Quantitative CT in Neuroendocrine Cell Hyperplasia of Infancy: Utility of Objective Evaluation of the Lung Parenchyma

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Purpose or Case Report: To evaluate the utility of quantitative CT in children with neuroendocrine cell hyperplasia of infancy (NEHI)
Methods & Materials: All children with a confirmed NEHI (from 2005 to 2019) and typical CT imaging findings, agreed upon by two pediatric radiologists, were included. Typical CT appearance was defined as ground glass density in the middle lobe/lingula and centrally, with lucency of the lower lobes. Age-, sex-, and height-matched control CTs included those interpreted as normal in patients without acute or chronic respiratory conditions. Lung parenchyma was segmented into individual lungs and lobes using a semi-automated technique with open-source software. Mean lung density (MLD), ventilation heterogeneity (VH), lung mass, and volume were calculated. Descriptive data are presented as mean ± standard deviation. Nonparametric tests were used to evaluate group differences.
Results: 11 children with NEHI (7 boys, 20.3 ± 18.1 months) and 11 controls (7 boys, 19.5 ± 18.5 months) were included. Those with NEHI had lower MLD (-615 HU vs -549 HU, p = 0.02) with higher mass (232 gr vs 151 gr, p = 0.04) and volume (0.59 L vs 0.34 L, p = 0.008) compared to controls.In the right middle lobe, the only significant difference was a higher mass in the NEHI cases compared to controls (32,9 g vs 19.6 g, respectively, p = 0.02); while in all other lobes, NEHI cases had lower MLD with higher VH, mass and volume. Significant differences by lobe were as follows:Right upper lobe: NEHI had lower MLD (-628 HU vs -572 HU, p = 0.02) and higher VH (0.20 vs 0.16, p = 0.02); Right lower lobe: NEHI patients had lower MLD (-616 HU vs -511 HU, p = 0.005) and higher VH (0.22 vs 0.17, p = 0.01), mass (58.2 gr vs 37.2 gr, p = 0.04) and volume (0.15 L vs 0.07 L, p = 0.007).Left upper lobe: NEHI patients had higher VH (0.21 vs 0.17, p = 0.02) and volume (0.14 L vs 0.08 L, p = 0.01); while in the left lower lobe, NEHI patients had a lower MLD (-599 HU vs -499 HU vs, p = 0.008), higher VH (0.23 vs 0.17, p = 0.01), and higher volume (0.13 L vs 0.07 L, p = 0.01)
Conclusions: Quantitative analysis of the typical NEHI CT pattern demonstrates significantly higher lung mass of the RML and higher VH and lower MLD (surrogates of air trapping) in the remaining lobes. Hence, quantitative CT in NEHI, shows that the typical CT findings represent a combination of the traditionally described ground glass opacities plus air trapping in the rest of the lobes (previously perceived as normal).

CASE REPORT, EDUCATIONAL AND SCIENTIFIC POSTERS

Authors are listed in the order provided. An author listed in bold identifies the presenting author.

Poster #: CR-001

3D Cardiac Models Aid in Surgical Planning for Complex Congenital Heart Disease in Infants

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Purpose or Case Report: Limited experience with 3D print technology has been reported for surgical planning in infants with congenital heart disease. We present 5 infants with complex intracardiac anatomy for whom 3D cardiac models from gated cardiac CT angiograms facilitated surgical planning.**Case 1:** Term 2-day-old infant with d-transposition of the great arteries (TGA), large anterior malalignment ventricular septal defect (VSD), and severe aortic arch hypoplasia. The 3D cardiac model confirmed feasibility of biventricular repair using a Yasui-type operation, with Norwood arch reconstruction, Rastelli VSD closure, and right ventricle to pulmonary artery (RV-PA) conduit placement.**Case 2:** 2-month old, ex-34-week premature infant with double-outlet right ventricle (DORV), side-by-side great arteries, large remote predominantly-subaortic VSD, and pulmonary stenosis (PS). The 3D cardiac model highlighted the remoteness of the VSD from the outflow tracts, prompting right ventricular outflow tract patch augmentation without VSD closure when the patient developed hypercyanotic spells.**Case 3:** Term 7-day-old infant with Goldenhar syndrome, D-TGA, large posterior malalignment VSD with inlet extension, and PS. The first 3D cardiac model raised concern that VSD closure would be difficult as a newborn due to VSD size, prompting placement of a BT shunt and pulmonary artery band. The second 3D model at 11 months of age demonstrated feasibility of biventricular repair with Rastelli VSD closure and RV-PA conduit placement.**Case 4:** Term 2-day-old infant with 22q11.2 deletion syndrome, type B interruption of a right aortic arch, aberrant left subclavian artery, posterior malalignment VSD, small bicuspid aortic valve, and superior-inferior branch pulmonary artery relationships. The 3D cardiac model demonstrated need for VSD enlargement to enable complete repair with Yasui operation with LeCompte maneuver.**Case 5:** Term 3-week-old infant with mesocardia, ventricular inversion, DORV, L-malposed great arteries, subpulmonic VSD, multilevel PS, and mitral chordal attachments to the crest of the ventricular septum. The 3D cardiac model suggested that VSD enlargement might enable a double switch operation with Rastelli VSD baffle. However, during the operation at 20 months old, mitral chordal apparatus prevented VSD enlargement, necessitating bidirectional Glenn instead.
Conclusions: In this series of neonates, 3D cardiac models were both feasible and useful in planning congenital heart surgery, despite some limitations.

Poster #: CR-002

Native True-FISP MRA for Assessment of Post-Transplant Renal Artery Stenosis

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Purpose or Case Report: **INTRODUCTION**Renal artery stenosis is a common complication after transplantation. In our institution, we have unfortunately found a high rate of false-positive Doppler ultrasound and non-contrast time-of-flight MRA studies that go to invasive catheterization which turn out negative for renal artery stenosis. We present one of many of our cases which show the utility of high-quality 3D MRA using another non-contrast technique, NATIVE True-FISP, which is appears better apt at achieving adequate signal even when the acquisition plane is not perpendicular to the vessel of interest.**CASE DESCRIPTION**A 13-year-old male with a history of idiopathic dilated cardiomyopathy and end-stage renal disease from presumed ischemic injury during cardiac catheterization underwent a combined cardiac transplant and deceased donor kidney transplant. Two months after the transplant, the patient was admitted for respiratory distress, pulmonary edema, and worsening cardiac function, the latter documented by routine outpatient echocardiography.On admission, a Doppler ultrasound showed elevated peak systolic velocity of the transplant renal artery anastomosis, up to 434 cm/sec. To confirm the sonographic suspicion of renal artery stenosis, a non-contrast 3D MRA was requested which showed tight juxta-anastomic stenosis (see Figure 1).The interventional radiology service was consulted who brought the patient to their angiography suite on the basis of the clinical and imaging findings. A diagnostic angiogram confirmed the pre-angiographic imaging findings with nearly one-to-one correlation with the MR 3D-volume-rendered images (see Figure 2). Angioplasty of this lesion was performed, and follow-up ultrasounds up to six-months post angioplasty show interval normalization of the renal artery velocities and blood pressure.
Conclusions: NATIVE TrueFISP MRA can provide high-quality 3D images that can confirm the presence of suspected stenosis and help interventional radiology with pre-procedural planning. In our institution, this sequence has replaced our former time-of-flight MRA-based protocol, and our interventional radiology department now routinely requests NATIVE TrueFISP MRA of transplant kidneys with suspected arterial stenosis following ultrasound.

Poster #: CR-003 - *Withdrawn*

Poster #: CR-004

Beware of the Mimickers of Vascular Malformations! Congential Flank Mass in a Newborn with the Appearance of a Vascular Malformation Found to be a Sclerosing Spindle Cell Rhabdomyosarcoma

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Purpose or Case Report: A full-term male was born with a 7 x 7 cm subcutaneous mass with central dark blue discoloration and peripheral erythema on the right flank/buttock. Initial hip and pelvis radiograph at one day old did not show evidence of

calcifications. An ultrasound demonstrated an ill-defined, heterogeneous mass with internal vascularity with invasion of underlying muscle. MRI of the abdomen and pelvis with contrast at two days of age showed a T2 hyperintense mass with mild postcontrast enhancement within the right flank with infiltration of the underlying muscles including the right psoas, iliacus, gluteal, and the left erector spinae. The differential diagnosis included: kaposiform hemangioendothelioma, rhabdomyosarcoma (RMS), tufted angioma and neuroblastoma.Given the broad list of differential diagnoses, a core biopsy of the right buttocks was obtained at 6 days of age to further characterize the lesion. Hematoxylin and eosin stained sections demonstrated highly collagenized and sclerotic spindle cells involving the adipose tissues extending into the dermis. Immunohistochemical stained sections showed positivity to desmin, myogenin and MyoD1. Fluorescence in situ hybridization studies indicated the presence of a VGLL2 gene rearrangement. These pathologic findings were consistent with sclerosing spindle cell RMS. At 13 days old, a PET scan showed the right flank lesion with minimal to no FDG uptake, a finding which is consistent with sclerosing RMS given that this sub-type consists mainly of collagen. There were no pulmonary nodules. After multiple chemotherapy cycles, subsequent MRIs of the abdomen and pelvis showed no residual enhancing lesion. The patient will be closely followed for local recurrence.RMS, the most common soft tissue tumor seen in children, are mesenchymal tumors of skeletal muscle and are most often seen in head and neck, but are less commonly noted on the flank. Sclerosing spindle cell RMS is a subtype often seen in childhood, but exceedingly rare in newborns. Cutaneous RMS should be considered in the differential diagnosis of a large subcutaneous lesion in a newborn.

Poster #: CR-005

Congenital Lung Malformation: Imaging and Pathologic Spectrum

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Purpose or Case Report: Congenital focal lung malformations (CLM) are a heterogeneous group of lesions that have been commonly classified by their features and the presence of systemic vascular supply into bronchial atresia, congenital pulmonary airway malformation, bronchogenic cyst and bronchopulmonary sequestration, however, pathologically there is considerable overlap not recognized by this classification method. Literature has hypothesized that a common pathogenetic origin of developmental bronchial obstruction, variable in timing and extent, is responsible for the spectrum observed.The purpose of this case report is to describe the findings of an unusual CLM with concurrent intra and extrapulmonary lesions demonstrated by pre and postnatal imaging, gross and microscopic pathology.A 19 year-old G1P0 female presented at 34 weeks gestation for evaluation of a fetal chest mass, first identified by US at 32 weeks. Fetal US showed a large right thoracic lung lesion containing two distinct macro cysts; fetal MR demonstrated T2 hyperintense signal throughout the lesion and increased volume of the affected lung with resultant mild mediastinal shift. No systemic feeding vessel was evident.The baby was born at 39 weeks and required intubation due to respiratory distress. Postnatal CTA showed a solid lesion right thoracic apex outlined by pleural air with systemic arterial supply from the subclavian artery, no visible airways, and a central cyst with peripheral atelectasis. There was an additional unilocular cyst with air-fluid level in the perihilar right middle lung.Thoracotomy on day 4 described an extrapulmonary sequestration (EPS) right thoracic apex and cystic lesions in the right upper and middle lobes, all of which were resected without complication. Pathology revealed similar histology throughout all resected tissue characterized by markedly dilated proximal bronchi and parenchymal maldevelopment with immature alveolar spaces as is seen in bronchial atresia, in addition to diffuse pulmonary interstitial glycogenosis.This case of a CLM with concurrent solid and cystic lesions supports a common pathogenetic mechanism based on developmental bronchial obstruction both with and without retention of embryonic systemic vascular communication. Prenatal classification into distinct lesions is hampered by overlapping pathological features. Characterization of vascular and airway connections and awareness of potential complications are most important to guide counseling and therapy.

Poster #: CR-006

Rare Case of Severe Ovarian Enlargement in an Infant with Significant Insulin Resistance.

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Purpose or Case Report: Massive ovarian enlargement (without underlying mass) is a rare finding in neonates. Ovarian enlargement has been associated with insulin-resistant states such as polycystic ovarian syndrome (PCOS) and rare congenital syndromes such as infants with leprechaunism. However, the extent, severity, and radiographic findings of ovarian growth in infants with syndromes of insulin resistance have not been fully described. We report a case of severe ovarian enlargement in an infant with congenital insulin resistance.A two-month-old born at 37 weeks via C-section with a history of intrauterine growth restriction was admitted for hyperglycemia consistent with neonatal diabetes and was subsequently diagnosed with insulin resistance syndrome (either leprechaunism or Rabson-Mendenhall syndrome) secondary to an *INSR* gene mutation. Insulin and proinsulin levels at 3 weeks of age were markedly elevated to 582.3 uIU/mL (2.0 – 19.6) and 674.3 pmol/L ($\leq$ 18.8), respectively.An abdominal ultrasound (US) performed for abdominal distension demonstrated very enlarged ovaries containing sub-centimeter follicles. Ovarian volumes were 12.8 mL and 8.7 mL on the right and left, respectively. The mean ovarian volume for this age is 1.06 mL with a standard deviation (SD) of 0.96; this would place this patient's right and left ovaries 12.2 and 8.0 SD above the mean, respectively.CT performed at three months of age for evaluation of persistent fevers demonstrated further enlargement of the ovaries. Ovarian volumes were 106 mL and 60 mL on the right and left, which were 109 and 61 SD above the mean, respectively. A repeat US performed at four months of age showed decreasing ovarian volumes measuring 51 mL and 18 mL on the right and left, respectively (which were still 49 and 25 SD above the mean).We postulate that this case of massive ovarian enlargement in the setting of severe insulin resistance was likely due to an insulin-mediated gonadotropin-independent mechanism, as has been previously suggested in infants with leprechaunism (perhaps mediated through an intact homologous IGF-I receptor). The ovarian enlargement seen in post-pubertal females with PCOS may have a similar pathogenesis, with resultant granulosa cell proliferation with antral follicles. Ovarian cysts have also been seen in non-insulin-resistant

hyperinsulinemic infants of diabetic mothers, suggesting that high circulating serum insulin may act in the trophic manner typical of gonadotropic hormones.

Poster #: CR-007

Prenatal Diagnosis of Closed Cloacal Exstrophy Variant

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Purpose or Case Report: To report the prenatal ultrasound (US) and magnetic resonance imaging (MRI) findings in a prenatally diagnosed case of closed (i.e. skin-covered) cloacal exstrophy.
Results: A 40-year-old female, G7P6006, was referred for fetal scoliosis and possible patent urachus. Non-invasive prenatal testing was low risk for aneuploidy and maternal serum alpha fetoprotein was not elevated. Amniocentesis and chorionic villus sampling were declined. Outside second trimester screening ultrasound at 19 weeks 3 days gestation was notable for angulation of the lower thoracic spine, and an outside follow-up ultrasound at 26 weeks 0 days was remarkable for partial herniation of the fetal bladder dome into the umbilical cord and suspected patent urachus. The patient was referred to our center for further evaluation. High-resolution ultrasound performed at 30 week 2 days demonstrated findings suspicious for closed cloacal exstrophy, including an identifiable anechoic fluid-filled urinary bladder protruding beyond the expected abdominal wall contour inferior to a low abdominal cord insertion, abnormal genitalia, multiple spinal segmentation anomalies, low conus medullaris at L4 and anteriorly displaced anus. No urinary tract dilation was present and the amniotic fluid was normal. Fetal MRI performed at 32 weeks 1 day confirmed the US findings and suspicion for a closed cloacal exstrophy. In addition, the orientation of the kidneys was noted to be abnormal with close approximation of the upper poles. Scheduled repeat cesarean section was performed at 39 weeks without complication. On physical examination, a large skin-covered infraumbilical defect, ambiguous genitalia, and imperforate, anteriorly displaced anus were noted. Examination under anesthesia and cystovaginoscopy demonstrated a short urethra, large bladder extending into the infraumbilical wall defect, septated vagina with two complete cervices and colonic fistula entering into the base of a vaginal septum. Postnatal imaging confirmed the presence of multiple thoracic segmentation anomalies and a low conus. The infant underwent divided transverse colostomy on day of life 2 and is undergoing urologic and orthopedic management.
Conclusions: Closed exstrophy variants are exceedingly rare. Although prenatal diagnosis can be challenging, this entity should be considered in the setting of an identifiable bladder with infraumbilical abdominal wall abnormality and additional findings associated with the exstrophy complexes.

Poster #: CR-008 - *Withdrawn*

Poster #: CR-009

Hemorrhagic Shock Secondary to Hemobilia As the Presenting Symptom of Gallbladder Polyps in Metachromatic Leukodystophy

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Purpose or Case Report: 5 yo male with PMHx significant only for autism presented to ED with acute abdominal pain, hematemesis, and melena. Patient was tachycardic but normotensive with Hgb 5.6 g/dL (normal 11.5 – 13.5 g/dL) requiring transfusion. Patient was also jaundiced with scleral icterus, markedly elevated liver enzymes, and direct hyperbilirubinemia. Abdominal X-ray and Abdominal US did not demonstrate significant bowel pathology. However, gallbladder was abnormal with thickened, hyperemic wall and abundant internal debris. Common bile duct was massively dilated to the level of ampulla and filled with heterogeneous, avascular debris. No cholelithiasis or mass was demonstrated. Based on US, a differential diagnosis of cholecystitis, cholangitis, or choledochal cyst complicated by hemobilia was offered. MRI demonstrated dilated central intrahepatic and extrahepatic bile ducts containing layering T1 bright, T2 dark material. On arterial post-contrast images, the right hepatic artery was immediately adjacent to dilated common hepatic duct and blush of enhancement was seen concerning for active hemorrhage into type 4b choledochal cyst. The patient proceeded to diagnostic angiography, which was unable to demonstrate a site of arterial bleeding. Biliary drain was placed across the choledochal cyst with initial drainage of bloody material followed by drainage of bile. Patient subsequently underwent open cholecystectomy. Pathology demonstrated "mucinous papillary proliferation with increased histiocytes in lamina propria, consistent with gallbladder changes in Metachromatic Leukodystrophy (MDL)." Subsequent brain MRI demonstrated classic findings of MDL.
Conclusions: Hemobilia is a rare finding in children and most commonly seen in the setting of trauma, such as hepatic laceration with subsequent bleeding into the biliary tree. Non-traumatic causes of hemobilia have been described, most commonly infection, underlying biliary abnormalities, or bleeding disorders. Metachromatic leukodystrophy (MLD) is a lysosomal storage disorder that results in accumulation of sulfated glycosphingolipids in the brain, peripheral nerves, and other organs including the gallbladder. Various case reports have described gallbladder polyposis in MLD including 4 cases associated with massive, life-threatening hemobilia. Thus, hemorrhagic cholecystitis in the setting of MLD should be considered in the differential diagnosis of non-traumatic hemobilia.

Poster #: CR-010

Abdominal Pain, Usually it's a Horse, but Sometimes it's a Zebra: A Case of Pediatric Peritoneal Mesothelioma

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Purpose or Case Report: Peritoneal disease in the pediatric population is exceedingly rare. When encountered, differential

diagnoses typically include infection, inflammation, and metastatic disease. However, we report a case of malignant epithelial peritoneal mesothelioma to emphasize that this primary malignancy should also be considered.A 14 year old male with a history of growth hormone deficiency, gastroesophageal reflux disease, and asthma presented to his primary care physician with chronic abdominal pain, mild anemia, and over 20 pound weight loss in a 9 month period. Outpatient workup by gastroenterology showed elevated ESR and CRP and a single hyperplastic polyp on endoscopy. MRI enterography of the abdomen and pelvis with intravenous contrast was completed to evaluate for inflammatory bowel disease. This exam revealed a thickened omentum, hyperenhancement of the peritoneum and omentum, peritoneal nodularity, a moderate to large volume of ascites, and enhancing nodules along the superior surface of the diaphragm. The nodules were further evaluated with a dedicated CT chest, abdomen, and pelvis, which confirmed the above findings.Differential diagnosis of an abdominal mesothelial process as above includes familial mediterreanean fever, malignancy, and infection. Laparoscopic omental and peritoneal biopsies showed mesothelial hyperplasia. Genetic testing returned positive for a CDKN2A homozygous and heterozygous deletion, confirming the diagnosis of diffuse malignant peritoneal mesothelioma.The patient is currently under treatment with a cisplatin-based chemotherapy regimen and is being closely followed. Our case exemplifies the symptoms, imaging findings, diagnosis, and treatment associated with malignant epithelial peritoneal mesothelioma.

Poster #: CR-011

An Atypical Presentation of Bilious Emesis and the Importance of Imaging in Diagnosis

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Purpose or Case Report: The ingestions of magnetic foreign objects are a common occurrence in the pediatric population. The American Association of Poison Control has documented 95,700 incidents of foreign-body ingestion in the year 2011 alone with most cases occurring in children younger than 5 years of age. In this case, we present a two-year-old male who presented to the emergency department with a four-day history of bilious vomiting.
Methods & Materials: A variety of imaging modalities including ultrasound, plain films, and fluoroscopy to aid in diagnosis and management of our patient.
Results: An abdominal radiograph in the frontal and supine positions to evaluate for a small bowel obstruction demonstrated a small amount of small bowel and colonic gas present, but was without gas-filled dilated loops of bowel or radiopaque foreign object present. Subsequently, an abdominal ultrasound was performed for the evaluation of intussusception, which was also ruled out. Due to an increasing suspicion of malrotation, a fluoroscopic upper GI series was performed that raised concern of a proximal to mid-jejuno-jejunal fistula. A repeat abdominal radiograph post- oral contrast administration also showed dilatation of the small bowel without evidence of volvulus. With evidence of at least a partial small bowel obstruction, pediatric surgery proceeded with an exploratory laparotomy. Surgery confirmed the presence of a jejuno-jejunal fistula and a fibrous band around the distal jejunum causing a small bowel obstruction.
Conclusions: This case displays a unique presentation of a jejeno-jejunal fistula caused by small magnet ingestion. We demonstrate the importance of various imaging modalities in determining the etiology bilious vomiting outside of the classic presentations. There have been many cases of pediatric ingestion of magnetic objects; however, this case demonstrates a rare presentation of a jejuno-jejunal fistula that has only been previously documented in two other cases. Upon further questioning of the family after surgical intervention, they revealed that the patient likely swallowed a few small magnets weeks ago. Since the events in question had been weeks prior, the magnets were no longer visible on imaging and clinical suspicion was therefore initially low. The use of additional imaging modalities was vital in this case to ascertain the final diagnosis and management that prevented immediate morbidity and potential long-term gastrointestinal complications.

Poster #: CR-012

Neutropenic Enterocolitis: A Common Complication In An Uncommon Location

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Purpose or Case Report: Neutropenic enterocolitis (NE), commonly referred to as typhlitis (from the Greek typhlos meaning blind / closed) or ileocecal syndrome, is an increasingly common complication of neutropenic pediatric patients, with a reported incidence of 0.8% – 26%. This is especially evident as the use of aggressive chemotherapy regimens in pediatric patients increases. While typically affecting the cecum, other large and small bowel involvement has been described. Symptoms often present within 2 weeks of therapy completion, concurrently with the expected leukocytosis. We present a case of NE with typical and atypical imaging findings.The patient was a previously healthy 7-year-old male that presented with a two-week history of daily fevers, increased fatigue, abdominal pain, and easy bruising. Flow cytometry confirmed the diagnosis of suspected B-cell Acute Lymphoblastic Leukemia/Lymphoma (ALL) and the patient was started on induction chemotherapy for High Risk ALL. On the patients last day of induction (day 7), the patient began developing worsening lower abdominal pain and bloody stool. Supine radiograph demonstrated a non-specific paucity of gas in abdomen. The patient continued to decline clinically and the physical exam also showed worsening distention with involuntary guarding. A contrast enhanced computed tomography (CT) was ordered which demonstrated NE with significant wall thickening in both the cecum and rectum. Despite ECMO and other heroic efforts the patient expired.There is one reported case in the available English literature of neutropenic enterocolitis involving the rectum. Our case demonstrates the typical location within the cecum and ascending colon, along with the rarely identified rectal involvement. It is hypothesized that an initial intestinal injury in an already immunocompromised state, allows for an increased inflammatory response and vulnerability to opportunistic bacterial invasion. Based on reports outlining colonic wall thickening in patients with NE seen on ultrasound, there is a reported mortality rate of 60% at 10 mm or greater and only 4.2% at <10 mm. The significant wall thickening present in this case was an ominous sign. However, the lack of adequate

research regarding the management NE makes it difficult to create a standardized treatment protocol. This case demonstrates a common and uncommon location of NE within the colon and further demonstrates the importance of early supportive intervention when NE is suspected.

Poster #: CR-013

Solitary Rectal Ulcer Syndrome: A Rare Yet Underdiagnosed Disease

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Purpose or Case Report: A 12 year old hispanic male with a past medical history of rectal prolapse presented to the ED from the pediatrician with a Hgb of 4.5 on outpatient lab work. The patient's mother reports a history of constipation, staying in the bathroom for long periods of time and straining. Additionally the patient has been fatigued and pale for the last year with intermittent bloody diarrhea for the last 3 years.Inpatient testing included defecography which showed evidence of rectal prolapse. MR enterography revealed wall thickening and hyperenhancement of the rectosigmoid colon, consistent with infectious/inflammatory etiology. Colonoscopy with biopsy was performed and histopathology results were consistent with solitary rectal ulcer syndrome.The patient was successfully treated conservatively with dietary changes, topical medications and education about bathroom habits.Solitary rectal ulcer syndrome (SRUS), first described in 1829, is an uncommon, benign disease characterized by clinical history, imaging (including defecography, and MR enterography), colonoscopy and diagnosed by histopathological findings. With an annual prevalence of 1 in 100,000, SRUS is most commonly found in young adults, but also seen in pediatric and geriatric populations.Clinical presentation usually includes a history of prolonged straining, constipation, lower abdominal pain, rectal bleeding, mucous discharge and rarely rectal prolapse. Solitary rectal ulcer syndrome is actually a misnomer as only 40% of cases present with ulcers; even fewer present with a solitary ulcer. The etiology is not completely understood but is likely multifactorial.Diagnosis of SRUS is often missed or delayed due to low clinical suspicion, inadequate rectal biopsy or failure to recognize histopathological features of the disease. It is therefore important to recognize solitary rectal ulcer syndrome and the diagnostic features and maximize the likelihood of accurately diagnosing SRUS early on.

Poster #: CR-014

Took an Imaging Test, Turns Out it's a 100% that Lymph: Mesenteric Lymphatic Malformations, a Rare Cause of Acute Abdominal Pain

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Purpose or Case Report: Mesenteric lymphatic malformations are rare intra abdominal masses. Large mesenteric malformations can present soon after birth secondary to abdominal distention or failure to thrive. However, they can also remain clinically inapparent throughout childhood. In this series, three patients, ranging in age from 8 to 16 years, present with acute or acute on chronic abdominal pain. Subsequent imaging studies demonstrated macrocystic, mesenteric lymphatic malformations. These malformations may become painful in the setting of hemorrhage or superimposed infection. As this condition is likely not at the forefront of the clinician's mind, it is incumbent upon the radiologist to recognize the imaging findings. This case study will present a multimodality approach to the diagnosis of macrocystic, mesenteric lymphatic malformations.

Poster #: CR-015

A Twisted Story of Concurrent Ovarian Torsion and Appendicitis

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Purpose or Case Report: Ovarian torsion is a very rare occurrence where the ovary becomes twisted, cutting off blood supply, and placing the ovary at risk of tissue death and loss of function. Appendicitis, although more common in the pediatric population, is still a relatively uncommon condition that can have grave consequences. Appendicitis secondary to ovarian torsion, in the instance where the ovary twists on its peduncle around the body of the appendix, is not only extremely rare, but puts the patient at risks for complications and consequences for both of these rare issues. This case report will tell the story of a 15-year-old girl including her initial presentation, clinical details, imaging, post-operative notes, and prognosis. Although a very atypical finding, this case highlights the importance of time and the particular dangers when dealing with two very critical diagnoses.

Poster #: CR-016

Rare Twists as the Cause of Pediatric Pelvic Pain: Torsion of Bilateral Paratubal Fallopian Cysts

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Purpose or Case Report: Isolated bilateral fallopian tube cyst torsion is extremely rare in the pediatric population. We have found no published reports of this entity in a child. Early diagnosis of such cases is crucial for the possibility of fallopian tube salvage surgery and the prevention of irreversible damage. Nonspecific clinical and imaging findings in a few reported unilateral cases in children often make surgical intervention mandatory for the diagnosis.A 10-year-old girl came to the hospital for acute lower abdominal pain. Ultrasound findings demonstrated two large para-ovarian cysts, contiguous with tortuous and dilated fallopian tubes, suggesting torsion of the tubes. A clinician ordered CT did not add any new information.The patient underwent a diagnostic laparoscopy that confirms the USG impression of the torsion of the bilateral fallopian tubes. Surgical exploration demonstrated twisting of about 1080 degrees of the hemorrhagic and necrotic right paratubal cyst and tube. The left cyst and tube were torsed at 360 degrees. Right partial salpingectomy, left paratubal cyst aspiration, and detorsion of fallopian tubes was accomplished. The uterus and ovaries were healthy.Isolated bilateral fallopian tube torsion is extremely rare in the pediatric population with nonspecific clinical and imaging findings. Diagnosis usually requires surgery. Our study showed a case of bilateral fallopian tube torsion that occurred about bilateral paratubal cysts. Visualization of a dilated fallopian tube in the presence of

normal-sized ovaries must be concerning for fallopian tube torsion, which can be secondary to a paratubal mass or cyst. Prompt early recognition and operative management of this relatively rare entity may prevent unnecessary tubal resection and improve long term fertility.

Poster #: CR-017

Berdon Syndrome: A Diagnostic Approach to a Rare Disease

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Purpose or Case Report: 1. Berdon syndrome, or Megacystis-microcolon-intestinal hypoperistalsis syndrome (MMIHS), is a rare condition with heavy morbidity and high mortality. Therefore, recognition and early diagnosis of this entity are critically important for improved patient management and family counselling. Awareness of this rare disease is a prerequisite to early recognition, whether antenatally or in the neonatal period.2. We present two cases of Berdon syndrome at our institution. Berdon syndrome is a congenital and generally fatal disease characterized by hypoperistalsis of the gastrointestinal system, non-obstructive bladder distension, and microcolon. As of 2018, only 450 cases have been reported in literature since first described in 1976.3. We present a logical diagnostic approach to this entity from the starting point of megacystis. Starting at megacystis helps narrow the differential diagnoses, with Eagle-Barret syndrome and posterior urethral valves being the main differential considerations.

Poster #: CR-018

A Rare Congenital Urogenital Anomaly: Case Report in a University Hospital in Chile.

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Purpose or Case Report: Show the imaging findings in a series of 4 OHVIRA syndrome, cases reported, in our hospital in a period of 10 years (May 2009 and May2019).
Methods & Materials: Femenines ≤15yo, with pelvic ultrasound and MRI, between May 2009 and May 2019, that reveals signs of complete uterine duplication, including the body and cervical region, presence of a vaginal septum with obstructed hemivagina and renal agenesia.
Results: 4 femenine patients with 10, 11, 13 and 14 years old with complete uterine duplication.3 patients with right renal agenesia, 1 patient with left renal agenesia.3 patients with right obstructed hemivagina, 1 patiente with left obstructed hemivagina.
Conclusions: Due to the complexity of the manifestations, the diagnosis of Müllerian malformations requires more than one imaging method.MRI is the most appropriate imaging method, with a sensitivity and accuracy close to 100%, providing great uterine anatomical detail.The recognition and early surgical treatment of this rare entity is important to avoid symptoms, preserve fertility and avoid complications.

Poster #: CR-019

Angiomatoid Fibrous Histiocytoma with Extensive Lymphadenopathy and Anemia - an Unusual Presentation of a Rare and Often Misdiagnosed Tumor

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Purpose or Case Report: Angiomatoid fibrous histiocytoma (AFH) is a rare soft tissue neoplasm presenting as a mass in the subcutis or deep dermis in the extremities of children and young adults. Although previously regarded as 'malignant', due to its benign microscopic appearance and favorable prognosis, this tumor was categorized as an "intermediate tumor of uncertain differentiation" in the 2013 World Health Organization classification.AFH is often misdiagnosed on imaging and pathology. We will present the unusual case of AFH with extensive lymphadenopathy and multiple episodes of anemia. The imaging findings will be illustrated with radiographic, ultrasound, MRI, and PET/CT exams. We will also present gross specimen and pathology images.Our case involves a 9 year old male presenting with asymptomatic left upper arm and left chest wall masses for two years. A previous biopsy of the mass and a lymph node had been performed, showing juvenile capillary hemangioma and benign progressive germinal transformation, respectively. The patient had several prior episodes of anemia requiring multiple blood transfusions. Coagulopathy workup was negative, and it was postulated that bleeding into the mass could be the source of the anemia.Radiographs revealed a 4.5 cm ovoid mass in the posteromedial soft tissues of the upper left arm with stable size but increasing calcific serpiginous opacifications throughout the lesion compared to two years prior. Multiple round soft tissue nodules within the left axillary region were also present.MRI revealed a heterogeneous lesion with a calcified rim with significant susceptibility artifact likely from hemosiderin. Several enlarged adjacent lymph nodes were present with additional marked lymphadenopathy filling the left axilla abutting the brachial plexus and neurovascular bundles, extending superiorly above the acromion. The largest lymph node measured 2.8 cm within a cluster of lymphadenopathy measuring 9 x 4 x 4 cm, increased compared to MRI two years prior. PET/CT revealed increased radiotracer uptake in the mass with a max SUV of 4.5 and within the left axillary lymphadenopathy with a max SUV of 6.5.The patient underwent surgical excision of the mass with dissection and removal of two adjacent palpable lymph nodes. The mass had a firm capsule with a red/myxoid appearance measuring 6.0 x 5.0 cm. Pathology of the mass was consistent with angiomatoid fibrous histiocytoma and pathology of the lymph nodes revealed reactive follicular hyperplasia.

Poster #: CR-020

Hypertrophic Pulmonary Osteoarthropathy in a Child with Pleuropulmonary Blastoma

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Purpose or Case Report: Hypertrophic pulmonary osteoarthropathy (HPOA) is a syndrome characterized by

excessive proliferation of skin and bone in the distal extremities. The classic imaging finding is symmetric, smooth periosteal reaction of the bones of the forearm or lower leg. The pathogenesis of this new bone formation is not well understood. Proposed mechanisms include growth factor release mediated by the tumor itself or the shunting of megakaryocytes through the pulmonary vasculature. These growth factors may contribute to vascular proliferation and bone formation. HPOA can be idiopathic but is more commonly secondary in patients with a variety of pulmonary disorders, congenital heart disease, and inflammatory bowel disease. HPOA is more commonly seen in adults than children. We present a case of HPOA in a patient with pleuropulmonary blastoma, a rare pediatric intrathoracic tumor.A 3 year-old girl was diagnosed with pleuropulmonary blastoma after presenting to the emergency department with a twelve-day history of fever and leg pain. As part of a fever of unknown origin workup, chest radiographs were performed, which showed a large left lower lobe mass. Contrast-enhanced computed tomography characterized the mass as mixed cystic and solid. As part of the preoperative evaluation for osseous metastatic disease, a technetium-99m bone scan was performed, which revealed bilateral, symmetric radiotracer uptake within the ulnar and fibular shafts, and the distal humeri. Subsequent radiographs of these bones demonstrated bilateral, symmetric smooth periosteal reaction. Following surgical resection of the pleuropulmonary blastoma and completion of chemotherapy, a bone scan was repeated which showed resolution of the previously seen scintigraphic findings.To date, HPOA has never been reported in a patient with pleuropulmonary blastoma. This case report highlights that HPOA, commonly thought of as an entity of adult lung disease, can also present in children.

Poster #: CR-021

Progressive Osseous Heteroplasia: A Case Report

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Purpose or Case Report: We report a case of 2-year-old female, twin, low birth weight (37 weeks, 1630 g - 3.59 lb), who was referred to our hospital to study an indurated nodular tumor involving her left leg, which extended from her pelvis to her left foot. Blood tests showed only an increase in alkaline phosphatase (862 mg/dl). Lower-limb X-ray was performed, which showed an extensive calcified mass with fibrillar pattern affecting dermis and deep connective tissue. MRI was also performed and showed an extensive signal alteration in muscle and dermis with hipointense signal in relation to heterotopic calcifications.The differential diagnoses were Albright hereditary osteodystrophy (AHO), fibrodysplasia ossificans progressiva (FOP), and progressive osseous heteroplasia (POH).AHO was ruled out because of the lack of compromise of muscle plane, and the absence of congenital malformations (such as brachydactyly, obesity, low height), hypocalcemia and hyperphosphatemia. Similarly, FOP was also ruled out since it is characterized by muscle ossification, with no dermal calcifications, and hallux malformation (also absent in this case).The diagnosis reached was POH, which is a rare genetic (autosomal dominant inheritance) disorder characterized by progressive periarticular ossification of dermis and deep connective tissues (muscles, tendons and ligaments), with no congenital malformations. The diagnosis is built upon the clinical symptoms, imaging findings and genetic study (GNAS mutation). There is no effective treatment, with frequent progression to ankylosis.
Conclusions: It is important for the pediatric radiologist to know about progressive osseous heteroplasia and its main differential diagnoses, and the importance of a simple x-ray study for the clinical suspicion and diagnosis of this infrequent entity.

Poster #: CR-022

Cochlear-Facial Dehiscence in a Pediatric Patient

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Purpose or Case Report: Congenital and acquired forms of temporal bone dehiscences involving the facial nerve (FN) canal, semicircular canals, and otic capsule can cause functional inner ear abnormalities and represent critical landmarks for cochlear implant surgeons. The rarest and most recently described type, cochlear-facial dehiscence (CFD), is characterized by lack of an osseous partition between the labyrinthine facial nerve canal segment and the cochlea. CFD has only been reported in adults, both by CT and histopathology. We share a case of CFD diagnosed by temporal bone CT in a pediatric patient presenting with hearing loss. This is an important condition for radiologists to be aware of when evaluating the temporal bone.Case Report (in brief)Our patient is a male toddler who presented at 15 months of age because he was not responding to parents' voices. Workup revealed profound bilateral sensorineural hearing loss.At 20 months of age, he underwent an axial high-resolution CT scan without contrast with 0.625 mm thick images of the temporal bones. Cochlear-facial dehiscence was noted bilaterally, with 0.8 mm bone defects between the labyrinthine segment of the facial nerve canal and the adjacent superolateral aspect of the cochlear mid turn (CFD). This was thought to represent a possible anatomic defect responsible for the patient's reported sensorineural hearing loss (SNHL). The remainder of the CT examination was normal without additional areas of dehiscence.Discussion (abbreviated):In its normal, mature state, the facial nerve passes through a fully enveloped bony canal situated superiorly and along the lateral part of the cochlea. Inadequate facial nerve canal ossification may occur secondary to impaired epithelial-mesenchymal interactions in precursor areas at intermembranous bone ossification sites.A presumed congenital cochlear-facial dehiscence was present in our patient bilaterally, and may have been partly or entirely responsible for his hearing loss. The defect could be from ossification failure or over-resorption of the bone. Cochlear-facial dehiscence is an important diagnosis to be primed for during the assessment of temporal bone CTs, especially in patients with findings suggesting a 3rd window phenomenon. Furthermore, it is critical to convey the presence of a CFD to the otolaryngologist prior to any consideration for cochlear implantation as it may predispose the patient to facial nerve stimulation during activation or usage of the implant.
Conclusions: See above

Poster #: CR-023

Duplication of the Pituitary Gland-plus Syndrome – New Case Report of a Severe Phenotype

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Purpose or Case Report: Duplication of the pituitary gland (DPG) is an extremely rare malformation, with only 40 reported cases in the medical literature. Phenotypes range from isolated DPG with normal development to cases with additional anomalies leading to morbidity and mortality ("DPG-plus" syndrome). We describe a patient with comprehensive fetal and postnatal imaging detailing known findings of DPG-plus syndrome and previously undescribed brain and body anomalies.An infant male was diagnosed with an obstructive oral cavity mass by fetal MRI. Postnatal neuroimaging showed a fatty oral cavity mass containing dysmorphic mandibular elements. Upon biopsy, pathological assessment showed duplication of the maxillary complex versus mesenchymal hamartoma. Other anomalies included duplicated nasal cavity, absent olfactory bulbs, duplicated sella with sellar spine, optic chiasm and tubomamillary fusion, duplicated basilar artery, persistent falcine sinus, cleft palate, and bifid tongue. In addition, there was an unusual complex brainstem and cerebellar anomaly and extensive anterior cervical vertebral clefting with anterior cervicomedullary junction myelomeningocele. Body imaging showed horseshoe pulmonary sequestration, hiatal hernia, multiple intrathoracic and intraabdominal spleens in a manner inconsistent with heterotaxy, midline liver, duplicated IVC, and vertebral anomalies. Echocardiogram showed double outlet right ventricle. Genetics evaluation revealed variants of unknown significance in CCDC39, TBX5, and ZMYND10 that were considered unlikely to be related to the observed anomalies. Due to poor neurologic prognosis, the patient was transitioned to comfort care and passed away at 4 weeks of age.
Conclusions: A wide spectrum of phenotypes is described in DPG-plus syndrome. To our knowledge, our case is the first with comprehensive fetal and postnatal brain, head and neck, and body ultrasound, CT, and MRI showing both known and novel anomalies. The hindbrain, cervicomedullary junction, and body anomalies are particularly distinctive. While the etiological mechanisms for DPG-plus syndrome and the unique combination of anomalies in our patient remain unknown, the constellation of predominately midline brain, head and neck, spine, and thoracoabdominal abnormalities favors a relatively severe notochordal splitting phenomenon. Such unique cases may further knowledge about the pathophysiology of this rare syndrome and ultimately shed light on incompletely understood embryological processes.

Poster #: CR-024

Nasopharyngeal Extraosseous Chordoma in a Pediatric Patient

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Purpose or Case Report: We present a case of an 8 year old female who presented with recurrent epistaxis. An endoscopy with cauterization was performed and an adenoidal mass was found. A subsequent CT showed a well-circumscribed, hypoattenuating mass within the nasopharynx. The MRI showed a heterogeneous, T2 hyperintense lesion, with predominantly hypointense T1 signal relative to muscle, and with heterogeneous contrast enhancement. An excisional biopsy was performed, and the lesion was found to be an extraosseous chordoma. The goal of this case report is to discuss the characteristics of this relatively rare entity that is a differential consideration for nasopharyngeal mass lesions.Chordomas are a rare type of malignant neoplasm that predominantly form in the sacrococcygeal and spheno-occipital regions. They arise from embryonic remnants of the primitive notochord, which is a primitive cell line that develops around the skull base and vertebral column. Chordomas are slow-growing, locally invasive tumors that have a low propensity for distant metastasis. They can occur in any age but are seen more commonly in adults with a peak prevalence in the 4th decade of life.Intracranial chordomas account for 1% of all intracranial tumors. They tend to have high mortality rates due to tumor recurrence and close relation to critical structures at the skull base, such as the optic system, cavernous sinus, carotid arteries, and brainstem. Extraosseous chordomas are a rare subtype, and due to the lack of classic lytic bone changes, they can be difficult to diagnose. Extraosseous chordomas of the nasopharynx can mimic many other common tumors of the nasopharyngeal region, including non-Hodgkin lymphoma, nasopharyngeal carcinoma, and Tornwaldt cysts. When a clival sinus tract is in view, however, extraosseous chordoma should jump towards the top of the differential.

Poster #: CR-025

Neuroimaging Sequelae of ACTA2 Mutation

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Purpose or Case Report: ACTA2 mutation occurs in the alpha-actin gene. Since the gene product is not expressed in brain parenchyma but is a contractile protein of smooth muscle cells that make up vascular walls, structural brain findings in this disorder are postulated to be the result of mass effect from abnormal rigid arteries during development. Presented here are typical imaging findings of ACTA2 mutation to emphasize the radiologist's role in diagnosing this disease prospectively.
Methods & Materials: A 2-year-old female presented to an outside hospital with ataxia. On physical exam, her pupils were dilated and poorly reactive. A CT performed at the outside facility demonstrated low attenuation throughout the white matter, greatest in the centrum semiovale. A preliminary diagnosis of possible demyelinating or leukodystrophy was assigned, and the patient was transferred to our pediatric hospital for further evaluation.
Results: An MRI of the brain was requested which exhibited confluent T2 hyperintensity throughout the periventricular white matter. The corpus callosum was minimally foreshortened, the paramedial frontal gyri were radially oriented, the anterior of the corpus callosum was v-shaped on the axial images, and a central indentation on the anterior pons along the course of the basilar artery was apparent. MRA demonstrated a broomstick pattern of the branches of the Circle of Willis. There was high-grade stenosis of the distal left internal carotid artery and narrowing of the distal right internal carotid artery, but both internal carotid arteries were dilated proximally. A follow-up transcranial Doppler also showed the distal internal carotid artery stenosis.

Flow velocity in the right middle cerebral artery was elevated.
Conclusions: ACTA2 mutation is a rare cause of encephalopathy in children. In the setting of unexplained white matter T2 hyperintensity and straightened branches of the Circle of Willis, ACTA2 mutation should be considered as a differential consideration. Corroborating structural anomalies such as those described in this case may further aid in diagnosis.

Poster #: CR-026

A Case Study of Orbital Cellulitis in a Patient with Congenital Glaucoma

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Purpose or Case Report: History 15 y/o female with congenital glaucoma presents to the emergency room with right eye pain, redness and swelling. She has baseline corneal opacifications and can see light and shadows but is otherwise visually impaired. The symptoms started 2 weeks prior foreign body sensation her right eye. Antibiotic drops were prescribed but symptoms continued to worsen. A week later another topical antibiotic was added but the eye began to swell, have increased pain, and developed discharge. Her opthomalogist referred her to the ER with concern of endophthalmitis (serious intraocular infection that affects the vitreous and/or aqueous humors of the eye).
Methods & Materials: Imaging performed: CT showed significant right orbital pre-and postseptal inflammatory process without abscess.Ultrasound with Doppler demonstrated marked right globe wall thickening, hyperemia and intraconal and extraconal fat inflammatory changes, concerning for right globe abscess (endophthalmitis).MRI revealed extensive inflammation of the right globe/orbit, globe rupture and endophthalmitis with early infectious spread to the right masticator space. Concern for panophthalmitis.
Results: Intervention: Due to the severe infectious process, enucleation (removal of the eye while keeping the muscles that control the eye in place) was completed. Cultures performed grew S. pneumonia which despite prompt treatment is associated with poor visual prognosis. A second surgery due to pus drainage around wound dressing was performed to clean out and repack the orbit. Once the infection was resolved, a prosthetic eye was placed during a third and final surgery.Congenital glaucoma is a rare condition that may be inherited, in which the drainage system of the eyes have not developed correctly. Increased intraocular pressure that cannot be relieved in turn damages the optic nerve. It affects 1 in 10,000 newborns, bilaterally in 2/3rd of cases, 2:1 males/females, and has no racial predilection.Symptoms include photosensitivity, excessive tearing and unusually large, cloudy eyes. Diagnosis is usually made within the first year of life. Early diagnosis and intervention is key as 2-15% of those affected may become legally blind. Monitoring of these patients intraocular pressures (IOP) is indicated throughout life.
Conclusions: In this case study, imaging of the orbits with various modalities provided a complete depiction of a grave condition that allowed for prompt intervention and management of a difficult infection.

Poster #: CR-027

Acute Flaccid Myelitis: MRI Findings in Three Pediatric Patients

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Purpose or Case Report: Introduction: Acute flaccid myelitis (AFM) is a relatively new subcategory of acute flaccid paralysis affecting children, which has gained increasing attention in the medical community and media in recent years. AFM is characterized by rapid onset acute flaccid limb weakness with spinal cord lesions on magnetic resonance imaging (MRI) predominantly involving the gray matter. Cranial nerve involvement has also been described. The severity of AFM nearly always requires hospitalization for supportive care, which may include mechanical ventilation. Evidence is lacking regarding the utility of specific therapies, although patients have been treated with intravenous immune globulin, steroids, and antiviral therapy. Unfortunately, though neurological improvement may occur, the majority of patients are left with persistent deficits.We present the imaging findings of three children with varying presentations and outcomes of acute flaccid myelitis treated at a tertiary care children's hospital.Case 1: An 11-year-old girl developed severe upper extremity weakness requiring weeks of inpatient rehabilitation with plan for evaluation for nerve transfer. MRI showed abnormal increased T2 signal of nearly the entire spinal cord, most notable in the cervical spinal cord.Case 2: A 9-year-old boy positive for Enterovirus presented with bilateral upper and lower extremity weakness, whose symptoms ultimately resolved. MRI of the brain and full spine were normal except for a thoracic spinal cord syrinx, which was felt to be incidental.Case 3: A 2-year-old girl with a history of acute lymphoblastic leukemia developed bilateral upper extremity weakness and lower extremity areflexia during a hospitalization for an acute viral illness, complicated by chronic ventilator-dependent respiratory failure. MRI demonstrated enhancing T2 signal in the brainstem and cervical and thoracic spinal cord.Discussion: Acute flaccid myelitis is an important pediatric neurological disorder of rapid clinical onset frequently resulting in persistent neurological deficits. Radiologists serve an important role in establishing the diagnosis by identifying this disease's characteristic MRI findings.

Poster #: CR-028

A Mimic of Post-op Infection: Aseptic Meningitis Following Transsphenoidal Craniopharyngioma Resection

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Purpose or Case Report: Aseptic or chemical meningitis is an inflammation of the meninges without an infectious cause. It is a diagnosis of exclusion which is reached only in the appropriate clinical context after a careful search for bacterial or viral pathogens is negative. Aseptic meningitis following transsphenoidal resection of craniopharyngioma has been reported in the neurosurgical literature with an incidence of up to 3%; however, it remains unfamiliar in the radiology literature and there have been only a few case reports describing associated imaging findings. The chemical meningitis is thought

to be caused by the release of craniopharyngioma fluid which contains inflammatory cholesterol crystals. Clinical and CSF findings can be identical to bacterial meningitis except for the absence of identifiable bacterial or viral pathogens. Complications can include vasospasm, stroke, and death. The purpose of this report is to describe two cases of aseptic meningitis following craniopharyngioma resection with the hope of improving awareness among pediatric radiologists.
Methods & Materials: Two patients (8 and 12 years old) underwent transsphenoidal resection of craniopharyngioma. Because of clinical concern for infection, both patients had post-operative MRIs which demonstrated leptomeningeal enhancement concerning for infectious meningitis. Both patients had elevated CSF neutrophils and protein, consistent with bacterial meningitis; however, CSF abnormalities persisted despite antibiotic treatment and CSF cultures remained negative. Follow-up MRI demonstrated resolution of leptomeningeal enhancement by 6 weeks with associated clinical improvement in both patients.
Conclusions: Craniopharyngiomas are relatively frequent tumors in children and aseptic meningitis should be included in the differential when a child presents with imaging findings concerning for meningitis following transsphenoidal craniopharyngioma resection, especially if CSF cultures are negative. It is possible that this entity is being underdiagnosed because patients are being treated for presumed infectious meningitis.

Poster #: CR-029

A Novel Safe In-NICU MRI Scanner for Evaluation of the Neonatal Brain – Case Reports

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Purpose or Case Report: A novel 1T MRI scanner, previously compared to a 1.5T Siemens scanner, was placed in our NICU. The 5-gauss safety line is inside the magnet, rendering standard magnetic safety precautions unnecessary and allowing maintaining ongoing critical care. Scans included near-term equivalent stable neonates and neonates in an acute / sub-acute setting of disease. Through the following cases we present the capabilities of the 1T in-NICU scanner to evaluate the neonatal brain throughout different phases of injury.Case 1–Chronic. A 28 5/7 week infant born to mother with chorioamnionitis, developed sepsis. Cranial US showed bilateral IVH Grade III (L) / IV (R) on DOL 2. At DOL 49, ventriculomegaly and porencephalic cysts were detected on US. MRI at term equivalent age demonstrated the post hemorrhagic cystic degeneration and ventriculomegaly. Follow up MRI was performed at 4 months of age due to increasing head circumference. Presence of prior MRI images increased diagnostic confidence.Case 2–Sub-acute. A term infant with moderate encephalopathy treated with therapeutic hypothermia, after absent fetal movements for two days. Complicated NICU course, with multi-system organ failure, seizures and severe hypoglycemia. MRI scan on DOL 14 showed punctate rim-T1 hyperintense foci with a hypointense center, opposite T2 signal and restricted diffusion, in the centrum semi-ovale and periventricular white matter. Sub-acute hemorrhage with suspected ischemic etiology was the working diagnosis.Case 3–Acute. A term infant delivered by stat C-section for non-reassuring fetal heart rate and low Apgar scores. Complicated NICU course, including multisystem organ failure, seizures, and burst suppression on cerebral monitoring. MRI scan on DOL 6 showed diffuse abnormal cortical T1 and white-matter T2 signal. Restricted diffusion was seen diffusely in a posterior distribution. Diffuse hypoxic ischemic injury was diagnosed.Case 4–Hyper-Acute. A 31 week infant was delivered by stat C-section after major maternal trauma, with extremely severe hypovolemic shock. An MRI scan was performed at 8 hours of life, to determine direction of care while intubated and on vasopressor support. Extra-axial and intraventricular hemorrhage were seen, as well as diffuse restricted diffusion. The scan assisted family and physicians to reach a decision regarding discontinuing of care.
Conclusions: The 1T in-NICU scanner serves as a safe potential diagnostic tool for different phases of neonatal brain injury.

Poster #: CR-030

Altered Biodistribution of FDG in Hodgkin Lymphoma after Completion of High Dose Steroid Therapy: A Case Series with Important Clinical Implications.

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Purpose or Case Report: PET/CT plays an important role in assessing response to therapy in patients undergoing treatment for Hodgkin's lymphoma (HL). A negative PET/CT following completion of chemotherapy has a high negative predictive value (>95%) for disease progression, relapse, or recurrence. Thus treatment decisions, including the decision to pursue radiation therapy or to alter chemotherapy regimens, are often made based on PET/CT results. Given the treatment implications, obtaining accurate PET/CT results is of the utmost importance.
Results: High doses of steroid are used in most HL treatment regimens. Reports in the literature have suggested high steroid doses being given around the time of PET/CT can be associated with altered FDG distribution and accumulation in white fat, thus limiting the interpretability of the PET/CT. We present a series of 4 pediatric HL patients in whom this altered pattern of FDG distribution was observed on PET/CT examinations performed after the patients had completed their HL therapy course and were no longer receiving high dose corticosteroids. We also present results from an additional patient with methylmalonic acidemia, in whom the same altered FDG uptake distribution was observed. These results demonstrate that the "Cushingoid" pattern of altered FDG uptake in subcutaneous white fat can occur even when patients are not actively receiving high treatment doses of steroid, and suggest an alteration in gluconeogenesis as a possible explanation for the altered uptake pattern.
Conclusions: An altered pattern of FDG biodistribution and accumulation in white fat has been observed in patients receiving high dose corticosteroid therapy. The results presented here extend those observations and show that this altered pattern of FDG distribution can also occur following treatment for Hodgkin lymphoma, and may be observed with lower doses of steroid and may occur even after patients are no longer actively receiving corticosteroids. A similar altered distribution of FDG uptake was also observed in a patient with MMA suggesting that alteration in gluconeogenesis may be involved as an underlying mechanism. In the patients with HL, repeat PET/CT examinations performed several days later revealed normalization of FDG distribution. These results indicate that a delay of up to two weeks following the completion of high dose

corticosteroid therapy should reduce the residual steroid effects on glucose metabolism and increase the diagnostic yield of re-staging PET/CT examinations.

Poster #: CR-031

Expect the Unexpected: Additional Finding on ^{68}Ga-DOTATATE PET/CT in a Patient with Von Hippel Lindau

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Purpose or Case Report: Patients with Von Hippel Lindau are predisposed to develop neuroendocrine tumors (NET) such as pheochromocytoma. These tumors are known to be somatostatin receptor positive and therefore can be imaged with specific radiotracers that target these receptors like ^{111}In-octreotide and ^{68}Ga-Dotatate. In addition to NET's, 80% of these patients will also develop hemangioblastomas in the brain and spinal cord which have been shown to harbor somatostatin receptor subtypes including SSTR-2a, one of the target receptors for DOTATATE. We present a case of a teenager with suspected NET in the adrenal gland who underwent ^{68}Ga-DOTATATE PET/CT. The PET confirmed uptake in the adrenal lesion, but also highlighted a focus of uptake in the spine. Correlative MRI of the spine demonstrates classic imaging features of hemangioblastoma. This finding has not previously been described in the published literature in children.This case report will discuss the mechanism and utility of ^{68}Ga-Dotatate PET/CT and emphasize the manifestations of Von Hippel Lindau disease. We will review the normal pattern of Dotatate uptake and the significance of somatostatin receptors in neoplasms in the VHL patient population.

Poster #: CR-032

PET/CT Imaging of a Unique Case of Multiple Myeloma in a Child

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Purpose or Case Report: To present the first PET/CT and PET/MRI imaging findings of acase of multiple myeloma, MM, in a pediatric patient.
Methods & Materials: 15 year old boy presented with painless occipital mass. The initial PET/CTand pathologic specimens as well as post-chemotherapy PET/MRI findings were reviewed and are presented.
Results: The midline occipital lesion demonstrated a soft tissue mass centered in the occipital bone with lytic change with a beveled edge on CT. The lesion was felt to represent an eosinophilc granuloma but on biopsy was shown to be a plasmacytoma. Staging PET/CT demonstrated marked hypermetabolism but no additional lesions. Laboratory findings demonstrated elevated IgA kappa light chain protein. Bone marrow biopsy was normal. The patient was treated for plasmacytoma with radiotherapy alone (5800cGy/28 fractions). The kappa protien level normalized. Post-radiation PET/MR demonstrated excellent results to the primary lesion.
Conclusions: Solitary plasmycytomas in children are extremely rare with only 14 cases previously reported with no previous published cases with PET imaging findings.

Poster #: CR-033

Vaping-Associated Lung Illness

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Purpose or Case Report: **Introduction:** The use of e-cigarettes, or vaping, has become increasing popular, and little is known about its long-term effects. We present a case of vaping-associated lung illness in a pediatric patient.**Case Presentation:** An 18 year-old male presented with worsening fever, chills, and vomiting over a week. He was diagnosed and treated for pneumonia. He denied smoking but endorsed vaping until developing his illness. Over the next two weeks, he lost 12-15 pounds but his cough improved and his appetite returned. He continued to feel weak, tired, and lightheaded upon standing. Labs revealed an elevated ESR and platelet count. The chest radiograph demonstrated an abnormal pattern of perihilar consolidation and ground glass opacity. Further evaluation by computed tomography demonstrated bilateral interstitial and ground glass opacities with areas of consolidation and tree-in-bud centrilobular nodules. The opacities were predominantly peripheral and peribronchiole in location with subpleural sparing. There was associated cylindrical and varicoid bronchiectasis. The overall appearance was most consistent with organizing pneumonia.**Discussion:** Little is understood about the relatively new vaping-associated lung illness. E-cigarettes were first introduced in 2007, marketed as a safer alternative to smoking cigarettes and as a method for smoking cessation. Vaping has become exceedingly popular among youth. E-cigarettes use heat to vaporize liquid into aerosol, which is then inhaled. Liquid cartridges often contain nicotine, tetrahydrocannabinol, and cannabinoid oils. Additional compounds also found in these products include diacetyl and propylene glycol for flavoring and glycerin to create visible smoke. The exact mechanism and cause for lung injury is unclear, but it is postulated that chemical irritation and potentially thermal injury lead to some of the effects seen thus far. Other ingredients can be added to cartridges, making the etiology of injury even more elusive. Based on reported cases, patients often present with a range of symptoms, including dyspnea, pleuritic chest pain, nausea, and vomiting. Work-ups often reveal lipoid pneumonia, bronchiectasis, eosinophilic pneumonia, pleural effusions, suspected hypersensitivity pneumonitis, and at least one case of diffuse alveolar hemorrhage. In our case the appearance was that of organizing pneumonia. It is unclear if damage is reversible, but some reports discuss clinical improvements with a steroid course.

Poster #: CR-034

Vaping Associated Lung Injury Requiring Bilateral Lung Transplant in an Adolescent

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Purpose or Case Report: E-cigarette, or vaping, product use associated lung injury (EVALI) is a newly recognized entity that is being reported with increasing frequency in the literature and mainstream press. The aim of this case report is to radiographically illustrate the fairly rapid progression of a

severe case of EVALI that ultimately required a successful bilateral lung transplant, and to describe a unique histopathology correlation. **Case Report:**Our patient is a 16-year-old, previously healthy male with a two year history of vaping who presented to an outside hospital for dyspnea and nonproductive cough. He was initially treated with antibiotics for community acquired pneumonia. Initial contrast-enhanced CT of the chest demonstrated subtle bilateral but right lower lobe predominant centrilobular nodules, ground glass opacities (GGO) and mild septal thickening. Bronchial alveolar lavage, microbiology studies and autoimmune panel were negative for an infectious or autoimmune etiology. Repeat chest CT only five days later following clinical deterioration demonstrated a dramatic worsening of bilateral nodular airspace opacities, septal thickening, GGO and dependent diffuse consolidations. Pneumomediastinum and mild bronchiectasis were also present. Our patient's condition continued to decline requiring intubation and subsequent ECMO support. He was transferred to our tertiary care center for bilateral lung transplant. Histopathology of the explanted lungs described predominant acute necrotizing and granulomatous bronchopneumonia with areas of organizing pneumonia.

Poster #: EDU-001

The Modified Barium Swallow Study: An Institutional Strategy for Radiation Dose Reduction

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Purpose or Case Report: The aim of this strategy is to standardize the performance of our modified barium swallow studies (MBSS) with a focus on communication between team members and the reduction of fluoroscopic radiation dose exposure to the radiosensitive head and neck region.The radiation dose reduction strategy is composed of the following steps:The radiology technologist will initiate the patient encounter, begin room setup, and notify the radiologist of patient arrival.The radiologist will review prior examinations, if available, and discuss the current indication and goal of the examination with the Speech/Occupational Therapist and Radiology Technologist.The pulsed acquisition rate is standardized at 15 frames/second, and the optimal field of view will be discussed and adjusted dynamically, if necessary.The team will utilize standardized consistencies based on the International Dysphagia Diet Standardization Initiative (IDDSI).Once the in-room team has a clear objective the performing radiologist will proceed with the fluoroscopic examination. The radiologist will announce to the in-room team when fluoroscopic time points are met at 1 minute, 2 minutes, and a "hard-stop" at 3 minutes of fluoroscopic exposure. In order for an examination to continue beyond the 3 minute time point a mandatory discussion regarding clinical necessity will occur between the supervising radiologist and the in-room team members.The average fluoroscopic time required for the acquisition of a MBSS at our institution was calculated and reviewed before (2.07 minutes) and after (1.35 minutes) the implementation of this fluoroscopic radiation dose reduction strategy. The result is a 36 percent reduction in time of fluoroscopic exposure.The implementation of a radiation dose reduction strategy to our MBSS protocol has resulted in decreased fluoroscopic times, and therefore, a decrease in fluoroscopic radiation dose. An emphasis on verbal communication between team members ensures an understanding of the goal of the examination and awareness of proper management of radiation dose to patients and workers. This modified approach to the MBSS better aligns with the principle of "as low as reasonably achievable" (ALARA).

Poster #: EDU-002

Imaging in Heart Transplant Surgery and its Complications

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Purpose or Case Report: Orthotopic heart transplant (OHT) is the treatment of choice for patients with end-stage heart disease including pediatric patients. Imaging has an essential role in evaluation of the perioperative and postoperative heart transplant patients. Although some of the imaging is performed and interpreted by cardiologists, a substantial portion of images are read by radiologist, therefore radiologists must be familiar with common normal and abnormal posttreatment imaging features.Many end stage heart failure patients require circulatory support as a bridge to transplant, with a ventricular assist device or intra-aortic balloon pump. The ventricular assist devices specially increase the risk of infection, and intra-aortic balloon pump requires frequent radiographic monitoring to ensure appropriate placement in the proximal descending aorta, just distal to the left subclavian artery. Proximal placement may result in great vessel compromise and distal placement may cause occlusion of mesenteric and/or renal vasculature.Expected postoperative findings in the first few weeks after surgery included enlarged cardiac silhouette, small pneumomediastinum, pneumothorax, pneumopericardium, subcutaneous emphysema, small atelectasis, and mediastinal widening.Transplant-related complications are divide to:Early complications (0-30 days): pulmonary infection, interstitial and/or alveolar pulmonary edema, and allograft failure, also symptomatic pneumothorax, mediastinal hematoma, mediastinal infection, sternal dehiscence and vascular complications.Intermediate term complications (1-12 months): acute antibody related allograft rejection, acute cellular rejection (T-cell mediated response) which is the most common form of rejection, also tricuspid regurgitation, constrictive pericarditis, drug toxicity can happen in this time period.Late postoperative complications (>12 months): posttransplant lymphoproliferative disease, cardiac allograft vasculopathy, infection, kaposi sarcoma and other malignancies, aortic dissection, pseudoaneurysm formation, and thromboembolism. **Conclusions**: As the use of OHT for end-stage heart disease continues, familiarity with expected and unexpected procedure and treatment-related imaging findings is needed. Because clinical manifestations of disease may be delayed in OHT recipients, radiologists can be the first one in the health care team to recognize early postoperative complications.

Poster #: EDU-003 - ***Withdrawn***

Poster #: EDU-004

Don't Clot Me Now: Pediatric Venous Thrombosis

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Purpose or Case Report: Venous thromboembolism (VTE) is a multifactorial disease and a significant source of morbidity. Though the incidence of VTE, composed of deep venous thrombosis (DVT) and pulmonary emobolism (PE), is more common in adults, an increasing number of children are being diagnosed. Children who are critically ill are at greatest risk of developing VTE.Duplex sonography is a critical front line tool in the detection and evaluation of venous thrombosis. Serial surveillance examinations allow real-time assessment of thrombosis including propagation and progression.Recognizing the presentation and sonographic appearance of venous thrombosis assists the clinician in timely therapeutic decision-making and clinical management.The goals of this exhibit are:1. Describe the technical approach of performing duplex vascular ultrasound, including tips and technology that assist in optimizing studies.2. Discuss the incidence, risk factors, and clinical characteristics of pediatric VTE.3. Depict the sonographic appearance of thrombosis with emphasis on correlation to other modalities.4. Discuss prognosis and long-term outcomes of VTE in children.5. Describe future techniques and applications.
Methods & Materials: Duplex vascular ultrasound studies at our institute were reviewed retrospectively with selected representative cases chosen to illustrate technical aspects and clinical indications for this procedure. Correlation was made with follow up radiology studies, clinical and/or surgical outcomes.Causes of venous thrombosis, including those due to trauma, infection, inflammation, and malignancy, will be described.
Results: An increasing number of pediatric patients treated at tertiary care centers are being diagnosed with VTE. Central venous catheters (CVC) are the most common cause of VTE in children. Typical findings in normal and abnormal pediatric venous duplex exams will be illustrated. Emphasis on technique and methodology for serial examination is described. Characterization of venous waveforms will be discussed.
Conclusions: Through this exhibit, participants will learn about the diagnostic evaluation of pediatric venous thrombosis, including sonographic appearance and characteristics of spectral waveforms. Correlation will be made to other modalities in cases of VTE.

Poster #: EDU-005

Dynamic Contrast-Enhanced MR Lymphangiography in Infants: How We Do It

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Purpose or Case Report: Dynamic contrast-enhanced MR lymphangiography (DCEMRL) with intranodal injection has emerged as a useful tool in evaluating lymphatic disorders. We share our institutional experience with DCEMRL in infants through a detailed discussion of technique and series of case presentations.Techniques for nodal access and imaging infants with DCEMRL are explained through text and step-by-step illustrations. MR lymphangiography images of infants between 22 days and 8 weeks of age are presented with multi-modality correlation, including patients with congenital chylous ascites, non-immune fetal hydrops, and postsurgical chylothorax. Each case discussion includes a review of relevant lymphatic anatomy, explanation of the disease process, and key teaching points regarding DCEMRL in infants.

Poster #: EDU-006

Fetal Cardiac Magnetic Resonance Imaging (CMR) (FCMR) Imaing Finding Illustration and Correlation with Prenatal (echo) and Postnatal Imaging

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Purpose or Case Report: The purpose of this educational exhibit is to show FCMR images of congenital heart disease (CHD) and anatomical findings associated with CHD. We will describe currently available FCMR image acquisition techniques and use a case-based approach to show a variety of CHD diagnosis with teaching points to highlight the added value of FCMR in diagnosis and prognosis.
Methods & Materials: 50 fetuses, 21 4/7-38 weeks gestation with known, suspected and unknown diagnoses of CHD underwent FCMR either for confirmation of cardiac findings and/or for diagnosis of associated fetal anomalies, including neurological, renal, pulmonary or musculoskeletal systems.FCMR was performed using a pseudo ECG-gating technique to generate an artificial ECG trace to enable steady state free precession images of the heart in coronal, sagittal and axial planes. We will describe other techniques currently available, Doppler US and integrated ECG methods.FCMR findings will be shown along with correlative fetal echo and postnatal echo, cardiac MR and cardiac CTA images.
Results: 65 CHD diagnoses made with FCMR included hypoplastic left heart syndrome (10), ventricular septal defect (9), anomalous pulmonary veins (7), transposition of the great arteries (4), tetralogy of Fallot (3), and double outlet right ventricle (2). Fetal MR revealed additional important anatomical findings in fetuses with CHD including abnormalities of the pulmonary parenchyma, bronchi, abdominal visceral situs, intracranial abnormalities (brain malformations, stroke, ventriculomegaly) and skeletal dysplasia.
Conclusions: FCMR is an important diagnostic tool used to confirm or clarify the diagnosis of CHD which is most often initially made with echo. Fetal MR is known to be a highly sensitive and specific method for identification of non-cardiac imaging findings associated with CHD. Early knowledge of severity of and complexity of CHD and accompanying anomalies enables guidance for delivery planning and immediate postnatal care and opportunities for possible genetic counseling for parents.

Poster #: EDU-007

Fetal MRI Troubleshooting: Strategies to Improve Image Quality and Reduce Artifacts

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Purpose or Case Report: Fetal MRI has transformed prenatal patient care, allowing for earlier and better detection of complex congenital anomalies. However, fetal MRI's diagnostic utility is often limited by technical barriers that introduce artifacts and reduce image quality. The main determinants of fetal MRI image quality are speed of acquisition, spatial resolution and SNR. Optimization of imaging is a challenge because improvements in one aspect generally leads to a tradeoff in the others. Moreover, the recent introduction of 3T fetal MRI to achieve better SNR adds to the complexity. Motion, banding artifacts, and aliasing artifacts impact the quality of fetal acquisitions at any field strength. High SAR and artifacts from inhomogeneities in the RF field are important limitations of high field strength imaging. Fetal and maternal motion create the need for rapid image acquisition. This generally limits imaging to SST2w, bSSFP, T1w spoiled-GRE, and EPI sequences. Acquisitions can be degraded by low SNR, resulting in grainy images. This can be improved by increasing the number of coil elements or increasing the field strength. Blurry images can be a result of low resolution and can be improved by decreasing the FOV (at expense of SNR) or increasing the field strength. Most strategies to improve quality will also increase SAR, which can be controlled by decreasing the number of slices, lowering the excitation or refocusing flip angles, increasing the TR or lowering the field strength. Fast sequences can prevent some motion artifacts, other strategies include decreasing the number of slices, swapping the PE and FE directions, maternal breath hold or oral sedatives, and image reconstruction by motion correction algorithms. Aliasing artifacts can be effectively addressed by phase-oversampling (at expense of SAR in SST2w sequences) or rotating the long axis of the PE direction. Banding artifacts of bSSFP sequences can be minimized by decreasing TR (at expense of SAR) or lowering field strength. High field strength imaging can be severely limited by shading secondary to RF field inhomogeneities. Multichannel field transmit and complex field strength shaping show promising results to address this issue.In this educational exhibit we will use visual examples to discuss: 1) fetal MRI quality optimization tradeoffs, 2) technical barriers and artifacts that impact image quality, and 3) solutions to improve quality and reduce artifacts.

Poster #: EDU-008

Pictorial review of Subcutaneous Fat Necrosis of the Newborn

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Purpose or Case Report: Subcutaneous fat necrosis of the newborn (SCFN) is an uncommon disorder predominantly occurring in full-term and post-term neonates during the first 6 weeks of life. Clinically it presents as an area of edema followed by indurated plaques or non-tender and mobile nodules with overlying erythema, typically along the back, buttocks, extremities, or cheeks. SCFN may result from localized tissue hypoxia and mechanical pressure that further compromises the local circulation. Fetal and neonatal conditions including macrosomia, perinatal asphyxia, traumatic birth and therapeutic hypothermia; and several maternal conditions including preeclampsia, hypertension, gestational diabetes, cocaine or cigarette exposure, calcium channel blocker use during pregnancy, and familial dyslipidemia have been associated with SCFN. Although SCFN is a self-limiting condition, patients should be monitored for associated hypercalcemia and its complications such as nephrocalcinosis and nephrolithiasis.As these lesions are superficial, they are well evaluated with high resolution ultrasound imaging for initial assessment and follow-up. Findings on ultrasound and MRI include lesions confined to the subcutaneous fat sparing the dermis, with indistinct borders lacking a distinct mass. Lesions of SCFN are echogenic on US, intermediate to low signal intensity on T1-weighted sequences, intermediate to high signal on fluid sensitive sequences, and may demonstrate cystic changes.We will review the imaging findings of subcutaneous fat necrosis in over ten newborns collected from three tertiary care hospitals, with a focus on ultrasound findings. Many of the lesions were multifocal and the majority involved the patient's back. Ultrasound evaluation was performed in all cases. MRI performed in a minority of cases will also be reviewed. While only one case was biopsied for pathologic correlation, each lesion was closely followed clinically. We will also review several mimickers of fat necrosis to be aware of.

Poster #: EDU-009 - *Withdrawn*

Poster #: EDU-010

Fetal Lung Maturity Assessment: Current Status

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Purpose or Case Report: Fetal lung maturity is a key factor determining perinatal morbidity and mortality. Clinicians can perform amniocentesis and evaluate the amniotic fluid for certain surfactant byproducts such as lethicin, sphingomyelin, and phosphatidylglycerol to assess lung maturity. However, amniocentesis is invasive, and its results can be prone to errors. Imaging can offer a reliable non-invasive alternative that can be used for prognostication as well as suggestion of further follow up. Ultrasound is the imaging modality of choice to assess fetal development. It is readily available on widespread scale to assess for various abnormalities that can occur during pregnancy. Parameters used to assess fetal lung maturity on ultrasound include lung to head ratio as well as the observed/expected lung to head ratio. However, ultrasound parameters can be subjective, have inter- and intra-observer variability and depend highly on the imaging technique and quality. The advent of ultrafast MRI sequences expanded its use in fetal imaging offering an alternative to ultrasound. It is generally used as a problem-solving tool due its excellent soft tissue resolution. Two parameters are gaining acceptance as means to assess fetal lung development on MRI: lung volume measurements and lung/liver signal intensity ratio. Our exhibit aims at familiarizing pediatric radiologists with parameters used to assess lung development on both ultrasound and MRI.

Conclusions: Imaging plays a central role in assessment of fetal lung development, which helps in risk stratification, and management of fetuses with various congenital lung lesions.

Poster #: EDU-011

Fetal MR Appearance of Trisomy 13 (Patau Syndrome) and Trisomy 18 (Edwards Syndrome)

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Purpose or Case Report: Trisomy 18 (Edwards Syndrome) and trisomy 13 (Patau Syndrome) are the second and third most common chromosomal trisomy disorders, respectively, and their characteristic syndromic features have been well described; however, to our knowledge, no prenatal studies have reported the fetal MR findings of trisomy 13 and trisomy 18. For this reason, typical fetal MR features of trisomy 13 and 18 remain incompletely characterized and its role and limitations in its prenatal evaluation and diagnosis are not established in the literature.In this cased-based, pictorial educational exhibit, we review the syndromic features of trisomy 13 and 18, and present the prenatal MR findings of six cases of trisomy 18 and three cases of trisomy 13, all confirmed by pre and/or postnatal genetic testing. We will discuss the strengths and weaknesses of prenatal MR imaging in the evaluation of trisomy 13 and 18 by comparing to prenatal ultrasound and utilizing postnatal imaging as a reference standard.After reviewing this presentation, the learner will: (1) Be able to recognize not only the individual fetal MR appearance of abnormalities associated with trisomy 13 and 18, but recognize them as part of a trisomy syndrome. (2) Understand the strengths, limitations, and pitfalls of prenatal MR in evaluation and diagnosis of trisomy 13 and 18. (4) Become familiar with the key points and measurements that should be used in the assessment and diagnosis of the fetus with trisomy 13 and 18 and be included in the radiology report to best assist the multidisciplinary care teams in counseling the pregnant patient and providing care of the fetus and neonate with trisomy 13 and 18.
Conclusions: Fetal MR imaging is playing an increasing role in the evaluation of known and unknown cases of trisomy 13 and 18 and serves as an important guide for parental counseling, decision-making regarding the pregnancy, delivery planning, and sometimes, controversially, surgical planning. Additionally, in unknown cases of trisomy 13 and 18, where the mother has declined prenatal genetic screening or amniocentesis, fetal MR can assist the obstetrician in finding a unifying diagnosis when a fetus has multiple congenital abnormalities. As such, it is essential that the fetal imaging radiologist be not only able to appropriately recognize and characterize fetal anomalies associated with trisomy 13 and 18 on MRI, but recognize them as part of a trisomy syndrome.

Poster #: EDU-012

Head Ultrasound Findings of Congenital Brain Anomalies

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Purpose or Case Report: Although head ultrasound (HUS) is most often used in the neonatal intensive care unit (NICU) setting as a screening exam for emergencies such as hydrocephalus, intracranial hemorrhage, and ischemic injury, a spectrum of congenital brain abnormalities may also be diagnosed, especially with state-of-the-art US technology that enables detection of more subtle malformations.While brain MRI remains the gold standard for comprehensive evaluation of congenital CNS anomalies, knowledge of the appearance of such pathologies on HUS is vital: HUS is often the first exam performed, and some infants are too critically ill to undergo MRI. Identification of congenital anomalies by the radiologist may generate prognostic information that can impact critical medical decision-making and patient/family counseling in the NICU.The goals of this educational poster are to provide a systematic approach to evaluating congenital brain anomalies on HUS and illustrate the ultrasound appearance of common and less common congenital abnormalities with MRI comparisons, as well as highlight potential pitfalls in making these diagnoses.Covered entities include:Posterior fossa malformations: e.g., Chiari II, Dandy-Walker Midline anomalies: e.g., Holoprosencencephaly, agenesis of the corpus callosum, pericallosal lipomaCortical malformations: e.g., Gray matter heterotopia, schizencephaly, lissencephalyVascular malformations: e.g., Vein of Galen malformationCongenital infections: e.g., Congenital cytomegalovirus

Poster #: EDU-013

Manifestations of Fetal Cystic Abdominal Lesions on MRI

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Purpose or Case Report: Various types of cystic structures are present in the fetal abdomen. Preliminary evaluation of cystic lesions utilizes ultrasound. Given the wide range of manifestations of cysts in the fetal abdomen including but not limited to mesenteric, duplication, choledochal, ovarian, to lymphatic malformations proper diagnosis can prove difficult. When ultrasound yields inconclusive results, the next step is further investigation with fetal MRI. Fetal MRI provides increased resolution to fully characterize an abdominal cyst. Proper identification of a cyst provides useful guidance for appropriate perinatal management. Clinical management of fetal cysts consists of watchful watching, serial ultrasounds after birth, to surgical intervention. Recognition of the various types of cysts by a radiologist can help allow a clinician to appropriately counsel families about the next steps in the medical care of their child.This presentation highlights the spectrum cystic lesions seen on MRI in the fetal abdomen. We outline a systemic method for identification of fetal abdominal cysts. Various examples of abdominal cysts will be reviewed focusing on key differences which can narrow the differential diagnosis and allow for proper identification. Results from fetal MRI will be correlated with an ultrasound shortly after birth to ensure appropriate diagnosis.

Poster #: EDU-014

Imaging Findings of Hypoxic Ischemic Encephalopathy in Neonates: A Multimodality Imaging Review

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Purpose or Case Report: Hypoxic ischemic encephalopathy occurs in up to 1.5-2.5 per 1,000 live births in developed

countries and can result in major neurologic deficits and mortality in the neonatal population. Currently, treatments are supportive and include moderate hypothermia which has demonstrated a significant reduction in disability and mortality in patients with moderate hypoxic ischemic encephalopathy. Despite improved mortality, morbidity in this patient population remains high with residual neurological deficits. This review will illustrate the patterns of brain injury as well as the imaging findings of neonatal hypoxic ischemic injury on ultrasound, CT, and MRI to assist with diagnosis and prognosis.By completion of this exhibit, the learner will:1. Review the anatomy of the neonatal brain on multiple modalities include ultrasound, CT, and MRI.2. Be familiar with the patterns of brain injury in neonates.3. Be able to identify the sonographic, CT, and MRI findings of neonatal hypoxic ischemic encephalopathy.4. Understand the treatments and prognosis for neonatal hypoxic encephalopathy.

Poster #: EDU-015

Fetal MRI Scanning Safety: A Review of the Literature

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Purpose or Case Report: Fetal Magnetic Resonance Imaging (MRI) scanning techniques have caused concern in both the general population and scientific community about their safety. Studies published in the past have called to question the current techniques and sequences used in fetal MRI from a safety perspective. Namely, noise of scanning sequences, specific absorption rate, heating of the fetus, and utility of MRI to detect Zika virus induced malformations in relation to practices of safety in the recent Zika virus outbreak.
Methods & Materials: This educational exhibit includes a literature review conducted using PubMed searching keywords "fetal brain development", "fetal brain volume", "fetal MRI" and "fetal MRI Zika". 61 papers of fetal MRI research using in-utero patients were selected based on whether details were included about safety considerations to the fetus in their methods or outcomes. Papers were also selected relevant to MRI use in Zika patients due to recent outbreaks.
Conclusions: Risk of acoustic damage to fetus from MRI sequences is negligible. The limitation of higher Tesla scanners causing too much specific absorption rate, as MRI magnetic strength improves, suggests that although specific absorption rate is detectable, it can be controlled safely. It was shown in models that the fetus could theoretically heat up over safety limits due to heat dissipation through convection currents in the amniotic fluid. Therefore, new studies should take into account amniotic fluid convection currents when examining specific absorption rate. In areas with limited MRI resources and Zika virus outbreaks, ultrasound scans may be used instead of MRI for detecting fetal abnormalities for better cost-effectiveness.

Poster #: EDU-016 - *Withdrawn*

Poster #: EDU-017

A Radiologist's Solution for Esophageal Atresia: Magnets

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Purpose or Case Report: **Purpose:** A new minimally invasive procedure, the use of magnets (Flourish™) for the treatment of esophageal atresia will be described. The invention's background, patient selection criteria, procedure details and complications are the subject of this exhibit.Background:Esophageal atresia is a rare congenital defect where the proximal esophagus does not connect to the distal esophagus. Classically, this defect has been treated by surgery to reconnect the ends and reestablish esophageal continuity, however a small subset may be treated with a magnetic catheter-based system. The primary goal of this procedure is to form an anastomosis while avoiding a major thoracic surgery and its complications.The Flourish™ device uses bullet-shaped rare earth magnets which are inserted into the upper esophagus and lower esophagus. Included in these magnets is the rare earth element neodymium, which along with iron and boron create an alloy with a strength of up to 1.2 Tesla. When the magnets are placed in close proximity at the ends of the esophageal pouches, they will attract over several days, eventually connecting the ends of the esophagus and causing an anastomosis via pressure necrosis. Criteria:Selection is based on absence of tracheoesophageal fistula, esophageal gap shorter than 4 cm and a mature gastrostomy tract.Procedure:Under fluoroscopy, the gastric catheter is advanced superiorly through the gastrostomy to the most superior end of the distal esophageal pouch. The oral catheter is then advanced in order to bring the magnets to closest proximity. Daily radiographs are obtained to evaluate magnet positions.
Complications/outcomes: Thirteen patients that have undergone placement of the magnetic catheter-based system at six institutions. Twelve patients had an average time to achieve anastomosis of six days and progressed to full oral feeds. The most common complication was magnetic anastomosis stenosis requiring dilatation. Currently, Flourish is approved as a Humanitarian Device Exemption (HDE).

Poster #: EDU-018

How to Estimate Liver Iron Content Using MRI R2 and R2* Relaxometry with pMRI from Start to Finish

Dmitry Khrichenko,*Khrichenko@email.chop.edu*; CHOP, Philadelphia, PA

Purpose or Case Report: Magnetic Resonance Imaging (MRI) R2 and R2* relaxometry has been shown to accurately quantify liver iron content (LIC) without the need for invasive biopsy. However, different post processing techniques and different calibration curves can lead to variability in the measured iron content. A detailed demonstration using the pMRI software package (www.parametricmri.com) of how to analyze R2 and R2* MRI relaxometry images to estimate LIC is presented. Linear monoexpoential, non-linear monoexpoential, biexponential and truncation models are used, compared and discussed. A selection of established LIC vs R2* calibration curves are compared in real time. Anonymized example cases of varying levels of iron overload are used to demonstrate segmentation techniques including region growing and semi-automatic vessel exclusion. After each analysis, a detailed LIC report is automatically generated and explained.

Poster #: EDU-019

Imaging in Anorectal Malformations: What the Radiologist Needs to Report

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Purpose or Case Report: Anorectal malformations are a fairly common group of congenital anomalies presenting at birth and often as part of a syndrome, with various other associated entities. The purpose of this article is to detail the role of imaging in the evaluation of the anomalies and provide a simple approach to reporting that will provide all the necessary anatomic details to the surgeons for best possible surgical and functional outcome.
Methods & Materials: 1. Review the embryological and anatomical considerations of the anorectum and urogenital tract in neonates, as per the prevailing classification schemes.2. Elaborate on the imaging modalities of choice in common clinical scenarios with respect to the area of concern, as well for evaluation of any associated anomalies.3. Detail a method of approach to reporting, so as to ensure all the relevant details are given to the surgeon.4. We will provide case based examples from a series of 10 patients that presented to our institute, with surgical outcome.
Results: After reviewing the exhibit, the reader will have a comprehensive yet simplistic approach to reporting anorectal malformations, enabling efficient management and prevention of complications.
Conclusions: The diagnostic and treatment approach to anorectal malformations is complicated by various factors, such as, coexistent anomalies increasing morbidity, possibility of renal damage if managed inappropriately and impact on general quality of life of the child with respect to creation of stoma, urinary and sexual function.As radiologists, we can greatly aid the surgeons in deciding the best time for intervention, proper planning of procedure and prevention of complications. Thus, it is imperative that we have a structured approach to cases and a reporting checklist for reference, providing crucial information for best surgical and functional results.

Poster #: EDU-020

Not-So-Mellow Yellow: Neonatal Cholestatic Disease Imaging and Approach

Simon Ho, *siho0001@radiology.ufl.edu*; Priya G. Sharma; Radiology, University of Florida, Gainesville, FL

Purpose or Case Report: The aim of this exhibit is to review imaging findings of neonatal biliary disease, with emphasis on biliary atresia and conditions of surgical interest. We will present a series of cases on cholestatic diseases encountered in the neonatal period and multi-modality approach to imaging these patients.
Methods & Materials: Neonatal biliary disease is an important source of morbidity in the pediatric population. Most cholestatic disease processes are classified as either obstructive or hepatocellular in origin, which crucially determines the surgical or non-surgical nature of effective treatment. In particular, biliary atresia requires time sensitive intervention to avoid cirrhosis and death. Ultrasound and nuclear biliary scintigraphy play a key role in screening and diagnosis of cholestatic diseases, and MDCT and liver MRI are supplementary in evaluation of surgical planning and complications.We will use a case based approach to discuss the following neonatal cholestatic diseases and related conditions of surgical interest: Biliary atresia; Neonatal hepatitis; Choledochal cyst; Alagille syndrome; Neonatal hemochromatosis; Inspissated bile syndrome; Cholelithiasis; Portosystemic shunt; Portal vein thrombus; Hepatic artery anomalies; Post-Kasai intrahepatic biliary cysts; Post-Kasai hepatic nodules
Conclusions: Imaging based diagnosis is crucial to the proper management of neonatal biliary disease. Definitive diagnosis and understanding of surgical and non-surgical complications are necessary to reduce morbidity from these similarly presenting diseases.

Poster #: EDU-021

Gastrojejunostomy Tube Intussusception: A Challenging Radiologic Diagnosis

Maaz A. Ghouri, *maaz.ghouri@gmail.com*; Ross Myers, Stephan Voss, Andy Tsai; Radiology, Boston Children's Hospital, Brookline, MA

Purpose or Case Report: Gastrojejunostomy (GJ) tubes play an essential role in the management of individuals with poor gastric function, chronic vomiting and respiratory problems. Small-bowel intussusception around the GJ tube is uncommon with reported incidence of ~16% (likely to be higher in younger patients and with the use of large bore tubes). Complications associated with GJ tube intussusceptions are typically sub-acute and resolve spontaneously, but in some instances can lead to more severe complications such as bowel obstruction, ischemia and perforation.
Methods & Materials: GJ tube intussusception most often occurs in the duodenum which surrounds the jejunostomy limb of the GJ tube. While the precise mechanism is controversial, the available evidence suggests that the tip of the tube acts as a lead point causing either antegrade or retrograde intussusception. In addition to reliably making the diagnosis of GJ tube intussusception, identifying which type of intussusception has occurred can be important in guiding management.Fluoroscopy has been the diagnostic modality of choice, however the techniques used vary widely amongst radiologists, and standardized terminology and diagnostic criteria are lacking. There is no consensus on the choice of enteric contrast material to use and also the choice of which port(s) to inject. Water-soluble contrast and barium have been used in isolation or in combination. Various combinations and sequences of single- or dual-port injections have been proposed. Fluoroscopy can demonstrate a so-called 'coiled-spring sign'. Though this sign is pathognomonic for intussusception, transient peristaltic mimicker of this sign makes this determination difficult and the term is often used expansively to describe a variety of normal physiologic, as well as other abnormalities in the bowel that are not intussusception.Most asymptomatic cases resolve on their own with conservative treatments. The majority of the symptomatic cases are managed by air or contrast reduction (only effective with retrograde intussusception), GJ tube exchange, or laparotomy.
Conclusions: GJ tube intussusception is a challenging radiologic diagnosis because of 1) poor understanding of pathophysiology, 2) lack of consensus on the fluoroscopic technique, 3) lack of standardized diagnostic criteria, and 4) unclear timing and management options. The goal of this educational paper is provide an overview of GJ tube intussusception, including potential mechanisms, diagnostic techniques and implications for management.

Poster #: EDU-022

Ultrasonography in the Assessment of Pediatric Gastroesophageal Reflux

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Purpose or Case Report: Although clinical history seems the most important diagnostic information in gastroesophageal reflux (GER), it is less reliable in pediatric practice, mainly under 2 years old. Diagnostic tests are needed to document the presence of GER and exclude associated conditions. Gastroesophageal ultrasonography (US) is a widely available, noninvasive and sensitive method that provides morphological and functional information in GER diagnosis.The purpose of this exhibit is:1. To highlight the main points in the pathophysiology of GER in children;2. To review the ultrasonographic technique employed in the evaluation of reflux episodes and in the assessment of gastroesophageal junction morphology;3. To discuss current state of the literature concerning US and pediatric GER.Ultrasonography cases from our Radiology Department will be employed to illustrate the following topics:- Clarifying GER and GER disease (GERD) concepts;- Pathophysiology of GER in children;- Clinical presentation of GER according to age;- Diagnostic approaches to pediatric GER;- The role of US in the management of children with suspected GER;- The US technique in GER evaluation;- Understanding the normal gastroesophageal morphology on US;- Recognizing reflux episodes in US;- Sonographic assessment of abdominal esophageal length and His angle;- Literature divergences and recommendations regarding each step of the technique.

Poster #: EDU-023

Pediatric Contrast Enhanced Ultrasound: From Head to Toe

Aikaterini Ntoulia, *ntouliaa@email.chop.edu*; Susan J. Back, Misun Hwang, Ami Gokli, Sudha Anupindi, David M. Biko, Abhay Srinivasan, Laura Poznick, Kassa Darge; Radiology, Children's Hospital of Philadelphia, Philadelphia, PA

Purpose or Case Report: Pediatric Contrast Enhanced Ultrasound (CEUS) is a safe and patient-friendly imaging modality. It improves the diagnostic capability of gray-scale and Doppler ultrasound without sedation, ionizing radiation and no use of iodinated or gadolinium-based contrast agents. Pediatric CEUS was originally used to detect vesicoureteral reflux, evaluate indeterminate focal liver lesions, assess and follow up solid-organ injuries sustained during blunt abdominal trauma. In 2016, the approval of Lumason® (Bracco Diagnostics Inc., Monroe Township, NJ) by the United States Food and Drug Administration (FDA) marked the beginning of a new era for CEUS imaging. Since then, clinical requests for pediatric CEUS not only increased in number but also for a variety of examinations covering practically every organ system, including pediatric brain, lungs, solid organs and bowel. In addition, intracavitary applications of pediatric CEUS are now extending beyond the urinary tract, to include urogenital and anorectal malformations. Intravenous and intracavitary CEUS is used in pediatric interventional radiology, to confirm enteric tube placement, guide biopsies and drainage procedures and aide organ vascular mapping (e.g. renal, central vessels). Novel pediatric CEUS applications now used include intranodal CEUS lymphangiography for confirmation of needle position preceding MRI lymphagiography. Pediatric CEUS is performed in a number of clinical settings including inpatient units, outpatient radiology, emergency department, and intraoperative. These evolving indications and uses of CEUS combined with continuous advances in ultrasound technology, such as three-dimensional/four-dimensional ultrasound and improved contrast sensitivity, are establishing pediatric CEUS as an important alternative imaging examination that can complement or supplement fluoroscopy, CT and MRI. This presentation reviews the current wide spectrum of pediatric CEUS applications and imaging findings, according to body part, and the associated imaging findings.

Poster #: EDU-024

Knowing "Urine" Trouble: Imaging Findings of Robotic-Assisted Laparoscopic Surgery Complications in Pediatric Urology

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Purpose or Case Report: Robotic-assisted laparoscopic surgery (RALS) has gained an upsurge in attention within the past two decades and now rivals many of the gold standard, open surgical procedures in pediatric urology. Since the first published cases of pediatric robotic surgery in 2001, case volumes of genitourinary RALS in children have increased exponentially. Given similar complication rates to their open surgical counterparts, and with the benefits of decreased pain medication usage and length of hospitalization, urologic procedures in children such as pyeloplasty, ureteral reimplantation, nephrectomy, and Mitrofanoff appendicovesicostomy will likely continue to see growth in the upcoming years. However, like many innovative technologies, RALS require years of experience to understand the operating control systems, to develop manual dexterity, and to master the technical aspects of specific procedures. As more hospitals and trainees are exposed to systems such as the Da Vinci Surgical System and new upcoming robotic platforms, such as the Senhance Surgical Robotic System, surgeons and radiologists alike will need to recognize common RALS-associated complications on imaging. This educational exhibit will educate non-surgical physicians on the basic steps of common RALS and provide both pediatric radiologists and pediatric urology surgeons with specific radiographic findings of their complications. Images will include expected post-operative findings, general complications such as hematomas, anastomotic leak, and infection/abscess, as well as more procedure specific complications such as anastomotic stenosis and recurrent ureteropelvic junction obstruction in pyeloplasties. Finally, we will explain and provide images on cases in which interventional radiology can play a pivotal role in the management of pediatric genitourinary RALS complications.

Poster #: EDU-025

Ovarian Tumors in Children: Pearls and Pitfalls

Cecilia Mackintosh, *cecimackin@gmail.com*; Veronica N. Gonzalez, Flavia E. Funes Pobkete, Maria C. Vargas; Pediatric Radiology, Garrahan Hospital, Buenos Aires, Argentina

Purpose or Case Report: To describe the most frequent imaging findings of ovarian tumors in pediatric patients through different imaging methods (ultrasound, computed tomography and magnetic resonance imaging), in order to help in the differential diagnosis between benign from malignant pathology.
Methods & Materials: Medical records and imaging studies were reviewed in the period between January 2014 and August 2019. Forty-three patients with imaging studies compatible with ovarian tumor were included, 41 were confirmed by the anatomopathological study and 2 corresponded to other pathologies (ovarian torsion simulating ovarian mass and appendicular plastron with ovarian involvement, respectively).
Results: Patients age ranged from 2 months to 17 years old. Median age was 11.4 years. An abdominal mass was the most frequent clinical manifestation. The most frequent diagnosis was mature teratoma (24.4% of patients), followed by dysgerminoma (19.5%) and immature teratoma (17%). Other diagnosis were mucinous cystoadenoma, serous cystoadenoma, fibroma, Sertoli Leydig cell tumors, mixed germinal tumor, granulose cell tumor, small cell carcinoma, and ovarian fibroma. 11.6% of the patients had a tumor associated syndrome, and 16.2% had distant metastases or peritoneal implants.
Conclusions: We highlight the clinical-radiological challenge in the diagnosis of ovarian tumors in pediatric patients, due to their low frequency and nonspecific clinical manifestations. It is essential for the radiologist to learn about the imaging findings and their correlation with histological types, in addition to serum tumor markers for differential diagnosis. This is important for choosing the best surgical treatment in every case, emphasizing on minimally invasive techniques in this age group.

Poster #: EDU-026

Pee You Later, VCUG! The Rise of Contrast Enhanced Voiding Urosonography in the Diagnosis of Vesicoureteral Reflux

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Purpose or Case Report: The investigation of vesicoureteral reflux (VUR) has been a long standing practice in pediatric radiology, traditionally accomplished using voiding cystourethrogram (VCUG). However, our institution demonstrates that the days of lead aprons and iodinated radiation may be behind us. Contrast-enhanced voiding urosonography (CeVUS) offers a safer, more sensitive alternative to VCUG in the diagnosis of VUR. Residents practicing at this children's hospital are exposed to and assist with CeVUS at an early stage in their training, enabling their familiarity and understanding of the modality to facilitate medical society's shift from fluoroscopic technique.Residents on their pediatric radiology rotation are expected to engage in the performance of CeVUS exams and in the dictation of associated reports. They quickly learn that the technical aspects of VCUG and CeVUS are very similar involving aseptic bladder catheterization, intravesicular instillation of contrast, and subsequent imaging of the urinary tract system. The sonographic contrast agent of choice is Lumason, a safe second generation microbubble formulation. Trainees also learn that the international grading system of VUR is maintained across the two modalities. Most importantly, however, is the lesson that CeVUS more frequently captures the clinically significant grades of VUR. This concept may be two fold. Firstly, the reflux of microbubbles into the kidney has greater visibility than that of its iodinated counterpart on fluoroscopy. Secondly, in order to reduce radiation-associated adverse effects of VCUG, radiologists will perform "pulse sequencing", which potentiates missed episodes of VUR.The field of pediatrics is certainly amidst a cultural shift with increasing awareness of the benefits and utility of contrast-enhanced ultrasonography. CeVUS is simply one example. Radiology residents at this institution are actively involved with this newer modality early in their training. This report demonstrates radiology residents performing these exams with supervision by the attending radiologist. CeVUS has been added to the teaching curriculum in pediatric radiology at our institution.

Poster #: EDU-027

Ovarian and Fallopian Tube Torsions and their Simulators: What the Radiologist Needs to Know and Look For

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Purpose or Case Report: Adnexal torsion is the most common gynecological emergency in children and adolescents. Early diagnosis is crucial. The diagnosis of torsion requires a summation analysis of clinical, laboratory, and imaging findings. Adnexal torsion may mimic abnormalities of the gynecological (such as ectopic pregnancy and pelvic inflammatory diseases), genito-urinary (such as renal or ureteric stones), and gastrointestinal tract abnormalities (mostly, appendicitis and inflammatory bowel disease like Crohn's). Gastrointestinal causes mimicking torsion may also include less likely abnormalities of the upper GI tract, including liver, gall bladder, pancreatic, and ulcer disease. Additionally, rare tumor masses may be a direct cause of ovarian or para-ovarian torsion or may simulate the pain. We present a spectrum of imaging cases showing simulators of ovarian torsion as well as a spectrum of actual gynecological system torsions, including those of the ovaries and para-ovarian structures in the pediatric population. We review the fundamental potential diagnostic pitfalls that may falsely suggest an adnexal torsion as well as imaging features to help evaluate adnexal and para-adnexal torsion. Imaging plays a critical role in the diagnosis of adnexal torsion and its simulators. We demonstrate imaging findings of those simulators as well as in adnexal torsion. Our study emphasizes primarily on the use of ultrasound to postulate key imaging points. Adnexal torsion can take a subacute, intermittent, or chronic course, which may be challenging to diagnose. Prompt early recognition and operative management of this abnormality is essential. Correct and early diagnosis facilitates prompt surgical exploration to prevent ovarian tissue loss and the consequent effect on future fertility.

Poster #: EDU-028

How to Analyze a Functional MR Urogram with pMRI from Start to Finish

Dmitry Khrichenko,*Khrichenko@email.chop.edu*; CHOP, Philadelphia, PA

Purpose or Case Report: CHOP-fMRU (www.chop-fmru.com), a functional MR Urography (fMRU) post processing tool, was released publicly in 2010. Since its release, I have gotten many questions about various aspects of fMRU post processing. This experience has aided in the development of pMRI (www.parametricmri.com), the successor to CHOP-fMRU. The aim of this electronic poster is to teach fMRU post processing using pMRI through several anonymized examples as well as address common questions that arise. An fMRU report is automatically generated and discussed at the end of each analysis. A comparison between fMRU and MAG3 with examples is included to better understand fMRU functional parameters.

Poster #: EDU-029

Imaging of the Urethra: Radiologic Anatomy in Fluoroscopic Urethrography

Benjamin Thompson,*benpthompson@hotmail.com*; Radiology, Nationwide Children's Hospital, Columbus, OH

Purpose or Case Report: To present an interesting collection of cases, collected over the course of 20 years, to familiarize pediatric radiologists of variants, congenital, acquired and post traumatic disorders of the urethra using flouroscopy.

Poster #: EDU-030

Tomographic Evaluation of Living Renal Donors for Pediatric Patients

Melissa Valdez Quintana, *melissavaldezq@gmail.com*; Instituto Nacional de Salud del Nino San Borja, Lima, Peru

Purpose or Case Report: The purpose of these educational exhibit is to illustrate the tomographic evaluation of living renal donors for pediatric patientsRenal transplantation has become the treatment of choice for end stage renal disease in children. Living donor renal transplantation is a better option for recipient and graft survival in comparison with cadaveric donor. Laparoscopic nephrectomy is preferred for removing the kidney from living donors, therefore the surgeons need accurate anatomic informationWe present an approach for the evaluation of living renal donors by tomography. Selected cases illustrating the evaluation of renal parenchyma, renal arteries, renal veins and collecting system are shown, including the key points of anatomic information that are valuable for the surgeons **Conclusions**: The evaluation of living renal donors by tomography require an detail anatomic evaluation

Poster #: EDU-031

To Shield or not to Shield: That is the Question

Emily Sellers, *emily.sellers@uchospitals.edu*; Emily Marshall, Zheng Feng Lu, Ingrid Reiser, Seng L. Ong, Kate A. Feinstein; Radiology, University of Chicago, Chicago , IL

Purpose or Case Report: Gonadal shielding is currently the standard of care in most radiology practices with gonadal shielding occurring many times throughout the day in practices worldwide. Currently, the utility of gonadal shielding is being widely debated. The American Association of Physicists in Medicine (AAPM) recently published a policy recommending the discontinuation of shielding which was then endorsed by the American College of Radiology (ACR). However, other professional societies as well as many state regulations still recommend the use of gonadal shielding. This educational exhibit will outline the benefits as well as the risks involved in gonadal shielding that are currently being debated. It will also include how to identify the various imaging artifacts which can result from gonadal shielding. We will then discuss the best practices we use at our institution for gonadal shielding, including how to work closely with our radiology technologist colleagues to reduce artifact and radiation dose in order to help mitigate the negative consequences of gonadal shielding while maximizing the benefits.

Poster #: EDU-032

A Multidisciplinary Approach to the Medical Evaluation of Accidental and Abusive Intra-abdominal Injuries

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Purpose or Case Report: Intra-abdominal injuries are a less common manifestation of child abuse, but can be associated with high mortality. These injuries may be difficult to detect on physical exam alone, as many children do not have external cutaneous signs of abdominal injury, and symptomatology may be non-specific. Once detected, no specific intra-abdominal injury is pathognomonic for abuse, though some are more common in physical abuse. Determination of the likelihood of abuse as a mechanism relies on the plausibility of the history provided in the context of the constellation of identified injuries.In this multidisciplinary educational presentation made in collaboration with pediatric radiologists and child abuse pediatricians, we will: (1) review physical exam and laboratory indicators to obtain abdominal imaging; (2) review imaging examples of intra-abdominal solid organ injuries; (3) review imaging examples of hollow viscus injuries; (4) discuss the types of trauma that causes solid organ and hollow viscus injuries; (5) review imaging modalities available, and (6) briefly discuss medical management.

Poster #: EDU-033

Thymic Pathology and Mimickers of Pathology in Children

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Purpose or Case Report: The Thymus appears in a variety of sizes and shapes, and may even change in size as a response to

disease process in the same patient. These underlying variations, as well as ectopic or accessory tissue, can mimic pathology and may become a source of confusion resulting in anxiety, unwarranted imaging, unnecessary biopsy, chemoradiation or even surgery.
Methods & Materials: 1. Educate about the different locations and imaging characteristics of accessory/ectopic thymus.2. Provide imaging examples of cases that can mimic pathology including Ectopic thymus in the neck, Thyroid, Thoracic inlet, and posterior mediastinum.3. Provide imaging examples of unusual presentation including right upper thoracic Thymic hyperplasia mimicking pneumonia.4. Provide imaging examples of cystic Thymic pathology including simple cysts, abscess, hematoma, and Langerhans cell histiocytosis.5. Discuss the utility and limitations of different imaging modalities.
Results: After reviewing the exhibit, the reader will be aware of the wide variety of normal thymic tissue and some unusual pathologies that can be challenging. We hope the reader will be able to recommend appropriate imaging modalities for confirming the diagnosis, and hopefully avoid unnecessary procedures in normal variant cases.
Conclusions: Cases of thymic pathology, normal variations, and ectopic thymic tissue could be challenging to diagnose in some patients. Familiarizing with normal variations and locations of Thymic tissue as well as different pathologies can help increase confidence and direct appropriate medical care.

Poster #: EDU-034

Developing a Radiology Resident Global Health Elective in Botswana

Jennifer Gillman, *jennifer.gillman@uphs.upenn.edu*; Maria A. Bedoya, Sung Kim; Diagnostic Radiology, Hospital of the University of Pennsylvania, Philadelphia, PA

Purpose or Case Report: Through our institution's established relationship with the Princess Marina Hospital in Gabarone, Botswana, we pioneered a radiology resident global health elective with a special focus in pediatric imaging. Our 5-week global health elective consisted of four major categories of activities: reading clinical cases (primarily CT and radiographs), bedside rounds and clinic tumor boards, didactic lectures and case conferences (to medical students, residents, technologists and faculty), and hands-on ultrasound training. For these activities, we primarily partnered with the departments of pediatrics, internal medicine, surgery and radiation oncology.The purposes of this educational exhibit are:1. To discuss the inherent challenges to practicing and teaching radiology in a Botswana government hospital.2. To describe our initial needs assessment and evaluation of the departmental work flow.3. To explain how we developed a cranial ultrasound workshop targeting pediatric and radiology residents, faculty and technologists. This workshop consisted of multiple didactic lectures and bedside hands-on ultrasound in the neonatal intensive care unit.4. To explore the relevant resources and available grants for residents, in order to help other programs support similar efforts.5. To present interesting cases to conclude our educational exhibit.Experiencing radiology in Botswana was an extremely rewarding experience, and as residents we had the capability to make a clinical impact on a daily basis. Our efforts have paved the way for more residents at our institution to have similar meaningful and impactful experiences.

Poster #: EDU-035

How to Analyze Diffusion Weighted Image (DWI) Data with pMRI from Start to Finish

Dmitry Khrichenko,*Khrichenko@email.chop.edu*; CHOP, Philadelphia, PA

Purpose or Case Report: Diffusion weighted imaging (DWI) is used in many diverse clinical and research applications including evaluation of stroke, avascular necrosis, renal tumor classification and others. Standardizing the apparent diffusion coefficient (ADC) value across different studies and institutions has proven difficult due to change in equipment and protocols used. The aim of this electronic poster is to explain this inconsistency in ADC estimation using the pMRI (www.parametricmri.com) software package. Variability in ADC due to b-value selection, low SNR, decay model choice, and theoretical perfusion effects is explained and demonstrated by image analysis of anonymized cases.

Poster #: EDU-036

Radiation Dose Outcomes: Transitioning to High-pitch Dual-source Chest CT Technique in a Pediatric Population

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Purpose or Case Report: Limiting radiation exposure while obtaining diagnostic-quality imaging is an essential goal of diagnostic radiology. This is particularly true for computed tomography (CT) scanning in children, who are more susceptible than adults to stochastic effects of radiation exposure. High-pitch technique with iterative reconstruction using modern dual-source CT scanners can reduce CT dose. This method uses some combination of peak kilovoltage (kVp) reduction and tube current modulation while also leveraging dual-source geometry to increase the pitch at which the images are acquired. Our institution recently transitioned to this method of performing CT scans. As part of a quality assurance study, we reviewed the dose exposure to our patients pre- and post-implementation.
Methods & Materials: All CT chest scans with intravenous contrast performed between November 2018 to October 2019 were reviewed retrospectively. This range included 6-month periods before and after our department transitioned to high-pitch scans as our routine method of acquisition in April 2019. Contrast-enhanced chest CT scans were chosen for this audit as they have already been well studied using high-pitch scanning. Scans were obtained using a SOMATOM Force dual-source scanner (Siemens, Germany). Low-pitch and high-pitch groups were compared. Data recorded included patient demographics; technical parameters including kVp, current-time product (mAs), and pitch; and dose measurements including CT volumetric dose index (32-cm phantom) ($CTDI_{vol32}$) and dose-length product (DLP).
Results: There were 29 low-pitch scans and 36 high-pitch scans. The two groups did not differ significantly with respect to demographics. Tube current-time product was significantly higher in the high-pitch group (70 mAs vs. 125.5 mAs, p=0.001), while kVp was similar between the two groups. Comparison of mean $CTDI_{vol32}$ between the low-pitch and high-pitch groups did not demonstrate any significant dose reduction (2.04 mGy vs. 1.72 mGy, p=0.817).

Conclusions: Early experience with high-pitch dual-source CT imaging at our institution has not demonstrated significant dose savings in pediatric patients. Potential reasons for this finding include already-low dose optimization with low-pitch scans at our site and small group numbers in this analysis. Our $CTDI_{vol32}$ average value for high-pitch scans is slightly higher than has been reported elsewhere, and individual scan-specific image quality optimizations may also be increasing dose.

Poster #: EDU-037

Pediatric Chest Wall Masses: Spectrum of Benign Findings on Ultrasound

Philip G. Colucci, *phc2009@nyp.org*; Sara Cohen, Michael Baad, Christy B. Pomeranz, Lee Collins, Arzu Kovanlikaya; Radiology, NewYork/Presbyterian Hospital - Cornell, New York, NY

Purpose or Case Report: A palpable finding along the chest wall is a frequent indication for pediatric ultrasound. Accurate identification of benign lesions can reassure families and appropriately triage patients who need follow-up, cross sectional imaging, or biopsy. The purpose of this exhibit is to review chest wall anatomy, illustrate ultrasound techniques, and discuss key ultrasound imaging features of common benign lesions and normal variants. Cases will include but are not limited to: accessory breast tissue, gynecomastia, sternalis muscle, angulated costal cartilage, rib fracture, chondral injury, ganglion cyst arising from the sternoclavicular joint, osteochondroma, neurofibroma, lipoma, myofibroma, pilomatrixoma, dermoid and epidermoid cysts, fibrous hamartoma of infancy, hemangioma, lymphatic malformation, and abscess. Each case will include the clinical presentation of the patient, classic ultrasound imaging features, and subsequent management.

Poster #: EDU-038

Chronic Nonbacterial Osteomyelitis: A Diverse Disease

Gregory Mowrer[4], *gmowrer@pennstatehealth.psu.edu*; Diego Jaramillo[2], Ricardo Restrepo[3], Lisa Imundo[2], Don Flemming[4], Nancy Chauvin[1]; [1]Radiology, Hershey Children's Hospital , Hersey, PA, [2]Columbia University, New York, NY, [3]Nicklaus Children's Hospital, Miami, FL, [4]Penn State Health, Hershey, PA

Purpose or Case Report: Chronic nonbacterial osteomyelitis (CNO) is an aseptic auto-inflammatory condition that affects children and presents with insidious bone pain. Children present with a variable clinical spectrum of disease with either unifocal or multifocal pain and acute (duration < 6months) or chronic (>6 months) symptoms. The disease course may be recurrent. In some cases, patients endure multiple lesions over a course of exacerbations and remissions. Bone lesions are often in symmetrical regions. Interestingly, clinically asymptomatic bone lesions are discovered during the imaging evaluation. Patient symptoms and clinical course may mimic other diseases, making CNO often difficult to diagnose with a consequent delay in diagnosis. Children with CNO may also develop arthritis and demonstrate similar cytokine profiles with children with juvenile idiopathic arthritis (JIA), suggesting at least a partial common disease pathway.
Methods & Materials: We plan to present the multimodality imaging spectrum of CNO, focusing on the radiographic presentation along with the use of whole body MR imaging (WBMRI). We will highlight the typical CNO locations and describe the early, progressive and chronic lesion appearance. Our discussion will include descriptive features that will aid in differentiating between infectious osteomyelitis, JIA (spondyloarthritis), primary bone lesions as well as other causes of osteitis. WBMRI protocols and imaging recommendations will be included as well as approaches to CNO lesion scoring. Complications of inflammatory CNO will be discussed. Lastly, treatment approaches and rationale will be described.
Results: An organized approach should be used to evaluate CNO lesions; with particular attention to lesion location and number, marrow edema, periostitis, soft tissue inflammation, clinically occult lesions, and joint effusions.
Conclusions: Familiarity with the imaging appearance of the CNO spectrum and differential diagnosis of osteitis will allow for accurate characterization of typical CNO lesions and will assist in making a timely diagnosis which may deter unnecessary interventions.

Poster #: EDU-039

High Resolution Color Doppler Ultrasound in the Study of Uncommon Skin Lesions in Children

Cristian G. Bruce, *cgarciab@uc.cl*; Florencia de Barbieri, Maria Soledad Zegpi, Gonzalez Sergio; Radiology, Pontificia Universidad Catolica, Santiago, Santiago, Chile

Purpose or Case Report: The purpose of this exhibit is to show a number of unusual skin lesions that can be seen in children, emphasizing the sonographic appearance and clinical and pathological correlation. We have found this barely described in the literature.
Methods & Materials: We reviewed retrospectively our experience with Ultrasound (US) in the study of superficial soft tissue nodules or masses in children for the last fourteen years, including clinical and pathological findings.
Results: All lesions were examined with US, which was the first imaging study in all patients. Examples of unusual lesions are shown, including congenital myofibromatosis, protruded subungual exostosis, plantar wart, neurocystic hamartoma, aplasia cutis, morphea, spiradenoma, giant pylomatricoma, cutaneous myasis, cutaneous Cysticercosis, septic emboli, post vaccination nodules, subcutaneous fat necrosis, metastatic neuroblastoma, granuloma annulare, pyogenic granuloma, congenital nodular melanocytic nevi, Hashimoto-Pritzker histiocytosis, juvenile xanthogranuloma, erythema perneo, blue nevus, villous nevus. In most cases, no additional imaging studies were necessary.
Conclusions: High-resolution color-Doppler US is helpful in the characterization and diagnosis of some uncommon skin lesions in children. Although findings might be nonspecific, they may suggest a diagnosis, especially when correlated with clinical findings and could avoid doing other more sophisticated studies, such as CT or MRI.

Poster #: EDU-040

Lower Extremity Manifestations of Cerebral Palsy

Mahesh Thapa, *thapamd@uw.edu*; Ezekiel Maloney, Sarah Menashe, Jeffrey P. Otjen, Anh-Vu Ngo, Ramesh Iyer; Radiology, Seattle Children's Hospital, Seattle, WA

Purpose or Case Report: The purpose of this educational exhibit is to demonstrate the lower extermity manifestations of

Cerebral Palsy (CP). The focus will be on plain radiographic findings, along with surgical approaches to the various abnormalities. Conditions presented will include the following: equinus, equinocavovarus, equinoplanovalgus, oblique talus, vertical talus, ankle valgus and hallux valgus. In addition, a thorough and systematic approach on how to evaluate pediatric foot abnormalities will also be discussed.CP is caused by abnormalities of the developing fetal or infant brain that result in permanent central motor dysfunction. The prevalence of CP is about 2 in 1000 live births. Although this is higher in pre-term and low birthweight infants. The proposed underlying causes are many and include infection, hypoxia, structural changes, ischemia, and hemorrhage. The underying neural damage is nonprogressive, but the clinical manifestations can change and magnify. Gross Motor Function Classification System (GMFCS) is used to grade the severity of disease. Affecting about 93% of patients with CP, foot and ankle deformities have a huge impact on patient ambulation and GMFCS score. Such lower extremity abnormalities are classified using three “levels” of severity which influnce treatment options. Level I is mild, flexible deformity; level II manifests as soft tissue contracture; and level III causes skeletal remodeling and bony deformity. Only by apprecaiting the clinical and radiological manifestations of CP can we attain a more thorough understanding of the condition and its multitude of presentations.

Poster #: EDU-041 - ***Withdrawn***

Poster #: EDU-042

Medial Elbow Injuries in the Pediatric and Adolescent Overhead Throwing Athlete: A Multimodality Imaging Review

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Purpose or Case Report: Sports related elbow injuries are very common in the pediatric population. Overhead throwing athletes are at particular risk for elbow injury, notably affecting the medial elbow at site of excess valgus stress applied during the overhead throw. With the increasing competitiveness and high level of training in young athletes, these injuries are commonly encountered in the pediatric sports medicine and orthopedic surgery clinics. A comprehensive knowledge of medial elbow anatomy by the radiologist is crucial to assist in both the diagnosis and management of these patients. This review will cover acute and chronic stress injuries of the medial epicondyle, ulnar collateral ligament, common flexor tendon and ulnar nerve. A full spectrum of injuries will be addressed, utilizing US and MRI to assist with diagnosis and to guide management.By completion of this exhibit, the learner will:Review the anatomy of the medial elbow joint.Be familiar with the injury patterns affecting the medial elbow in overhead throwing athletes.Understand the utility of radiographs, MRI and dynamic and static US in making a diagnosis.Visualize the technique for performing dynamic medial elbow ultrasound in the setting of ulnar collateral ligament injury and understand its implications for treatment.

Poster #: EDU-043

Mimickers of Chronic Recurrent Multifocal Osteomyelitis: Case-based Review

Hassan Aboughalia, *Ha_aboughalia@yahoo.com*; Ramesh Iyer; University of Washington Medical Center, Seattle, WA

Purpose or Case Report: Chronic recurrent multifocal osteomyelitis (CRMO) is a relatively new autoinflammatory pediatric musculoskeletal diagnosis. It was first discovered by Giedion et al 1972, who described “an unusual form of multifocal bone lesions with subacute and chronic symmetrical osteomyelitis”. CRMO can be a problematic diagnosis due to its variable presentation. Clinical, laboratory, and imaging findings must be aggregated to arrive at a CRMO diagnosis. Imaging plays a central role in CRMO diagnosis and management. Typical imaging findings that are generally but not necessarily multifocal, and exhibit changes over time, are crucial to CRMO management plan.Many pathologic entities can mimic CRMO because of its diverse clinical and imaging manifestations. These conditions include infectious processes such as septic arthritis and osteomyelitis, other inflammatory conditions such as psoriatic arthritis, metabolic disturbances such as rickets and scurvy, traumatic injuries such as acute fractures and osteonecrosis from repetitive microtrauma, neoplastic entities such as metastasis and lymphoma, and neoplastic-like entities like Langerhans cell histiocytosis. In our exhibit, we will review the classic imaging manifestations of CRMO and present a spectrum of lesions in which CRMO was an initial consideration, but ultimately proved to be a different pathology. **Conclusions**: Imaging plays a central role in diagnosis and management of CRMO. Many pathologic entities can mimic CRMO due to its protean manifestations, and a nuanced understanding of these mimics may assist the radiologist in both recognizing CRMO and generating differential considerations when the diagnosis remains unclear by imaging.

Poster #: EDU-044

A Problem Based Approach to Learning Shoulder Ultrasound in a Pediatric Patient

Darragh Brady,*darraghbrady@gmail.com*; Radiology, Children’s National Hospital, Washington, DC

Purpose or Case Report: Learning muculoskeletal ultrasound is challenging. We provide an interactive, problem based approach to learning how to ultrasound the shoulder in a pediatric patient, focusing on key anatomy, static positioning, and dynamic maneuvres, using a stepwise logical approach. Photographs with tranducer positions are provided. Cine images are provided for dynamic maneuvers. This approach may provide a framework for musculoskeletal ultraound workhops that can be adapted for the pediatric radiology trainee, or ultrasound technician.

Poster #: EDU-045

Not Enough Bone: Correct Terminology Can Lead to a Correct Diagnosis

Mitchell Boehnke[1], *mitchell.boehnke@gmail.com*; Diego Jaramillo[2], Tal Laor[1]; [1]Radiology, Boston Children's Hospital, Cambridge, MA, [2]Columbia University, New York, NY

Purpose or Case Report: In adults, the terms ***osteopenia*** and ***osteoporosis*** are used to describe different severities of diminished bone density which can result from a variety of causes. The World Health Organization has defined osteopenia as decreased bone density corresponding to a bone densitometry T-score of -1 to -2.5 and osteoporosis as a more severe deficiency (T score > -2.5). However, the etiology usually is not apparent on radiographs of skeletally mature patients. Osteopenia and osteoporosis are used regardless of the etiology of apparent decreased bone density.In contradistinction to the ambiguity inherent in adult radiographs, in growing children, the distinctly different etiologies and corresponding histopathologic abnormalities that result in diminished radiographic bone density can be differentiated, thanks to clues offered by the open physis. Disorders that manifest as rickets (the equivalent to adult osteomalacia) result from the decreased ability to deposit calcium hydroxyapatite on a normal amount of osteoid. This causes disruption of endochondral ossification at the physis and results in apparent physeal widening with loss of the zone of provisional calcification. Alternatively, disorders that cause osteoporosis result from diminished osteoid available for subsequent mineralization, show prominent zones of provisional calcification, and are without rickets-like changes.This educational exhibit will begin with a review of the steps of normal endochondral and intramembranous ossification, followed by a discussion of the pathophysiology of osteomalacia and osteoporosis. Upon this foundation, we will illustrate various etiologies that result in either rickets/osteomalacia or osteoporosis. Finally, we will present the imaging clues that lead to a diagnosis and to the corresponding correct terminology. This use of precise language cannot be stressed enough, as it has important clinical implications.

Poster #: EDU-046

Ultrasound Evaluation of Muscles Hernias: The Tumor that Wasn't

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Purpose or Case Report: Muscle hernias occur when a muscle protrudes through a fascial defect into the subcutaneous fat, hence presenting as a subcutaneous palpable mass. While the palpable abnormality is usually asymptomatic, it can also present with pain. Muscles hernias occur most often in adolescents and young adults and might be due to sporting activities, trauma, or overlying fascia weakness. Because of its dynamic real-time imaging capabilities, ultrasound is best suited for the evaluation of these lesions. Moreover, a definitive diagnosis can be reached with ultrasound hence avoding additional time and expenses while promptly providing reassurance to the patients and families. US has excellent sensitivity and specificity for the identification of muscles hernias. However, baseline knowledge of this disease as well as close attention to technique are needed to reliably reach the proper diagnosis. Our educational poster will: 1. Summarize proper US equipment, technique and protocol for diagnosing muscle hernia 2. Discuss advantages and benefits of US over other imaging modalities 3. Illustrate the sonographic findings of muscles hernias
Methods & Materials: Pictorial review of US findings of muscle hernias including grayscale and color Doppler.
Results: The spectrum of normal and abnormal deep soft tissues scanning are presented. Abnormal findings are presented using illustrative cases.
Conclusions: Ultrasound is a powerful tool that is particularly well suited for the evaluation of suspected or unsuspected muscle hernias. This educational exhibit provides a practical guide to identify and diagnose muscle hernias.

Poster #: EDU-047

Imaging Phenotypes of Mitochondrial Diseases

Rahul Nikam[1], *rahulnikam@hotmail.com*; Ashrith Kandula[1], vijay krishnan[1], Achala Donuru[2]; [1]Radiology, Nemours A I duPont Hospital for Children, Philadelphia, PA, [2]Thomas Jefferson University Hospitals, Philadelphia, PA

Purpose or Case Report: Mitochondrial diseases are a heterogeneous group of disorders caused by defects in intracellular energy production. Due to this heterogeneity, it is not surprising that multiple systematic approaches to diagnosis exist; all of which use a combination of clinical, biochemical and structural criteria. Several distinct syndromes have been recognized with variable clinical and imaging phenotypes, including Leigh's syndrome, Kearns-Sayre syndrome (KSS), mitochondrial encephalopathy with lactic acidosis and strokelike episodes (MELAS). In this exhibit, we discuss imaging morphology of various mitochondrial disease with emphasis on imaging protocol and diagnostic approach.
Methods & Materials: The various mitochondrial diseases discussed in this exhibit include Leigh syndrome, mitochondrial encephalopathy with lactic acidosis and strokelike episodes (MELAS), myoclonic epilepsy with ragged red fibers (MERRF), BOLA3-associated leukodystrophy, POLG-related disorders, TRMU mutation, short chain acyl coA deficiency (SCADD), and NARP mutation.
Conclusions: After the exhibit., the reader will be well-versed with the imaging protocol and manifestation of various mitochondrial disease.

Poster #: EDU-048

Cortical Ischaemic Patterns in Term Partial-prolonged Hypoxic-ischemic Injury – The Inter-arterial Watershed Demonstrated Through Atrophy, Llegyria and Signal Change on Delayed MRI Scans in Children with Cerebral Palsy

Anith Chacko[1], *anithchacko@gmail.com*; Savvas Andronikou[2], Fabricio G. Goncalves[2], Ali Mian[2], Schadie Vedajallam[1], Ngoc Jade Thai[1]; [1]Clinical Research and Imaging Centre, University of Bristol, Bristol, United Kingdom, [2]Children's Hospital of Philadelphia, Philadelphia, PA

Purpose or Case Report: The inter-arterial watershed zone in neonates is a geographic area without discernible anatomic boundaries, is difficult to demarcate and usually not featured in atlases. Schematics currently used to depict the areas are not

based on any prior anatomic mapping, as compared to adults. Magnetic resonance imaging (MRI) of neonates in the acute to subacute phase with suspected hypoxic ischaemic injury can demonstrate signal abnormality and restricted diffusion in the cortical and subcortical parenchyma of the watershed regions, although this can often be subtle.In contrast, in the chronic stage of evolution of partial prolonged hypoxic-ischaemic injury, atrophy and ulegyria can make the watershed zone more conspicuous as a region. Our aim is to use images extracted from a large medicolegal database (approximately 2000 cases), of delayed MRI scans in children with cerebral palsy, to demonstrate the watershed region.To achieve this, we have selected cases diagnosed on imaging as having sustained a pattern of term, partial-prolonged hypoxic-ischaemic injury affecting the hemispheric cortex, based on the presence of bilateral, symmetric atrophy with ulegyria. From these we have identified those patients demonstrating injury along the entire watershed continuum as well as those demonstrating selective anterior or posterior watershed predominant injury for demonstration.Recognition of this zone is essential for diagnosing partial-prolonged hypoxic-ischaemic injury sustained in term neonates, which also has implications for potential compensation in litigation. The set of images presented in this pictorial review provides a template for identifying the cortical watershed distribution when there is milder regional (anterior, parasagittal, peri-Sylvian and posterior) watershed injury and for more severe injury where multiple regions are injured in combination or as a continuum.

Poster #: EDU-049

Differential Diagnosis and Imaging Patterns of Commonly Encountered Pediatric Stroke Mimcs

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Purpose or Case Report: **Background:**In pediatric patients presenting with neurological deficit in emergency department, special attention should be given to identify the conditions that can mimic a stroke to avoiding unnecessary interventions. There are various pathologies in pediatric populations that can mimic stroke both clinically and radiologically. Radiologists, by identifying specific imaging patterns of classical stroke and also patterns of those stroke mimics, shall aid clinician in deciding treatment options in a timely manner.**Objectives:**In this educational poster we aims at,1) Discussing typical imaging patterns of ischemic stroke.2) Discussing common pathologies in pediatric age group which can mimic ischimic stroke and pose challenge to the clinicians as well as radiologists.3) Describing various imaging findings of those stroke mimics that help to differentiate from ischemic stroke.We discuss the imaging patterns of following pediatric stroke mimics:- Infective pathologies, including HSV encephalitis- Demyelinating lesions.- Vasculitis- Migraine.- Mitochondrial encephalomyopathy, lactic acidosis, and stroke-like episodes (MELAS).- Hypoxic ischemic encephalopathy.- Moya Moya disease.- Posterior reversible encephalopathy syndrome.- Drug related pathologies.- Miscellaneous conditions.**Conclusion:**Differentiation of commonly seen stroke mimics from ischemic stroke in a timely manner helps clinician for proper management and unnecessary interventions.

Poster #: EDU-050

Intracranial Calcifications in Childhood

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Purpose or Case Report: Intracranial calcification (ICC) can be either physiological or pathological. Physiological ICC is not an expected neuroimaging finding in the neonatal period but can be seen as children grow older in the pineal gland, habenula, choroid plexus, and occasionally in the dura mater. Pathological ICC can be broadly divided into six groups: infectious, toxic, neurodegenerative, neoplastic, vascular, and syndromic. The first two groups are typically composed of diseases that more commonly result in static encephalopathies, whereas the last four groups are composed of diseases that tend to cause progressive encephalopathy.Various neuroimaging modalities have distinct utilities and sensitivities in the depiction of ICC. Age at presentation, ICC location, and additional neuroimaging findings are useful information that may be useful to narrow down the differential diagnosis of ICC. Bilateral ICC is commonly due to congenital infections or due to neurodegenerative or infectious diseases. ICC involving the basal ganglia and thalami are commonly seen in neurodegenerative diseases. ICC can be seen in isolation or be associated with other neuroimaging features.TORCH infections are the most common neonatal causes of ICC. ICC in congenital infections can be associated with clastic changes, hydrocephalus, chorioretinitis, white matter abnormalities, skull changes, and cortical development malformations. Specific non-infectious causes of ICC that mimic TORCH infections are known as pseudo-TORCH. Neurodegenerative diseases causing ICC are mainly due to parathyroid and thyroid hormone dysfunction and inborn errors of metabolism, such as MELAS, Kearns Sayre and Cockayne syndrome, interferonopathies syndrome, and Krabbe disease. Tumoral ICCs are more commonly seen in low-grade tumors. Arteriovenous malformations, arteriovenous fistulas, chronic venous hypertension, and cavernomas are also known causes of ICC. Other vascular causes of ICC include atherosclerosis, healed hematoma, radiotherapy treatment, old infarct, and disorders of the microvasculature such as COL4A1- and COL4A2-related diseases. Down syndrome and phakomatosis are also known causes of ICC.Clinical information such as age at presentation; maternal exposure to teratogens, such as virus; in addition to the association with chromosomal abnormalities; genetic mutations and postnatal infections, facilitate in the differential diagnosis of the multiple causes of ICC.

Poster #: EDU-051

Pictorial Review of Congenital Oral Lesions with Prenatal Correlation when Available

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Purpose or Case Report: The purpose of the pictorial review is to aid in understanding and identifying the spectrum of possible congenital oral lesions and make the radiologist familiar, as

early detection of these is required to avoid potential perinatal and postnatal complications.We performed a retrospective review of radiology reports from our pediatric hospital system, inclusive of our fetal imaging center, focusing on congenital oral lesions with prenatal or postnatal diagnoses. Utilizing multiple keywords through our radiology report data mining software, we reviewed cases over the last 15 years and grouped lesions based on the most likely diagnosis. Available prenatal and postnatal imaging, clinical management, and pathology was reviewed.Our review of cases yielded both common congenital oral lesions, such as hemangiomas, as well as more extensive malformations and tumors of the face extending to the oral cavity. Lesions such as epulis, oral duplication cysts, and lingual ectopic thyroid were rarer in our review, but have imaging characteristics important to recognize by the radiologist. We selected representative images from the spectrum of congenital oral and outlined radiology and clinical teaching points.

Poster #: EDU-052

The Curious Incident of the Missing Middle Cerebellar Peduncle: A Pictorial Review of Pontine Tegmental Cap Dysplasia

Simon Clifford, *cliffors@gmail.com*; Gabrielle Colleran; Pediatric Radiology, Children's Hospital Ireland, Dublin, Ireland

Purpose or Case Report: Pontine tegmental cap dysplasia (PTCD) is a rare malformation of the hindbrain and brainstem. The imaging hallmark is an ectopic dorsal transverse pontine fibre which projects from the tegmentum into the fourth ventricle. There is commonly aplasia/hypoplasia of the middle cerebellar peduncle.This is a rare congenital abnormality, with very few reported cases in the literature. The small number of reported cases may be related to a failure to recognise this entity on imaging. Affected children often present with developmental delay and cerebellar/pyramidal abnormalities. Cranial nerves V, VII, VIII and XII can be affected, leading to hearing loss, swallowing difficulties, ataxia and abnormal gaze. The underlying cause has not yet been established.This rare condition may be missed or misclassified on imaging. It is important that pediatric radiologists are aware of this entity and its imaging findings. MRI is the optimal method of imaging. Findings include an ectopic dorsal transverse pontine fibre which projects from the tegmentum into the fourth ventricle. There may be hypoplasia or aplasia of the middle cerebellar peduncle. Sometimes it can be difficult to identify when a normal structure is absent; Therefore it is important to look specifically for its absence. There may occasionally be hypoplasia of the inferior cerebellar peduncle. The course of the superior cerebellar peduncles may be more lateral than normal, which can lead to a ‘molar tooth’ configuration of the midbrain. It is important to use high resolution MR imaging to look for cranial nerve abnormalities. There may also be non-specific supratentorial abnormalities, including hydrocephalus. This educational poster uses imaging examples from our institution to explain and describe the relevant findings of pontine tegmental cap dysplasia. It is important that pediatric radiologists are aware of this rare entity and its imaging findings, so that the diagnosis is not missed.

Poster #: EDU-053

Diffusion Restriction in Disorders of Cerebrovascular Autoregulation

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Purpose or Case Report: The goals of this educational exhibit are to: 1. Explain the basis for the cause of diffusion restriction on brain MRI in children. 2. Discuss the broad differential diagnosis for diffusion restriction in pediatric emergency neuroradiology. 3. Emphasize causes of diffusion restriction unrelated to vascular occlusive disease in the brain. 4. Describe patterns of diffusion restriction commonly encountered in post-ictal states and posterior reversible encephalopathy syndrome.
Methods & Materials: This is an educational exhibit depicting the contrast of differential considerations for non-stroke-induced diffusion restriction in the pediatric brain. Typical signal abnormalities exhibited in post-ictal states and posterior reversible encephalopathy sydrome are emphasized.
Results: Diffusion restriction in disorders of impaired cerebrovascular autoregulation do not exhibit a typical vascular territory distribution. Post-ictal diffusion restriction is commonly seen within the splenium of the corpus callosum, cortical grey matter, subcortical white matter, and mesial temporal lobes. In posterior reversible encephalopathy syndrome, common sites of signal abnormality include the parieto-occipital, superior frontal, and watershed white matter. Hyperintense signal on diffusion weighted images in PRES may be associated with increased or decreased apparent diffusion coefficient values reflecting that the edematous change may be due to vasogenic or cytotoxic edema.
Conclusions: Diffusion restriction in the encephalopathic child can have a myriad of causes. Understanding patterns of diffusion restriction unrelated to stroke is important to guiding appropriate therapy. Posterior reversible encephalopathy syndrome is a partial misnomer, as findings may manifest in additional parts of the brain.

Poster #: EDU-054

Don’t Lose Your Head: A Review of Encephaloceles

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Purpose or Case Report: Encephaloceles are neural tube defects less commonly encountered in clinical practice. While often sporadic, genetic causes and TORCH infections are factors that predispose patients to encephaloceles. The majority of encephaloceles present at birth; however, some encephaloceles may demonstrate a more delayed presentation with cerebrospinal fluid rhinorrhea, nasal obstruction, or feeding difficulties.This electronic exhibit reviews various encephaloceles--occipital, sincipital, parietal, and basal encephaloceles--including antenataland postnatal cases. The distinction between nasoethmoidal,nasofrontal, and naso-orbital encephaloceles will be reviewed. The differential diagnosis of encephaloceles, especially of the sincipitallesions, will be detailed. Atretic cephaloceles will also be discussed.

Poster #: EDU-055

Chiari 1.5 Malformation - Definition and Measurements as a Guide to Surgery

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Purpose or Case Report: Chairi 1.5 malformation is different than usual Chair i1 malformation. Neuroisurgery treatment depends on certain specific measurements performed on MRI. Purpose of this presentation is to illustrate the method to perform these measurements.
Methods & Materials: When obex and cerbellar tonsils are below the foramen magnum, it is called Chiari 1.5 malformation. MRI performed on children with Chiari 1.5 malformation tereated at our tertiary care Children's hospital will be used for the purpose of illustration of various lines and measurements performed at skull base that are important in determining surgical approach. Various grades of pB-C2 line will be described. Various lines and angles at the skull base for diagnosis of basilar invagination will also be demonstated.
Results: Based on published paper by Ladner et al, when pB-C2 line measures 3 mm or more, the patients are more likely to have syrinx. These patients are morel ikely to get syrinx reduction and headache reduction after surgical treatment. Research by Bollo et al has demonstrated that clivo-axial angle of less than 125 dergrees is associated with increased risk of requiring occipito-cervical fusion in addition to posterior fossa decompression.
Conclusions: Diagnosis of Chiari 1.5 malformation and knowledge of how to perform its specific measurements are very important as this information is of immense value to the pediatric neurosurgeons.

Poster #: EDU-056

Congenital Inner Ear Anomalies: A Pictorial Essay

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Purpose or Case Report: The inner ear anomalies are a complex group of disorders, the radiologic findings of which may be difficult to interpret. This exhibit details the basic embryology of inner ear with stress on correlation of timing of insult or arrest of development to patho-morphology, the classification schema of inner ear anomalies and various salient features aiding in accurate diagnosis.
Methods & Materials: We commence by describing the relevant embryology of inner ear with stress on implications of timing of insult on patho-morphology. The various pathologies we will be discussing include: 1. Anomalies of semicircular canal: CHARGE syndrome, semicircular canal - vestibule globular anomaly, semicircular canal dysplasia - Waardenburg syndrome, dehiscence of superior semicircular canal (Minor's syndrome), 2. Anomalies of cochlea: complete labyrinthine aplasia, cochlear aplasia, common cavity malformation, incomplete partition type I, cochlear hypoplasia, incomplete partition type II, 3. Miscellaneous: oval window atresia, stapes gusher syndrome, stenosis of IAC, and Branchio-oto-renal syndrome.:

Poster #: EDU-057

Congenital Melanocytic Nevi Syndrome: A Pictorial Review of the Brain and Spine Abnormalities in Children with Neurocutaneous Melanosis

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Purpose or Case Report: Melanocytic nevi which present either at birth or soon after are known as congenital melanocytic nevi. Neurocutaneous melanosis is a rare sporadic phakomatosis caused by pigment cell tumours of the leptomeninges; These can be seen in association with giant congenital melanocytic nevi. Unfortunately, giant congenital melanocytic nevi with neurocutaneous melanosis has a poor prognosis. This pictorial review aims to present and describe the imaging features on MRI and CT of children with melanocytic nevi and neurocutaneous melanosis. These changes affect both the brain and the spine.
Methods & Materials: Imaging of children from our institution with congenital melanocytic nevi are shown. These demonstrate the salient imaging features, including intraparenchymal melanosis with focal T1 signal hyperintensities involving the mesial temporal lobes, amygdala, pons, medulla and cerebellum. Extensive leptomeningeal disease is also a common finding, which can result in hydrocephalus. Other features include arachnoid cysts. Associations include Dandy-Walker malformations.
Results: Relevant imaging features are shown and explained.
Conclusions: Congenital melanocytic nevi syndrome with neurocutaneous melanosis is a rare sporadic phakomatosis, which has characteristic imaging features. These imaging features are demonstrated and explained to assist pediatric radiologists with understanding and reporting these rare cases.

Poster #: EDU-058

Cruise Through the Myriad of Neuroimaging Findings in Crouzon Syndrome

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Purpose or Case Report: Crouzon syndrome is an autosomal dominant hereditary craniosynostosis.Although rare it is the most common syndrome seen within craniosynostosis. It is thus important for a pediatric radiologist to be aware of this condition and the imaging findings that can be seen.This presentation will provide an illustrative imaging review of the neuro findings one will encounter in cases of Crouzon Syndrome.Neuroimaging CT and MR images will be reviewed including shallow orbits with exophthalmos, hypoplastic maxilla, mandibular prognathia, premature fusion of sutures, kissing carotid canals, cervical fusion anomalies, and Chiari I malformations.Some of the non-neuro findings which can also be seen include stylohyoid ligament calcification, various musculoskeletal deformities, and visceral anomalies.

Poster #: EDU-059

McCune-Albright Syndrome from Pathophysiology to Imaging: Why Radiologists Matter

Larissa A. Defendi, *lariad@gmail.com*; Yoshino Sameshima, Henrique M. Lee, Erica A. Naves, Suheyla P. Ribeiro, Maurício Yamanari, Miguel José F. Neto, Marcos Queiroz; Radiology, Hospital Israelita Albert Einstein, Sao Paulo, SP, Brazil

Purpose or Case Report: McCune Albright syndrome (MAS) is a rare disease with a broad spectrum of clinical manifestations that may include café-au-lait macules, hyperfunctioning endocrinopathies and fibrous dysplasia. The latter is an uncommon and debilitating skeletal disorder that leads to fractures, deformity, functional impairment and pain. Since bone imaging provides essential data for diagnosis, prognosis evaluation and follow-up, the radiologist plays a crucial role at all steps of MAS management – and sometimes becomes the first health professional to assess non-skeletal associated conditions in routine exams.The present study proposes a practical approach for imaging McCune Albright syndrome. The main findings on various imaging modalities will be discussed according to their topography, bringing together relevant information to enhance the diagnostic, prognostic and follow-up procedures.Case material from our institution will be used to illustrate the following topics:1. Brief review of MAS pathophysiology;2. Clinical features and differential diagnosis of MAS;3. MAS and polyostotic fibrous dysplasia;4. Craniofacial fibrous dysplasia: imaging features, prognosis and follow-up;5. Role of various imaging methods in non-skeletal manifestations.

Poster #: EDU-060

Neck Lesions in Infants: A Pictorial Review

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Purpose or Case Report: Neck lesions are a common clinical scenario encountered in children. They can present as neck lumps or be discovered incidentally on medical imaging performed for other indications. While most paediatric neck lesions are benign, they can be a source of morbidity to patients and cause considerable anxiety to their care givers. Neck lesions in infants are made additionally more challenging as this area can be difficult to assess clinically. A clinically evident or suspected neck mass has, as a result, become a common indication for medical imaging in this age group. Being aware of the spectrum of neck lesions seen in infants and their respective imaging manifestations helps direct management appropriately in these cases.A review of neck lesions seen in infants seen at a tertiary paediatric centre over the last two decades is presented with correlation of imaging findings across multiople modalities with the final diagnosis. Our aim is to provide an overview of both common and rare neck lesions seen in this age group by using broad categories of congenital, inflammatory and aggressive/malignant lesions. As well as showcasing cases with classic imaging findings we will include some cases where features overlapped between different varieties of neck lesions to illustrate pitfalls in imaging neck lesions in infants.

Poster #: EDU-061

Neck Masses in Children: Pictorial Imaging Review

Youck Jen Siu Navarro, *youckjen.siunavarro@americanacademic.com*; Erica Poletto, Archana Malik, Mea Mallon; Radiology, St Christopher for children Hospital, Philadelphia, PA

Purpose or Case Report: A neck mass is a frequent chief complaint in the pediatric population and includes a wide variety of etiologies. The age of the child, symptoms and physical exam findings may narrow the differential diagnoses. The radiologist can aid in diagnosis and management by guiding the selection of the appropriate imaging modality. It is important for the radiologist to recognize the features of common and rarer neck masses in children. This pictorial review will describe the multimodal imaging features of a variety of pediatric neck masses in four categories: 1. Congenital/developmental: Thyroglossal duct cyst; Branchial cyst; Dermoid cyst; Epidermoid cyst; Venolymphatic malformation; Cervical extension of thymus 2. Infection/inflammatory: Lymphadenitis; Retropharyngeal/peritonsillar abscess 3. Neoplastic: Hemangioma; Neurofibroma; Neuroblastoma/ganglioneuroblastoma; Rhabdomyosarcoma; Lymphoma; Thyroid carcinoma; Teratoma 4. Miscellaneous: Ranula; Fibromatosis colli

Poster #: EDU-062

Ultrasound and Magnetic Resonance Imaging of Brain Injury in Premature Neonates (An Educational Exhibit)

Tom Soker, *sokert@gmail.com*; Michael Wien; Radiology, University Hospitals Cleveland, Cuyahoga Falls, OH

Purpose or Case Report: Objectives:To review normal neonatal brain anatomy as seen on ultrasound.To review the pathophysiology of common brain injuries in premature neonates.To detail the utility of ultrasound and MRI in evaluation of common neonatal brain injuries.Table of contents:1) US evaluation of the neonatal brain: Review standard views; Review normal neonatal brain anatomy 2) Pathophysiology of Germinal Matrix Hemorrhage (GMH) 3) Review of ultrasound and MRI findings in GMH: Initial injuries, and how they evolve over time; Sample cases and mimics 4) Pathophysiology of Periventricular Leukomalacia (PVL) 5) Review ultrasound and MRI findings in PVL: Initial injuries, and how they evolve over time; Sample cases 6)Summary and key facts

Poster #: EDU-063

Facilitating Temporal Bone Learning with Method of loci' Technique

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Purpose or Case Report: The anatomy of the temporal bone is complex and dense. Learning its complexity provides a challenge. One method to facilitate its learning is the 'method of loci' method. It is a method of memory enhancement which uses visualizations with the use of spatial memory, familiar information about one's environment, to quickly and efficiently recall information. This educational exhibit uses a simple story

and imagery superimposed on the multiplanar CT images to impose a natural structure and sequence that will aide in learning how to read, and detect normal, and abnormal anatomy of the temporal bone.

Poster #: EDU-064

Hemorrhage and Vascular Malformations.

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Purpose or Case Report: Review the causes of cerebral hemorrhage in the pediatric patient based on clinical cases.Stroke is a major cause of morbidity and mortality in children worldwide. The reported annual incidence ranges from 2.3 to 13 per 100,000 children per year in developed countries. In contrast to the adult, in children, diagnosis is not as straightforward, because when children present with acute neurological deficits, stroke is often not the first diagnosis considered by the medical providers.Neuroimaging is essential for diagnosis and differentiation of stroke from stroke mimics that can present similarly.Stroke in children can be ischemic or hemorrhagic, referring to the term hemorrhagic stroke as a intracerebral hemorrhage that is nontraumatic and whose most common etiology is secondary to a vascular malformation (Arteriovenous Malformation (AVM), Dural/Pial Arteriovenous Fistula (Dural AVF/Pial AVF), Cavernous Malformation, Vein of Galen Aneurysmal Malformation (VGAM), Developmental Venous Anomaly (DVA), Capillary telangiectasia, Sinus Pericranii, Aneurysms). The most commonly used classification of vascular malformation is based on angioarchitectural and histomorphological characteristics. To differentiate these classic types, in a first step, shunting lesions have to be discerned from nonshunting lesions, as well as other features of the vascular contribution that will be evaluated by image.We cannot forget the hemorrhage associated with coagulopathy, haematological disorders, brain tumors and cerebral sinovenous thrombosis (CSVT) which in the latter case can be found as venous infarction or hemorrhage; and other less common causes of hemorraghe in pediatrics as the intracranial aneurysms, in 15% of all pediatric aneurysms are secondary to an infection (micotic aneurysm).

Poster #: EDU-065

Improving the Detection of Ventricular Shunt Disruption Using Volume Rendered Head CT

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Purpose or Case Report: Ventricular shunt failures are common with as many as 40% failing by 1 year and 70% by 10 years. Approximately 15% of these shunt failures are related to shunt disconnections. The typical presenting symptoms of shunt malfunction are nonspecific and include nausea, vomiting, and altered consciousness; therefore, imaging is critical for diagnosis. Conventional radiographs can be used to identify shunt disruption although they can have limited sensitivity. Most children with suspected shunt dysfunction will also undergo CT or MR imaging to evaluate ventricular sizes. In addition, the integrity of the shunt system within the field of view on head CT can be assessed in detail; however, subtle shunt disconnections or fractures can still be difficult to detect on multiplanar CT images. Volume rendered CT images of the shunt apparatus can be used to improve the detection of subtle shunt disruptions
Methods & Materials: In this educational exhibit, we describe the technique for generating volume rendered images of ventricular shunt systems within the field of view on head CT scans. To optimally assess shunt integrity on volume rendered images, careful attention to window and level settings is necessary. We demonstrate the benefit of volume rendered CT images for improving detection of shunt disruption by reviewing several cases with subtle disconnections or malpositions, and compare the volume rendered images to the corresponding multiplanar CT or radiograph images. In addition, we highlight possible interpretive pitfalls when using volume rendered CT images in the evaluation of ventricular shunt malfunction.
Conclusions: Volume rendered CT images of ventricular shunt systems should be considered to improve the detection of shunt catheter disruption.

Poster #: EDU-066 - *Withdrawn*

Poster #: EDU-067

Thyroid Hemiagenesis: A Mimicker of Palpable Thyroid Nodule

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Purpose or Case Report: Thyroid hemiagenesis (TH) is a rare congenital abnormality associated with a higher incidence of thyroid disease. It is often asymptomatic and an incidental finding. However, TH may present as a palpable thyroid nodule, prompting sonography and thyroid function testing. Ultrasound (US) can differentiate between total absence of the thyroid lobe and severe hypoplasia. It is also useful for guiding fine needle aspiration when warranted. Scintigraphy is useful for determining the presence of ectopic thyroid tissue and to further characterize focal nodular thyroid lesions. Despite their respective roles, imaging findings on both US and scintigraphy can pose diagnostic challenges to the pediatric radiologist. This educational poster will review the embryology of the thyroid gland, frequency of TH, clinical presentation and associations with additional thyroid anomalies such as malignancy, thyroiditis and abnormal gland function. Imaging features of TH will be reviewed with focus on (US) and scintigraphy. The goals of this exhibit are:1. Review the incidence and clinical presentation of pediatric patients with TH 2. Describe the imaging findings and role of ultrasound and scintigraphy in the diagnosis and follow-up of TH3. Discuss prognosis and outcomes of TH in children

Poster #: EDU-068

How Long will I Glow in the Dark? Updates to I-131 Hyperthyroid Therapy with Focus on Duration of Post-therapy Radiation Precautions

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Purpose or Case Report: This electronic poster discusses the various clinical and imaging features of pediatric hyperthyroidism, including Graves' disease and toxic nodule. Imaging modalities reviewed include ultrasound and molecular imaging. We will provide an overview of I-131 hyperthyroid therapy with focus on guideline-based practices of patient preparation, I-131 dosing and post-therapy radiation precautions. A pressing concern for patients and families following I-131 therapy is how long radiation precautions must be followed and when the patient may return to school or work. We have developed and implemented a table listing the appropriate duration of post-therapy radiation precautions based on the administered I-131 dose. We propose the use of such tables for ease of consultation and standardization of discharge procedures.

Poster #: EDU-069

Risky Business: Treatment Assessment Using the International Neuroblastoma Response Criteria

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Purpose or Case Report: In this exhibit, we will outline the revised International Neuroblastoma Response Criteria (INRC) used to assess treatment response in children with neuroblastoma, particularly high risk patients, in the context of clinical relevance to their treatment plan. Neuroblastoma is the most common extracranial solid malignancy in children, accounting for approximately 12% of deaths in children younger than 15 years of age affected with cancer. Up to 50% of children with neuroblastoma are found to have a high-risk phenotype with poor long-term survival and risk of therapy-related toxicity. Due to a lack of consensus regarding the definition of disease response, the development of more effective therapy treatment of high-risk disease has been hindered. The revised INRC consensus integrates modern, functional imaging techniques and quantitative assessment of bone marrow disease. It is anticipated that the revised INRC will enable a more precise assessment of treatment response that can be used to inform treatment decisions. This exhibit will delve into these modalities which are more sensitive and specific for Neuroblastoma detection. This exhibit will also demonstrate how the revised response criteria are used in the clinical setting in the Children's Oncology Group clinical trials.

Poster #: EDU-070

Dynamic 4D Airway CT: Accounting for Variations in Ventilation, Position, and Other Factors in Interpretation and Optimization of Diagnostic Utility

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Purpose or Case Report: CT with 4D cine imaging can non-invasively and dynamically characterize airways for various pathologies, such as airway caliber fluctuations in tracheobronchomalacia, intermittent compression by cardiovascular or other mediastinal structures, or constriction from anatomic anomalies like those associated with craniofacial syndromes. However, optimal interpretation of dynamic airway CT studies requires an understanding of the impact of such extrinsic factors as the presence of support apparatus (e.g., endotracheal tube, enteric tube), level of required respiratory support (e.g., positive end-expiratory pressure), and differences in positioning (e.g., with jaw thrust). We have performed more than 100 pediatric cases of dynamic airway CT under a variety of conditions, in patients who range from free-breathing to ventilator-dependent, and for a variety of pathologies. In this educational exhibit, we will consider how to balance and tailor extrinsic factors when using dynamic CT for the guidance of airway management, in order to meet diagnostic considerations and supplement other cardiopulmonary investigations, including cases with bronchoscopic and surgical correlates.

Poster #: EDU-071 - *Withdrawn*

Poster #: EDU-072

Holy Smokes! Recognizing the Imaging Findings of E-cigarette, or Vaping, Product use Associated Lung Disease in Adolescents

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Purpose or Case Report: The incidence of e-cigarette, or vaping, product use associated lung injury (EVALI) has been increasing since the summer of 2019. At least seven distinct patterns of lung injury have been described with this emerging disease (1). A recent report from the United States Centers for Disease Control and Prevention indicates that approximately 15% of patients diagnosed with EVALI have been in the pediatric age group (2). Because of the potential legal and social repercussions of vaping and cannabis use, pediatric patients may be disinclined to admit to use of electronic cigarettes. As such, recognition of the potential imaging patterns of this disease may allow the pediatric radiologist to raise the possibility of EVALI to facilitate timely diagnosis and appropriate management of the disease.This educational exhibit will review the imaging findings seen in the various patterns of lung injury identified with this increasingly common lung disease. We will also discuss the indications for obtaining imaging studies in patients with suspected EVALI. In addition, we will describe the potential clinical presentations in these patients.References:1. Henry TS, Kligerman SJ, Raptis CA, et al. (2019) Imaging findings of vaping-associated lung injury. AJR 1-8. 10.2214/AJR.19.222512. Centers for Disease Control and Prevention. (2019) Severe pulmonary disease associated with electronic cigarette product use—interim guidance. https://www.cdc.gov/mmwr/volumes/68/wr/mm6836e2.htm

Poster #: EDU-073

Imaging of Lung Disease Associated with E-cigarette use in Children and Young Adults

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Purpose or Case Report: 'E-cigarettes,' also known as 'vapes',

are handheld battery-powered devices which heat and deliver aerosolized liquid (usually containing nicotine) to the respiratory tract via inhalation. E-cigarettes are the most commonly used tobacco product amongst youth in the U.S. today. Over 1 in 4 U.S. teens report vaping in the past 30 days. Pod-based forms, such as JUUL, are especially popular with teens. These and other devices are also popular among adults.The contents of commercially available solutions, or e-liquids, are poorly regulated. Aerosol generated by the devices may contain varying levels of nicotine, flavorings (which are often toxic), heavy metals, ultrafine particles, volatile organic compounds, and other unknown materials. Moreover, users may add substances of their choice to the liquid, including marijuana or other THC-containing products. Short and long-term health effects associated with vaping are incompletely understood, likely in part due to heterogeneity of products, variable consumption amongst users, and the relatively recent introduction and popularization of these devices.Awareness of negative health effects associated with vaping is increasing. Exposure to highly addictive nicotine has effects on the developing brain, leading to ADHD-like symptoms and often lifelong addiction. Teen e-cigarette use has been associated with an increased risk of future conventional cigarette smoking. Over 1000 cases of acute vaping-associated lung injury in the U.S. have been reported to the CDC as of October, 1, 2019. There is increased recognition of lung injury with early studies identifying a number of imaging patterns of pulmonary disease in adults, including hypersensitivity pneumonitis, diffuse alveolar hemorrhage, acute eosinophilic pneumonia, organizing pneumonia, lipoid pneumonia, and others.Radiologists should maintain a high index of suspicion for vaping-associated lung injury in the assessment of patients with respiratory distress and possible exposure. Recognition of imaging features of vaping-associated lung injury is especially important in children and young adults, who may not endorse a history of exposure. Identification of clinical and radiologic features associated with e-cigarette use can drive screening and cessation efforts.In this presentation, we present cases which highlight radiographic and CT imaging features of acute lung disease associated with e-cigarette use in children and young adults.

Poster #: EDU-074

Imaging Patterns of Vaping Associated Lung Injury in Children – A Single Institution Experience

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Purpose or Case Report: Vaping is a recreational activity of inhaling heated liquid vapor from electronic cigarettes which has been increasingly used as an alternative to cigarettes. Common substances that may be used in the liquids include nicotine, tetrahydrocannabinol, cannabinoid oils and other additives. There is increasing concern about lung injury associated with vaping, especially in children. While a nascent body of literature is beginning to develop regarding this entity, further investigation from different geographic regions (with access to varying chemical profiles of vaping material) and in differing age populations is necessary to ascertain the imaging patterns of vaping associated lung injury. In this poster, we describe the imaging patterns of pediatric vaping associated lung injury we encountered in our institution. Although this is inherently a diagnosis of exclusion, we consider these imaging patterns strongly suggestive if there is a history of vaping and absence of other risk factors or preexisting disease. We observed the following imaging patterns of lung injury associated with vaping:**Chest radiograph findings:**1) Normal.2) Coarse bilateral interstitial opacities.3) Pseudo pulmonary edema pattern: bilateral central predominant air space opacities with peripheral sparing.4) Mixed pattern: combination of air space opacities and reticular opacities.**Various patterns of computed tomography findings:** 1) Bilateral central ground glass opacities (GGO).2) Sub pleural sparing , in most of the cases.3) Interlobular septal thickening in association with GGO - crazy paving pattern.4) Lower lobe predominant thick subpleural parenchymal bands.5) Scattered GGO without any lobar predominance - an atypical finding seen in one patient.6) Mild bronchial wall thickening**Take home message:** - Bilateral central predominant ground glass opacities with lower lobe predominance and sub pleural sparing are the most consistent findings seen in most of the cases. The GGO show an anteroposterior (dependent) gradient of increasing attenuation.- Posterior dependent parenchymal bands were observed subjacent to subpleural spared lung parenchyma in several cases, a finding which has not been described previously to our knowledge. These parenchymal bands, in association with above mentioned findings, are highly suggestive of vaping associated lung injury in the appropriate clinical setting.- We have observed complete resolution of findings in at least two of the cases on short term followup.

Poster #: EDU-075

Using Dual-Source, Dual-energy CT Material Decomposition Technology for Pediatric Thoracic Imaging

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Purpose or Case Report: Dual-energy computed tomography (DECT) decomposition software has expanded the scope of CT post-processing. It is an efficient method in pediatric thoracic imaging to define both vascular and parenchymal abnormalities. **Methods & Materials**: There are 5 basic material decomposition tools: virtual nonenhanced (iodine subtracted from the image), iodine overlay (iodine image superimposed on the gray-scale image), lung vessel, lung perfusion and automated bone removal images. The lung software, generates pulmonary vessel images by color-coding their iodine amounts, which serves as an indicator of flow. Pulmonary vessels with high flow are color-coded blue and those with slower flow are color-coded red. The software generates so-called perfused blood volume images by analyzing the iodine content in the lung parenchyma, allowing assessment of hypoperfusion. The automated bone removal software for CT angiography subtracts iodine from bone based on differences in their atomic numbers. This poster is based on experience with approximately 400 chest CT scans done on 2nd and 3rd generation dual-source systems. **Results**: Virtual nonenhanced images play a role in lesion characterization by facilitating detection of small foci of calcification, fat and blood. Iodine overlay images allow for qualitative and quantitative assessments of iodine content, helping in characterizing masses and monitoring treatment response, such as in lymphoma and neuroblastoma, Demonstration of low iodine concentrations (< 1 mg.ml) support the diagnosis of a benign solid mass whereas demonstration of higher iodine concentrations increases concern for malignancy. In thromboembolic disease, absent or

hypoplastic pulmonary arteries and pulmonary hypertension, DECT lung vessel images facilitate detection of flow in small subsegmental vessels, which can be difficult in small children. In the same diseases, DECT perfusion images increase sensitivity of detecting perfusion defects based on reduction in iodine content. The bone removal software improves evaluation of coarctation and vascular rings by improving vessel cutoff. This poster will display a wide variety of pathologies to illustrate the material decomposition tools.
Conclusions: The proposed session will demonstrate the latest generation DECT material technology. Material decomposition has increased the robustness of CT in imaging of lung perfusion and lung vessels, characterization of masses, assessment of tumor response to treatment, and vessel evaluation.

Poster #: EDU-076

It's Getting Harder and Harder to Breathe: A Review of Imaging Findings in Childhood Interstitial Lung Disease

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Purpose or Case Report: In this educational exhibit, we will present a series of childhood interstitial lung diseases (chILD) cases from our institution and present the x-ray and computed tomography (CT) images. We will describe a wide variety of pathologies that are encountered but are rare. We will discuss key imaging features and include teaching points of these chILDs.
Methods & Materials: Childhood interstitial lung diseases are a heterogeneous group of conditions that affect children of all ages. These pathologies can be split into two broad categories: those that are present during infancy and those which are not specific to the infancy. During infancy disorders can be further divided into those that are a result of abnormal pulmonary development, lung growth abnormalities, chronic lung disease of prematurity, structural changes associated with chromosomal abnormalities and disorders related to surfactant deficiency. In the older population disorders are divided into those seen related to systemic disease processes, those of the immunocompromised host and those that mimic interstitial lung disease including but not limited to infections and inhalation injuries. We will also discuss the latest techniques to optimize the imaging ILD in the pediatric population and discuss pitfalls in imaging acquisition.
Results: We will use a case based approach to discuss pathologies from the following categories divided by those seen infancy versus those that are not specific to infancy. Pathologies include the following:Alveolar capillary dysplasiaPulmonary hypoplasiaChronic lung disease of prematuritySurfactant deficiency disordersTrisomy 21 related interstitial lung diseaseSarcoidosis – Blau's DiseaseNoonan's Related LymphangectasiaBronchiolitis ObliteransBronchiolitis Obliterans with organizing pneumonia (BOOP)Adenovirus Interstitial PneumoniaChronic Eosinophilic PneumonitisPneumocystis Pneumonia (PCP)Chlamydia PneumoniaVaping Related Lung Disease
Conclusions: Childhood interstitial lung diseases, though rare, are significant cause of morbidity and mortality in both infants and children. Knowledge of the different clinical presentations and radiologic appearances of these varied pathologic conditions is of the upmost importance in order for the radiologist to provide guidance for the referring pediatric clinicians.

Poster #: EDU-077

Patterns of Atypical Pulmonary Metastases in Children

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Purpose or Case Report: Pulmonary metastases typically present as well-circumscribed, solid nodules of variable size in most pediatric malignancies. Hematogeneous metastases tend to have a basilar and peripheral predilection. Atypical patterns of pulmonary metastases can however occur and lack of recognition can result in understaging or delay in diagnosis. The purpose of this poster is to review the imaging findings of atypical pulmonary metastatic disease in children. Cases from two large tertiary care institutions will be used for illustration.Atypical pulmonary metastatic patterns include: 1. Dilated and beaded peripheral pulmonary vessels secondary to intravascular metastatic disease (e.g. osteosarcoma). Though central tumor embolus or tumor thrombus is easy to recognize, certain tumors such as osteosarcoma can cause intravascular metastatic disease in peripheral pulmonary arteries which has a characteristic imaging appearance and can mimic a "tree-in-bud" pattern. 2. Interstial thickening secondary to lymphangitic spread of tumor (e.g. lymphoma, renal medullary carcinoma, adenocarcinomas in children). This can be seen with or without mediastinal lymphadenopathy and is characterized by nodular septal line thickening. 3. Miliary pulmonary nodules (e.g. papillary thyroid cancer). Papillary thyroid carcinoma, the most common pediatric thyroid malignancy, can present with innumerable tiny pulmonary nodules which maybe mistaken for an infectious etiology secondary to indolent course. 4. Cavitary pulmonary masses (e.g. sarcomas). Cavitary nodules maybe seen at presentation in certain sarcomas or as a consequence of therapy induced central necrosis. 5. Calcified nodules (e.g. osteosarcomas) which can be mistaken for granulomas. 6. Nodules from hypervascular tumors can show hemorrhagic halos (e.g. angiosarcoma, choriocarcinomas). 7. Endobronchial metastasis can present with persistent segmental/lobar collapse.An awareness of the spectrum of imaging findings of atypical pulmonary metastases along with their histopathologic correlates will allow the radiologist to make an accurate diagnosis.

Poster #: EDU-078

Closing in on CLOVES: A Pictoral Review

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Purpose or Case Report: Although rare, CLOVES syndrome, a *PIK3CA*-related congenital overgrowth disorder, presents radiologists with opportunity for vital diagnostic and treatment planning. CLOVES syndrome is characterized by Congenital Lipomatous Overgrowth of the trunk, Vascular malformations, Epidermal naevi, and Skeletal and Spinal anomalies. Multimodal imaging findings can help distinguish CLOVES from other overgrowth syndromes such as Proteus syndrome and Klippel-Trenauny syndrome. We present multimodal imaging of four patients with CLOVES syndrome which demonstrate characteristic findings: - Thoracic lipomatous hyperplasia, a key sign of CLOVES syndrome in which predominantly thoracic lipomatous masses grow in the

subcutaneous tissues and invade the pleura, mediastinum, and upper abdomen, often with superficial vascular malformations- Renal anomalies, including agenesis, hypoplasia, hydronephrosis, and cysts.- Vascular malformations, including venous, venolymphatic, and lymphatic malformations- Spinal cord defects, including spina bifida, medullary arteriovenous shunts, and congestive myopathy of the paravertebral venous plexus Management of CLOVES syndrome focuses on debulking of lipomatous masses, treatment of clinically significant vascular malformations, and medical management of renal and neurologic sequelae. To that end, the role of the radiologist is accurate diagnosis of the syndromic pattern, isolation of the extent of lipomatous masses for pre-operative planning, and identification of renal and spinal cord anomalies. The purpose of the poster is to:1. Briefly review the types of congenital overgrowth disorders as demonstrated in various imaging modalities.2. Focus on characteristic imaging findings of CLOVES syndrome.3. Review the benefits and disadvantages of various imaging modalities.4. Identify the most relevant radiologic findings for surgical, interventional and medical management.

Poster #: EDU-079

Congenital Lung Malformations – From Parenchyma to Vessels

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Purpose or Case Report: Congenital lung malformations are a heterogeneous group of developmental disorders whose etiology is not well stablished. Since they represent a spectrum of anomalies, diverse imaging appearance and clinical manifestations can be found. Although rare, their clinical importance is remarkable. Some of them can be a source of important morbidity and mortality in infants and children. Others, however, remain asymptomatic and may be incidentally detected in adulthood. Nowadays, these malformations are usually diagnosed in utero by prenatal imaging. In order to optimize diagnostic accuracy and disease management, it is imperative for radiologists to be familiar with the imaging characteristics of each lesion and the proper methods employed in their evaluation.The purpose of this exhibit is:- To describe the postnatal radiological appearance of some congenital lung diseases on conventional radiography, ultrasound (when available) and cross-sectional imaging methods;- To conduct a brief review of the literature regarding etiology, epidemiology, clinical features and adequate diagnostic approach;- To highlight the key imaging findings of each abnormality and their differential diagnoses;- To briefly discuss management and follow-up of each condition.Illustrative cases from our Radiology Department will be used to demonstrate the following entities:1. Parenchymal anomalies:- Lung hypoplasia;- Congenital bronchial atresia;- Congenital lobar emphysema;- Congenital pulmonary airway malformation (previously known as congenital cystic adenomatoid malformation);- Pulmonary bronchogenic cysts;- Tracheal bronchus;- Accessory cardiac bronchus.2. Vascular anomalies:- Interruption of a main pulmonary artery;- Pulmonary artery stenosis;- Anomalous pulmonary venous drainage.3. Combined parenchymal and vascular anomalies:- Bronchopulmonary sequestration;- Hypogenetic lung (scimitar) syndrome.

Poster #: EDU-080

Pediatric Chest Ultrasound-beyond Pleural Effusion-pictorial Review

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Purpose or Case Report: Sonography is well established, effective and radiation free imaging tool in pediatric chest conditions, primarily and widely used for evaluation of pleural effusions and assessment of chest wall abnormalities. Beyond that, it can also provide valuable information in evaluation of congenital abnormalities, anatomical variations, infectious process and malignancies in the chest.
Methods & Materials: We retrospectively reviewed and identified patients who underwent a chest ultrasound examination and then correlated the findings with their available radiographic and/or cross sectional imaging findings and also surgical and pathology results.
Results: Our review illustrates a wide spectrum of congenital, infectious and neoplastic abnormality including pathology involving the mediastinum, lung parenchyma, diaphragm and pleura.
Conclusions: Sonography can provide useful information and often final diagnosis about various chest pathology, especially in the pediatric population with reduction in the need for more invasive investigations, also utilization of sedation and/or ionizing radiation.

Poster #: SCI-001

Commercial Insurance is Associated with Greater Head CT Utilization for Pediatric Headache in a Children's Hospital Emergency Department

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Purpose or Case Report: Head CT is not recommended as a first test to evaluate non-traumatic headaches in children unless the headache is acutely severe. While CT can provide important diagnostic information, they expose children to radiation and increase healthcare costs. The purpose of this investigation is to evaluate the association between insurance type and the likelihood of receiving a head CT scan for headache in a single pediatric hospital system.
Methods & Materials: All children presenting with a chief complaint of headache at either of two pediatric emergency departments affiliated with a large pediatric healthcare system over 1 month were retrospectively reviewed. Patients with a history of trauma, charity care patients, and self-pay patients were excluded. We developed a multivariate logistic regression model. The outcome variable was whether or not the patient received a head CT scan. The predictor variables were insurance type (commercial or government) and hospital location (urban main or suburban satellite).
Results: 333 patients presented with headache during the period studied. 38 patients total (11.4%) received a head CT scan, comprising 23 of 100 patients (23%) with private insurance and 15 of 233 patients (6%) with government insurance. On multivariate logistic regression, after controlling for the location of the hospital, having private insurance was independently associated with a higher probability of receiving a head CT

scan. The odds ratio of CT imaging in patients with commercial compared to government insurance was 3.72.
Conclusions: Commercially insured children who presented with headache were 3.72 times as likely to receive head CT imaging compared to those with government insurance. Multiple patient- and provider-driven factors may contribute to this difference. Parents of children with commercial insurance may have higher socioeconomic status, education, and familiarity with imaging. These factors may influence them to request more imaging. As to provider effects, physicians may order more imaging for privately insured patients because of possible implicit bias, insurance reimbursement concerns, and/or litigation risk. The difference in the likelihood of CT raises concerns about health care disparities between children with government insurance and those with private insurance as well as greater risk of radiation exposure among those with private insurance.

Poster #: SCI-002

Diagnostic Performance of Ultra-Low (Radiographic) Dose Chest CT in Pediatric Patients with Pectus Excavatum

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Purpose or Case Report: Pectus excavatum (PEx) is a chest wall deformity that leads to sternal depression and can impair cardiopulmonary function. CT imaging is used for surgical planning but exposes children to a significant radiation dose. Ultra-low dose CT enables PEx assessment in children with radiation exposure comparable to plain radiographs. The purpose of this study is to evaluate image quality and detection of thoracic pathology on ultra-low dose CT in children with PEx.
Methods & Materials: A HIPAA-compliant, IRB-approved retrospective query of a single institution clinical database identified children who underwent a CT scan for PEx from 2010 to 2019. Scans were either performed using conventional chest CT protocol or using the ultra-low dose pectus protocol. The ultra-low dose protocol consisted of low kV (80-100kv) and low mA (25-50mA) settings. Image quality was determined objectively by signal to noise ratio (SNR) and subjectively by two radiologists scoring on a five-point Likert scale. Any additional findings were noted (e.g. nodules), and follow-up imaging were reviewed to evaluate for potential pathology missed on CT. Student's t test was used to assess significance in differences between continuous variables.
Results: 161 children and 195 chest CTs for PEx were identified during the study period, including 102 ultra-low dose (mean age: 14.0±2.2) and 93 conventional scans (mean age: 14.6±2.5). The mean effective dose was 0.2±0.1mSv for ultra-low dose CT and 1.1±0.8mSv for conventional CT ($p<0.01$). The average SNR on ultra-low dose CT was 22.8±10.8 and on conventional CT was 37.7±12.3 ($p<0.01$). The subjective image quality for ultra-low dose and convetional scans of bones were scored at 4.2±0.6 and 5.0±0.1 and lungs were scored at 4.3±0.5 and 5.0±0.1, respectively ($p<0.01$). For additional findings on the images, nodules were identified in 13% of ultra-low dose scans and 29% of conventional scans ($p<0.01$). Follow-up demonstrated no evidence of pulmonary nodule enlargement or associated malignancy.
Conclusions: Ultra-low dose CT has allowed the evaluation of children with PEx at radiation doses approaching that of chest radiography. The radiation dose reduction leads to decreased image quality, likely reflected in the reduced number of lung nodules detected on ultra-low dose scans. However, follow-up of these nodules did not demonstrate clinical significance. These results suggest that ultra-low dose CT is a viable strategy for As Low as Reasonably Achievable (ALARA) imaging of pediatric patients with PEx.

Poster #: SCI-003

Unexpected Extracardiac Findings in Dedicated Cardiac CT

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Purpose or Case Report: The advent of fast CT scanners with lower radiation doses has resulted in rapid growth in the numbers of cardiac CTs being performed in children. This has also increased the number of CTs interpreted by cardiologists, similar to adult cardiac CT. Pediatric cardiac CT demonstrates multiple potential extracardiac variants and pathology that may occur in conjunction with congenital heart disease (CHD). Prior publications in adult cohorts demonstrate a wide-range and incidence of extracardiac findings (6-39%) but the prevalence in children is unknown. Therefore, the purpose of this abstract is to describe incidence, distribution and significance of the extracardiac findings found in pediatric cardiac CT at a tertiary referral center.
Methods & Materials: Our institutional review board approved this HIPAA-compliant retrospective study; informed consent was waived. We identified all (n=262) records for patients who received a Cardiac CT study between January 1 and August 1, 2019 at our tertiary referral children's hospital. All non-cardiac indicated CT angiograms (including airway and vascular ring studies) were excluded.CT reports were interrogated for extracardiac findings categorized by system (airway, lung, vascular, abdomen, malpositioned lines and miscellaneous). Each of these findings was subclassified by level of clinical importance based upon the need for urgent intervention or treatment.
Results: 262 dedicated cardiac CT exams were performed in the 8 month time period. Patient age: median 3 years, range 3.6 days-56 years. Of the 262 exams, 56 (21%) demonstrated clinically important findings (airway n=10, pulmonary n=27, vascular n=13, abdomen n=2, malpositioned lines n=4, new neuroblastoma n=1), of which 19 (7%) were deemed to be of critical importance including pneumothorax, lung collapse, dissection, venous obstruction, necrotizing enterocolitis and endobronchial intubation.
Conclusions: Extracardiac findings are relatively common in pediatric cardiac CT, highlighting the importance of interpretation by experienced pediatric radiologists.

Poster #: SCI-004

Bright Babies: Features Associated with Serosal and Soft Tissue Enhancement after Cardiac Catheterization in Newborns

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Purpose or Case Report: Diffuse serosal and soft tissue enhancement (SSTE) is a unique pattern of contrast enhancement seen on abdominal radiographs after cardiac catheterization in newborns. While thought to be benign, SSTE can be misdiagnosed as pneumoperitoneum, resulting in unnecessary and potentially invasive diagnostic procedures. The purpose of this study is to describe the incidence of SSTE on abdominal radiograph performed in infants within 2 days of cardiac catheterization and identify clinical features associated with this imaging finding.
Methods & Materials: Patients under 1 year of age who had undergone cardiac catheterization between January 2010 and September 2019 were identified from a cardiology database. Patients with abdominal radiographs performed within 2 days of cardiac catheterization were evaluated by a pediatric radiologist for the presence of SSTE. Laboratory and clinical information, including renal function tests, contrast dose, and patient demographics were recorded. A two-sample t-test and univariate logistic regression analysis were used to determine variables that correlate with SSTE.
Results: 294 patients less than 1 year of age (182 boys; mean age 123 days) who underwent at least one abdominal radiograph within 2 days of catheterization were included in the study. SSTE was found in 37% (108/294). Compared to those without SSTE, patients with SSTE had a higher total contrast volume ($p<0.0001$) and higher contrast volume per body surface area (BSA) ($p<0.0001$). Those with SSTE had lower creatinine pre- ($p=0.02$) and post-catheterization ($p=0.047$), without a significant difference in calculated GFR at either timepoint ($p=0.066$ pre-, and $p=0.22$ post-catheterization). In addition, the mean age ($p=0.001$), weight ($p=0.0013$), and BSA ($p=0.004$) were higher in patients with SSTE. After univariate analysis, pre-catheterization serum creatinine ($p=0.03$), age at catheterization ($p=0.001$), weight ($p=0.001$), BSA ($p=0.005$), total contrast volume ($p < 0.0001$), and contrast volume per BSA ($p<0.0001$) were determined to be significant predictors of SSTE.
Conclusions: SSTE was present on 37% of abdominal radiographs performed on infants within 2 days of cardiac catheterization in our study. A higher total contrast volume and higher contrast volume per BSA were the variables most strongly correlated with the presence of SSTE. Although patients with SSTE have lower creatinine levels, the lack of a statistically significant difference in GFR suggests that SSTE is unlikely to be associated with renal function.

Poster #: SCI-005

Evaluating the Utility of Screening Hip Ultrasound Examination for Developmental Hip Dysplasia in Extremely Preterm Infants

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Purpose or Case Report: Developmental dysplasia of the hip (DDH) results from the abnormal development of the acetabulum, femoral head and mechanical instability of the hip joint. DDH often presents at birth, and if diagnosed early and treated successfully, children are able to develop a normal hip joint without functional limitation. If left untreated, DDH can lead to pain and osteoarthritis by early adulthood as well as discrepancy in leg length and functional disability. DDH risk factors include breech position in utero, oligohydramnios, female sex, primigravida, family history of DDH and improper swaddling. While there are recommendation for ultrasound screening in breech infants, only a few studies have dealt with the influence of gestational age on the development of DDH. Optimal timing of hip US and identification of patients who need follow-up are important to reduce unnecessary treatment and to avoid overtreatment. We aim to evaluate whether extremely premature infants (<28 weeks gestational age) warrant ultrasound screening for DDH in the absence of other risk factors.
Methods & Materials: We performed a retrospective review of 1528 consecutive patients who had a dynamic infant hip ultrasound at our institution from 2014-2019. Gestational age at birth, the position of in utero fetal lie, delivery method, evidence of hip instability, acetabular alpha angle, types of treatments pursued, and long-term outcome were evaluated based on medical records.
Results: Among 882 patients with known gestational age, 66 patients met the criteria for extreme prematurity. Within the study group, 1 patient had hip dysplasia. As our control group, there were 816 patients were born at 28 WGA or greater. Within this control group, 74 patients had hip dysplasia. The incidence of hip dysplasia in extremely premature infants was significantly lower than patients born at 28 weeks or greater (1.5% compared to 9.1% respectively, $p=0.036$).
Conclusions: Our findings are in agreement with other published literature that reported a lower incidence of DDH in premature infants. The one extremely premature infant in our study group who developed complete right hip dislocation and clubfoot deformity had preterm premature rupture of membranes with prolonged severe oligohydramnios. We propose that extremely premature infants do not need ultrasound screening for hip dysplasia in the absence of certain risk factors. Further study is needed to expand our knowledge on the extremely premature infants and the associations of individual risk factors with DDH.

Poster #: SCI-006

Fetal Liver T_2* Values using 3.0 T MRI

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Purpose or Case Report: Magnetic Resonance Imaging is a powerful tool for the detection of ferromagnetic components. This property can be used for the early detection of pathologic conditions related to liver iron overload. Neonatal hemochromatosis and hemosiderosis are conditions associated with severe liver disease. Infections like parvovirus and cytomegalovirus, metabolic conditions and gestational allo-immune liver disease can produce neonatal hemochromatosis phenotype.Fetal iron overload can be detected early by using T_2* multi-echo gradient sequence.There are only few studies reporting standard T_2* values of the fetal liver at 1.5 T.The aim of this study is to evaluated the standard T_2* values of the fetal liver using prenatal MRI with 3.0 T.
Methods & Materials: The T_2* sequence of the liver was obtained from eight fetuses (5 normal, 2 IUGR and one placenta

hematoma) between 24 and 30 gestational weeks at 3.0 T Siemens Vero MRI system with a 6-channel flex coil and a 4-channel spine coil. T_2* weighted images were collected by multi-echo Spoiled Gradient Echo sequences with all the echoes flow compensated. The data were collected by four difference protocols. T_2 Half-Fourier Acquisition Single-shot Turbo Spin Echo (T2-HASTE) sequence was also performed as the reference. All the data analyses were performed by custom-written software in MATLAB™. T_2* map was created by a pixel wise exponential fitting, and only the voxels with a goodness of fit higher than 0.85 were considered as reliable results which were used in the calculation of average and standard deviation of T_2* value of the liver.
Results: Eight Singleton pregnant women underwent fetal MRI for research purposes in a 3.0 Tesla magnet. The average gestational age was 28.5 ± 3.8 weeks (range between 24 – 30 weeks).The mean fetal liver T_2* value for the normal subjects were 15.8 ± 2.1 ms. The lowest value was 12.1 ms in a subject with 30 + 3/7 weeks of gestation, and the higher value was 21.6 ms in a subject with 30 + 5/7 weeks of gestation. No significant variation of T_2* values crossing gestational ages was found. The liver T_2* value in the case of placental hematoma at 25 weeks was 21.5 ms. The values for the IUGR subjects were 10 ms for the one at 35 weeks and 16.1 ms for the other one at 24 + 2/7 weeks.
Conclusions: Noninvasive evaluation of the fetal liver iron deposition is possible with T_2* MRI sequences using 3.0 Tesla. This study is important as a quantitative standard reference value especially in the assessment of chronic fetal liver conditions.

Poster #: SCI-007

Argentina's Experience Supports the Usefulness of Urinary Tract Dilation Risk Groups Proposed by the American Consensus

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Purpose or Case Report: Introduction: The American Consensus established risk groups for urinary tract dilation (UTD), however it has not been validated. Purpose: To validate the usefulness of the upper UTD risk groups according to a long-term outcome of patients stratified with a homologous classification.
Methods & Materials: Homsy grading system is comparable to the Consensus: mild hydronephrosis (HN): anteroposterior pelvic diameter (APPD) ≤15 mm without calycial dilation and normal parenchyma -, moderate (M) – APPD > 15 mm with calycial dilation and normal parenchyma - and severe (S) – APPD > 15 mm, calycial dilation and parenchymal thinning- , equivalent to low (P1), intermediate (P2) and high (P3) risk groups respectively. Frequency of presentation, outcome for each risk group was analyzed in 919 patient with prenatal UTD. Possible predictors of evolution: gender, bilaterality, value of APPD, size and renal function, urinary tract infection (UTI) was determined. The outcome was assessed as resolution, stability or progression . Statistics: descriptive analysis: averages, percentages.
Results: Out of 919 newborns, 537 (58.4%) had mild HN-P1-, in 230 (42.8%) was bilateral, 88 NB (9.5%) had M HN – P2- and 43 (5%) had S HN- P3-. Median follow-up: 30 months (r: 12-212m). 80% of mild HN-P1- resolved spontaneously during the first year of life. Only 1% progressed and required surgery, less than 10% had a UTI. Bilaterality did not imply a worse prognosis either in terms of outcome or in UTI rate. In patients with M HN- P2- 2/3 resolved spontaneously the dilation , 73% with APPD 15 to 25mm in the first postnatal ultrasound in an mean time of 16 months;14% progressed (mean APPD >24 mm) and required surgery. Increased renal size and supranormal function were predictors for surgery.There were no statistically significant differences in the outcome by sex (p = 0.44), laterality and UTI. All the S HN-P3-were resolved surgically, except in 3 patients in whom the dilation regressed spontaneously.
Conclusions: Both classifications are based on the assessment of APPD and renal characteristics, and establish the same limit to define mild HN-P1-, being the most frequent abnormality found with an excellent prognosis. APPD was the most important predictor of clinical outcome. Our long-term follow-up results allow to validate the usefulness of the grading system proposed by the American consensus.

Poster #: SCI-008

Doppler Ultrasound in Pediatric Liver Transplantation: Portal Vein Velocity Distal to the Anastomosis on the Immediate Post-operative Assessment Predicts Complications

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Purpose or Case Report: Doppler ultrasound (DUS) is routinely used to assess graft status after liver transplantation (LT). Although early post-surgical assessment is encouraged, the exact prognostic value of DUS parameters is unknown.The purpose of this study was to determine the prognostic value of DUS parameters obtained in the immediate postoperative period.
Methods & Materials: We included all children (<18 years) receiving a primary LT at our center from 2000 to 2019 who were assessed with DUS within 12 hours after LT. Our primary outcome was development of any graft-related complication requiring invasive management.Descriptive statistics were presented in absolute values, percentages, median and interquartile range (IQR). Associations between predictors and outcomes were determined using univariate and multivariable logistic regression and expressed as odds ratio (OR) or adjusted odds ratio (aOR) with 95% confidence intervals (95%CI). Receiver operator characteristic curve analysis was used to find optimal thresholds for predictors.
Results: Our sample included 79 liver recipients with a median age of 1.3 years (0.72 – 7.2), 25 (44%) were females and 45 (57%) had a living donor. The median time between LT and DUS was 1.8 hrs (1.1 – 3.9); 61 (77%) within 4 hrs.Twenty-eight (35%) patients required invasive management, with a median time to detection of 11 days (IQR 4 - 46) . The most common complications were portal vein thrombosis (10, 21%), biliary leak (9, 19%), and biliary stricture (7, 15%). The median follow-up was 3.16 years (IQR 1.5 – 7.0). Two of these 28 patients had vascular complications detected on the immediate post-op scan.Univariate analysis showed that the median (IQR) portal vein velocity (PVV) distal to the anastomosis was lower in complicated grafts [43 (20 - 59) vs 60 (40 – 94), p=0.008]. The optimal cutoff value was <60 cm/s (sensitivity=81%,

specificity=54%, AUC=0.69, 95%CI: 0.57 - 0.82). No other clinical or DUS parameter showed statistically significant differences in patients that required intervention vs mildly or uncomplicated grafts.A multivariable regression analysis showed an approximately 5 -fold higher odds of requiring invasive management with a PVV<60 cm/s, compared with PVV≥60 cm/s, after adjusting for age, sex, graft type, operation time and hepatic artery peak systolic velocity (aOR 5.3; 95%CI 1.5-17.6, p=0.007).
Conclusions: Immediate DUS assessment detects immediate complications and identifies patients at risk of complications through the PVV distal to the anastomosis.

Poster #: SCI-009

Imaging Features and Clinical Decision-making in Pediatric Focal Nodular Hyperplasia

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Purpose or Case Report: Describe imaging features of pediatric focal nodular hyperplasia (pFNH) in a large cohort of children with clinical, radiological and surgical management with a significant follow up period. We aim to provide an algorithm to treat these patients using the evidence base we have created.
Methods & Materials: Imaging of 88 children with 110 pFNH lesions from 1977-2018 were evaluated by 2 radiologists for features such as size, number, echogenicity/density/intensity, presence of central scar and enhancement pattern. All patients referred from 1996 were assessed for symptoms, risk factors, initial management, follow up and outcome. Results were used to form management guidelines for future patients.
Results: 88 patients (68% female) with 110 lesions were analysed. 10 patients (11.4%) had multiple pFNH. Size ranged from 1 - 29cm. Ultrasound (US) imaging was available for 89 lesions, CT in 50 lesions and MRI of lesions. pFNH are iso-/hyperechoic on US in 82.8% (72/87) with arterial Doppler flow in 74% (37/50). Contrast US shows typical enhancement in 87.5% (7/8). On CT, pFNH are iso-/hypodense in 94.9% (37/39) pre-contrast with typical enhancement in 69.6% (32/46). On MRI, pFNH are iso-/hypointense on T1 in 86% (43/50), iso-/hyperintense on T2 in 88% (44/50), hyperintense on diffusion in 80.6% (25/31) and show typical enhancement in 68.1% (30/44).50 patients were referred after 1996 and comprised our surgical follow up cohort: 74% females, mean age 8.9 years old with 46% symptomatic. Follow up was for a mean length of 5.2 years. Mean long axis diameter pFNH lesion at diagnosis was 5.9cm. 74% of patients had active radiological and clinical surveillance, whereas 26% had primary surgical resection. Of the patients undergoing surveillance only, 25 (67.5%) had lesional growth, 6 (16.2%) showed stability and 6 (16.2%) showed lesional decrease. 9 (24.3%) of the observed patients had eventual surgery. 92% of patients were asymptomatic at the end of follow-up with no significant difference in the surgical and observational groups.
Conclusions: pFNH is a rare tumour which compared to adults can be large, multiple, atypical on imaging and have a weaker predisposition for females. Given our clinical findings, we propose an evidence-based conservative approach to treatment consisting of first-line radiological and clinical surveillance. However, surgery can still be considered first or second-line for patients presenting with compressive abdominal symptoms, rapid growth of persistent symptoms.

Poster #: SCI-010

Gastric Tube Checks: Are After Hours Exams a Safe Alternative to Fluoroscopy?

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Purpose or Case Report: Gastrostomy tube (GT) or gastrojejunostomy tube (GJT) checks are a frequently ordered radiographic procedure to confirm placement. The goal of this study was to evaluate the accuracy of after-hours examinations for GJ or GJT placement using abdominal radiographs after injection of contrast, as compared to traditional fluoroscopy exams, which utilize a radiologist to perform the procedure.
Methods & Materials: We performed a retrospective cohort study including all subjects who underwent a GJ or GJT tube checks utilizing fluoroscopy and after-hours protocols between 1/1/2008 and 1/1/2019 at a single tertiary pediatric center. After-hours examinations were defined as checks that consisted of frontal and lateral abdominal radiographs after injection of contrast through the indwelling GT or GJT, regardless of time performed. Fluoroscopy exams were defined as exams which were performed in the fluoroscopy suite supervised by a radiologist. Radiology reports were evaluated for complications, such as malposition or extravasation. Clinical notes from the day of the procedure and longer term clinical follow up notes were used as a gold standard for complications. Sensitivity and specificity of the two procedures was calculated and a Fisher's exact test was used to compare the two procedures.
Results: A total of 147 (n=68 (46%) fluoroscopy, n=79 (54%) after hours technique) studies were evaluated. Long term clinical notes from a median of 37 days were used as part of the gold standard (range: 1-176 days). Clinically, seventeen exams (12%) demonstrated either malposition or serious complication. Radiologically, eight exams (12%) were abnormal by fluoroscopy and five exams (6%) by after-hours technique. There were five (3%) false negative examinations, where complication or malposition was discovered on follow up clinical evaluation. Of these, four were by fluoroscopic evaluation. Fluoroscopy exams had a sensitivity of 67% and specificity of 100% for tube position and after-hours exams had a sensitivity of 80% and specificity of 99% for tube position. Using a Fisher's exact test, the sensitivity and specificity are equivalent for these two types of exams.
Conclusions: This study concludes that fluoroscopy and after-hours techniques have no significant difference in detecting tube complications.

Poster #: SCI-011

Utility of Applying White Blood Cell Cutoffs to Non-diagnostic MRI and Ultrasound Studies for Suspected Pediatric Appendicitis

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Purpose or Case Report: Non-contrast magnetic resonance imaging (MRI) and ultrasound studies in pediatric patients with suspected appendicitis are often non-diagnostic. The primary objective of this investigation was to determine if combining these non-diagnostic imaging results with white blood cell (WBC) cutoffs improves their negative predictive values. The secondary objective was to determine the test characteristics of the fast, non-contrast MRI protocol used for suspected appendicitis.
Methods & Materials: A retrospective chart review was conducted including patients ≤ 18 years old with suspected appendicitis who had MRI performed with or without a preceding ultrasound study in a pediatric emergency department. Imaging results were sorted into 2 diagnostic and 5 non-diagnostic categories. Negative predictive values were calculated for the non-diagnostic MRI and ultrasound categories with and without combining them with WBC cutoffs of < 10.0 and < 7.5×10^9/L. Sensitivity, specificity, predictive values, and likelihood ratios were calculated for the MRI protocol.
Results: Of the 612 patients with MRI studies included, 402 had ultrasound studies performed. MRI with incomplete visualization of a normal appendix without secondary signs of appendicitis had a negative predictive value of 97.9% that changed to 98.1% and 98.2% when combined with WBC cutoffs of < 10.0 and < 7.5, respectively. Ultrasound studies with incomplete visualization of a normal appendix without secondary signs had a negative predictive value of 85.3% that improved to 94.8% and 96.5% when combined with WBC cutoffs of < 10.0 and < 7.5, respectively. The MRI protocol, with equivocal results excluded (7.7% of studies), had a sensitivity of 94.9%, specificity of 99.6%, positive predictive value of 98.2%, negative predictive value of 98.7%, positive likelihood ratio of 212.5, and negative likelihood ratio of 0.05.
Conclusions: In pediatric patients with suspected appendicitis, MRI studies with incomplete visualization of a normal appendix without secondary signs have a high negative predictive value that does not significantly change with the use of these WBC cutoffs. In contrast, combining WBC cutoffs with ultrasound studies with the same interpretation identifies low-risk groups. The fast, non-contrast MRI protocol is limited by a high number of equivocal results, but demonstrated excellent test characteristics for the 92.3% of studies that were evaluable.

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Poster #: SCI-012

Weighing in on Obesity and Suspected Appendicitis: A Radiologic Conundrum

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Purpose or Case Report: Ultrasound is often the initial imaging modality in evaluation for pediatric appendicitis, but there is concern that the increasing prevalence of pediatric obesity may affect both the sensitivity of ultrasound and the interpretation of an equivocal result. We hypothesized that higher BMI percentile would correlate with lower ultrasound sensitivity, higher equivocal rate, and higher rate of CT acquisition.
Methods & Materials: A retrospective review of consecutive ultrasounds for suspected appendicitis over three months at a dedicated pediatric healthcare institution was performed. Patients without weight and height recorded within two weeks of their exam were excluded. Patients were designated as underweight, healthy weight, overweight or obese according to CDC guidelines. Studies were reported as positive, negative (normal appendix), or equivocal (with low, moderate, or high suspicion) using a predefined rubric. Equivocal low suspicion was reserved for non-visualization of the appendix or normal appearance of a partially visualized appendix without secondary signs of appendicitis. Data regarding ultrasound result, CT acquisition, appendectomy, and pathology was obtained from the medical record.
Results: 499 ultrasounds on patients ranging in age from 12 months to 18 years were reviewed. Sensitivity of ultrasound for appendicitis in underweight, healthy weight, overweight, and obese patients was 94%, 72%, 80%, and 48%, respectively. Equivocal ultrasound rates for these groups were 18%, 48%, 48%, and 75%. Percentages of equivocal low suspicion results for which an ultimate diagnosis of appendicitis was made were 0%, 8%, 14%, and 13%. Of the patients with equivocal low suspicion results that had a final diagnosis of appendicitis, 65% (13) were greater than the 90th percentile for BMI, and 95% (19) were greater than the 50th percentile for BMI. There was no apparent correlation between BMI percentile and CT acquisition for equivocal results.
Conclusions: Decreased ultrasound sensitivity and higher equivocal ultrasound rate for appendicitis is observed in obese pediatric patients. Furthermore, an equivocal low suspicion result may be insufficient to exclude appendicitis in this population, as there are higher rates of subsequently diagnosed appendicitis. For underweight patients, the high negative predictive value of an equivocal low suspicion result may provide reassurance to the clinician. Without high suspicion of an alternate emergent diagnosis, CT utilization in these cases may be unwarranted.

Poster #: SCI-013

Assessment of Ovarian Torsion Using a Limited MRI Protocol for Appendicitis: Can We Rule Out Torsion? A Pilot Study

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Purpose or Case Report: This retrospective pilot study was performed to assess the utility of limited protocol MRI for appendicitis in excluding ovarian torsion by assessing ovarian symmetry with regard to size and appearance comparing torsed cases to controls.
Methods & Materials: Retrospective review of limited appendicitis MRI cases was IRB approved. 699 female patients were imaged between 12/2013 and 7/2019. Imaging findings and impressions were collected from the medical record.7 cases of surgically proven torsion were identified.Ten age-matched, pubertal status-matched, and MRI field-strength-matched controls for each torsion case were selected for this pilot study.Ovarian dimensions, T2 signal intensity sampled to exclude follicles or cysts, and diffusion coefficient of the most

restricted stroma excluding hemorrhage were tabulated.Differences in size and appearance between normal and torsed ovaries were analysed utilizing ratios of bigger to smaller ovaries for ovarian volume, more intense to less intense ovaries for T2 signal, and more restricted to less restricted ovaries for diffusion coefficients.Median values, quartiles, ranges, and odds ratios were calculated for each ratio variable and Mann-Whitney tests were performed.
Results: Of 70 selected controls, 66 had adequate ovarian visualization. Of the 66, 2 control patients and one torsion case could not be evaluated for diffusion coefficient.Control patients had symmetric appearing ovaries in most cases.The torsed ovary was always larger than the normal ovary. Using a 3:1 volume ratio, we observed 7 true positives, 61 true negatives, and 5 false positives. There were no false negatives. The 3:1 volume ratio in exclusion of torsion was 100% sensitive (95% CI 59% - 100%) and 92.4% specific (95% CI 83.2% to 97.5%) with a p value of 0.134. The median T2 signal ratio was larger in torsion cases than in controls: 2.0, range 1.3 - 5.5, p value 0.025, although the torsed ovary could be brighter or darker than the normal ovary. The median diffusion coefficient ratio was larger in torsion cases than controls: 3.3, range 1.7 - 7.0, p value 0.008, although the torsed ovary could have a higher or lower diffusion coefficient than the normal ovary.
Conclusions: The limited MRI appendicitis protocol can exclude ovarian torsion. An ovarian volume ratio greater than 3:1 has a sensitivity for torsion of 100%. Asymmetric T2 signal and diffusion restriction can suggest the presence of torsion, but further research is needed with a larger cohort of cases.

Poster #: SCI-014

The Diagnostic Utility of DWI and ADC Measurement in the Evaluation of Renal Function in Children with Chronic Kidney Disease

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Purpose or Case Report: Our aim is to evaluate the role of DWI sequence and ADC value measurement in the assessment of chronic kidney disease (CKD). Additionally, to estimate the relationship between changes of renal parenchyma ADC values and different stages of CKD
Methods & Materials: Over a nine months' period, we prospectively evaluated 20 patients with CKD (group A: 7 females and 13 males), they are ranging in age from 2 to 18 years with the mean age of 10 ± 5.80 years. Ten healthy control of matching age were included (group B: 3 females and 7 males).All patients with CKD were also examined by renal ultrasonography and color Doppler ultrasound for initial assessment or to clarify the diagnosis.Routine MRI and axial DWI (b=600s/mm2) were performed in all patients. The ADC values of renal parenchyma in the two kidneys were measured. Three regions of interest (ROIs) of about 10mm2 were placed to the upper, the middle, the lower regions and calculating the average values.
Results: Causes of CKD include glomerulonephritis (n=9, 45%), hemolytic uremic syndrome (n=5, 25%), lupus nephritis (n=2, 10%), Nephronopathisis (n=2, 10%), infantile nephrosis (n=1, 5%), unknown (n=1, 5%). According to KIDGO guidelines patients with CDK were classified into 5 stages: (stage 1: n=6, 30%), stage 2 (n=4, 20%), stage 3 (n= 3, 15%), stage 4 (n=2, 10%), stage 5 (n= 5, 25%).The mean ADC in group A (1.85X10-3 ±0.24) was lower than that of group B, (2.21X10-3 ± 0.12) with statistical significant difference (p value <0.00). There was a moderate negative correlation between stage of CKD and ADC with 'r' value of -.655 and a significant p value of <0.001.
Conclusions: MR DWI is an accurate and noninvasive method to evaluate children's renal function. Quantitative DWI and ADC values may potentially play a role in the early diagnosis and staging of CKD as well as follow-up of disease progression.

Poster #: SCI-015

Pediatric GU Emergencies: Are Residents Ready for the Real World?

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Purpose or Case Report: The Wisdom in Diagnostic Imaging SIMulation (WIDI SIM) is a strategically designed computer aided simulation of an emergency imaging experience, which rigorously tests residents' readiness to diagnose various Radiology emergencies. It has proven to be a reliable means for assessing resident preparedness to competently and independently cover radiology call. The residents are provided with a total of 65 cases of varying difficulty, including *normal studies*. The residents respond using free text which is then scored by faculty members utilizing a robust grading rubric. The identification of pertinent GU emergencies by the "on-call" resident is of the utmost importance as it the resident who must then notify the clinicians of this concern and so that emergent treatment can be expedited.
Methods & Materials: The WIDI simulation, an 8 hour web based ED shift simulation, was utilized as a call-readiness simulation for residents from programs around the country and then scored accordingly. The amount of residents who underperform (score less than 5 points out of 10) were tabulated.
Results: A total of 351 radiology residents were given a case of renal laceration with urine leak and a case of bilateral severe hydroureter, hydronephrosis, uretrocele and malpositioned foley. In this group, 29.6% of residents undeperformed for the first case and 65.2% for the second case. Additionally, a total of 253 residents were given a case of pyelonephritis. Nine percent of residents underperformed for this case. The diagnosis of these GU emergencies was consistently under-called by radiology residents being tested for call readiness, hence proving a huge educational gap in diagnosing the GU emergencies.
Conclusions: Radiology residency is lacking in teaching residents to accurately recognize various findings in pediatric GU emergencies. This has great implications for programs where a radiology attending is not present at night as it raises the concern that certain GU emergencies will be missed by residents taking overnight call. Clinicians rely upon the radiologist to help recognize pertinent findings that can significantly affect management. The solution proposed and being implemented by our institute is the WIDI learn platform, which will have the online modules on Critical/ Emergent Radiology diagnosis. WIDI Consult, integrated in the Learn platform, provides rapid scenario-based (clinical problem + a specific imaging test at hand) access to an expert approach to such a specific critical care problem.

Poster #: SCI-016

Ultrasound Shearwave Elastography in Pediatric Renal Transplants

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Purpose or Case Report: Approximately 800 children in the United States undergo renal transplant each year. Allograft failure is driven by interstitial fibrosis often due to chronic antibody mediated rejection. Renal biopsy is the gold standard to detect allograft dysfunction but limited by sampling error and inherent procedural and anesthesia risk. Ultrasound shearwave elastography (US-SWE) is a non-invasive imaging technique that assesses the mechanical stiffness of tissue. The primary aim of this study was to examine the relationship between US-SWE values, pathologic fibrosis/rejections scores and serology in pediatric recipients of renal transplant.
Methods & Materials: Our IRB approved retrospective study includes 83 children (age = 14 ± 4.6 years; 57 males) from October 2017 to August 2019 who had undergone US-SWE and biopsy of renal allografts. Shear wave PQ elastography was performed using EPIQ 7 (Philips Healthcare, Amsterdam, Netherlands) and C5-1 broadband curved-array transducer. Six US-SWE measurements were made in the renal cortex: upper (2), mid (2) and lower (2) poles. Median US-SWE scores were calculated. Renal transplant biopsy results and serological testing including BUN, creatinine, estimated glomerular filtration rate (eGFR) and nuclear medicine derived GFR were reviewed. Data were analyzed to examine associations between renal transplant US-SWE with biopsy and serological results. Since histopathology scores (fibrosis, acute/chronic rejection, C4d) are categorical variables, non-parametric Spearman bivariate correlations between pathology scores and US-SWE were obtained. Pearson correlations between US-SWE, nuclear medicine GFR and serological biomarkers were also examined.
Results: There were no statistically significant or clinically meaningful relationships between US-SWE and allograft fibrosis, rejection scores, nuclear medicine derived GFR or estimated GFR based on the bedside Schwartz equation (all $r < 0.15$; $p > 0.5$).
Conclusions: Given the lack of significant relationships between US-SWE and renal pathology scores as well as biomarkers, it is unlikely that US-SWE is meaningfully assesses allograft rejection or pathology. From a healthcare resource utilization perspective, US-SWE does not appear to be an effective test for renal allograft screening in pediatric recipients of renal transplants. These data have implications for allograft screening in this population.

Poster #: SCI-017

Diffusion weighted imaging (DWI) of the Kidneys in Healthy Controls and Patients with Autosomal Recessive Polycystic Kidney Disease (ARPKD)

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Purpose or Case Report: ARPKD causes diffuse microcysts in the kidney parenchyma, and cyst burden cannot be quantified by standard image segmentation methods. We sought to assess whether apparent diffusion coefficient (ADC) measured by DWI could serve as a non-invasive biomarker of ARPKD severity, with the hypothesis that ADC would be higher in cystic vs. non-cystic parenchyma due to higher extracellular water content. We examined whether ADC could distinguish healthy kidneys from those affected by ARPKD, and whether a threshold ADC value could be established to differentiate cystic vs. non-cystic parenchyma.
Methods & Materials: 12 individuals with ARPKD (age 14.4±5.9y) and 10 healthy controls (age 12.5±4.0y) were compared cross-sectionally. DWI was acquired in a fasting state with parameters: TR 7100ms; TE 67ms; slice thickness 4mm, b-values: 0, 200, 500, 800, and 1000 s/mm^2 (Siemens Skyra 3T). Whole-kidney regions of interest were drawn manually, excluding the collecting system and large blood vessels, and ADC was calculated using a mono-exponential decay model (pMRI software, parametricmri.com). Mean and median kidney ADC were compared in healthy controls vs. ARPKD (Mann-Whitney U test). Histograms of voxel-wise ADC frequencies were examined in control and ARPKD groups to determine if the distribution was skewed towards higher ADC in cystic parenchyma.
Results: Mean kidney ADC values were similar in the ARPKD group (3.42±0.40 x 10^{-3}mm^2/s) and healthy controls (3.44±0.47 x 10^{-3}mm^2/s) ($p = 0.9$). On histogram analysis, voxel-wise ADC frequencies were not normally distributed in either control or ARPKD groups, with significantly right-skewed distribution with long tails towards high ADC values and a large number of high-ADC outliers in both groups (ARPKD vs. control skewness 3.6 vs. 4.0 and kurtosis 21.5 vs. 25.6). Given the non-normal distribution of ADC values, we also compared median kidney ADC between the ARPKD and control groups and found no statistically significant difference ($p = 0.5$).
Conclusions: ADC values obtained from DWI do not appear to distinguish between cystic and non-cystic kidney parenchyma in individuals with ARPKD, possibly due to confounding effects of kidney fibrosis on ADC measurements in individuals with ARPKD. Further studies are needed to determine if other MRI sequences could identify potential biomarkers of kidney disease severity in ARPKD.

Poster #: SCI-018

Ultrasound Techniques to Assess Fluid Overload in Children on Hemodialysis: A Pilot Study

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Purpose or Case Report: Volume overload is linked to increased cardiovascular morbidity and mortality in children receiving hemodialysis (HD). Clinician assessment of volume status lacks accuracy and has substantial inter- and intra-observer variability. We investigated the use of ultrasound (US) skin thickness, and muscle elastography in pediatric HD patients.
Methods & Materials: Participants were recruited from our hospital's outpatient HD unit. The following ultrasound measures were obtained before and 1-hour after HD, for up to 5 separate HD sessions per participant: (1) US elastography of the tibialis anterior muscle (median of 8 shear wave speed

measurements; GE Logiq-E9, E10); and (2) US of dermal thickness on the medial surface of the mid tibia (mean of 3 measurements; Vevo 2100 VisualSonics). These measurements were obtained as part of a larger study that includes inferior vena cava and lung US. All images were obtained by sonographers and reviewed by 2 pediatric radiologists.
Results: Six children [median (range) age 13.6 (3.4-17.7) years; 67% male] completed 23 study visits (41 ultrasound scans). The average duration of ultrasound scan (including time to obtain IVC and lung images) was 20.5 minutes (range: 11-35). The average skin thickness was 1.36 mm pre-dialysis and 1.30 mm post-dialysis; while average median velocities for muscle elastography were 2.71 m/sec (IQR: 2.17-3.1) pre-dialysis and 2.67 m/sec (IQR 1.85-3.34) post-dialysis
Conclusions: This pilot study shows that skin thickness and muscle elastography ultrasound measurements were feasible, and differences between pre- and post- dialysis scans exists. Further larger studies that establish the correlation between US, anthropomorphic and laboratory determinants of fluid overload are needed to develop these potential bedside ultrasound applications.

Poster #: SCI-019 - *Withdrawn*

Poster #: SCI-020 - *Withdrawn*

Poster #: SCI-021

Breast Ultrasounds in the Children's Hospital Emergency Department

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Purpose or Case Report: The practice of performing dedicated breast ultrasounds in the pediatric emergency department varies according to institution. In the adult population, breast ultrasounds are commonly interpreted by dedicated breast imagers and/or radiologists appropriately qualified to interpret mammograms. Children's hospitals with dedicated pediatric radiology faculty are less likely to have such individuals on staff. This paper examines the practice of breast ultrasounds ordered in the emergency department throughout a large children's health system.
Methods & Materials: This is a retrospective review performed throughout a large pediatric health system. All patient encounters of children presenting to any location within the health system undergoing breast ultrasound over a 16-year-period were reviewed. The encounters were then stratified according to indication, biological sex, age, and location/department presenting.
Results: A total of 3,459 breast ultrasounds were reviewed with 774 (22%) ordered from the emergency department. The mean age of patients presenting to the emergency department was 11.65 compared to 11.49 for non-emergency department patients. In the emergency department, 33% present of breast ultrasounds were ordered with an indication related to acute infection compared to 3% outside the emergency department. Emergency department patients were 12% male versus 16% male outside of the emergency department. Among males, 48% of breast ultrasounds in the emergency department were ordered for gynecomastia, breast lumps, or breast buds. Findings suggestive of fibroadenoma were uncovered in 15% of females in the emergency deparrment.
Conclusions: When pediatric emergency department providers have access to breast ultrasound, orders for non-acute breast complaints are common. Acute infectious states are more likely to result in ultrasound in the emergency department than outside the emergency department, but such ultrasounds represent the minority of emergency department breast ultrasounds. Children's hospital emergency departments may consider a more restrictive policy with regard to breast ultrasound utilization.

Poster #: SCI-022

Feedback Fridays: An Innovative Intervention to Structure Serial Resident Feedback and Assess Resident Interest in Subspeciality Training

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Purpose or Case Report: Demonstrate how a pediatric radiology division at a single institution structures short-interval feedback to residents. Describe how the division collects interval resident feedback. Demonstrate resident responses to this pilot program of instituting standardized weekly feedback.
Methods & Materials: At our academic institution, residents were traditionally evaluated at the end of the rotations online and with informal one-sided feedback from faculty to residents. A majority of the residents indicated that end-of-rotation feedback was insufficient to accurately assess growth during their rotations and that there was no regular opportunity to give resident feedback about the rotation. In January 2019, our division piloted a program in which a designated faculty member collected feedback from other faculty who worked with the resident throughout the week.This “feedback faculty” member would then summarize the most salient points from collected data and have a face-to-face discussion with the resident every Friday afternoon.The residents were then given a weekly anonymized online form to evaluate the following: overall experience over the week, aspects of the rotation that they felt were valuable (ie: case mix, case volume, teaching experience, duty hours), change in interest in pursuing a pediatric radiology fellowship, and whether the resident would like more time in their training in pediatric radiology.
Results: To assess the effectiveness of this program for the residents we collected data from January 2019 to September 2019. Anonymized online surveys yielded 46 responses. Over 90% of the responses reported case variety and teaching experience as the most valuable areas of resident education. 50% reported an increase in the likelihood of pursuing a pediatric radiology fellowship following the week’s experience. 80% reported a request for more allotted residency training to pediatric radiology. Using the resident feedback, the division was able to facilitate changes to the rotation in order to better meet the educational needs of the residents. Changes included working with the radiology residency program to increase pediatric radiology exposure and establishing a resident interest group with quarterly social events to continue fostering interest in pursuing pediatric radiology as a subspecialty.
Conclusions: In conclusion, formalized feedback in the form of weekly “Feedback Fridays” is an effective tool in incorporating real-time responses into resident education.

Poster #: SCI-023

Establishing a Standardised Protocol for Performing and Reporting Contrast MRI Perfusion of the Hips for Legg-Calvé-Perthes Disease; A Combined Radiologic-Orthopedic Approach

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Purpose or Case Report: Legg-Calvé-Perthes disease (LCPD) is juvenile idiopathic osteonecrosis of the femoral head, which can lead to permanent hip deformity and painful early-onset osteoarthritis. An issue in clinical practice is that there is wide variation in imaging and management of patients with LCPD. In our institution, we have created a rapid access pathway, so those with clinically suspected LCPD are imaged with a pelvic radiograph, seen by an orthopedic specialist in a dedicated LCPD clinic and subsequently a contrast MRI perfusion of the hips is expedited. This rapid pathway ensures imaging and management is not delayed. High quality MRI of the hips is important to prognosticate and guide orthopedic intervention. It was therefore important to standardise how the MRI hips is performed and reported.
Methods & Materials: Optimising care for those with LCPD required creating a standardised imaging protocol for contrast MRI perfusion of the hips. The protocol includes multiplanar axial and coronal imaging with T2W, STIR and T1W fat saturation pre and post contrast sequences with post processing subtraction. Once the MR sequences were standardised, it was then essential to create a formal reporting template for the MR study. This was created in collaboration with radiology and orthopedics. The reporting template ensures that the formal report contains all relevant information the orthopedic team require. The reporting template includes quantitative analysis of the relevant zones of the epiphysis of the femoral head. The volume of affected epiphysis is calculated.
Results: The standardised protocol for performing the MRI ensures that all relevant sequences are acquired. The structured reporting template allows the orthopaedic team to standardise their intervention. Standardised MRIs and reports enable optimal management. The full imaging protocol and the standardised reporting template will be described.
Conclusions: We have introduced a rapid access pathway for Legg-Calvé-Perthes disease with standardised imaging. Standardising how the contrast MRI perfusion of the hips is performed and reported facilitates a structured approach to orthopedic management. This structure enables formalised research into outcomes. Ideally, this standardised approach will be utilized by other institutions. This approach can be further modified to create an evidence based collaborative approach between radiology and orthopaedic teams to manage Legg-Calvé-Perthes disease.

Poster #: SCI-024

MRI Findings for Osteochondritis Dissecans of the Talus in Children

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Purpose or Case Report: The tibiotalar joint is the third most common location for osteochondritis dissecans (OCD) lesions, which poses the risk of premature osteoarthritis, and often associates with a history of prior ankle sprains and fractures. Unstable lesions require surgical intervention. A 4-stage radiographic classification system has been previously proposed, but this system has a 50% false negative rate when compared to arthroscopic assessment (reference standard). Recently, MRI and arthroscopic findings have been correlated in adults, but no such validation study has been performed in children. Thus, the purpose of our study was to identify MRI findings that predict instability of OCD lesions of the ankle in children.
Methods & Materials: This retrospective IRB-approval and HIPPA compliance study included 48 children with OCD lesions of the ankle, who underwent ankle MRI examination between March 1, 2011 and May 31, 2018. Skeletal maturity, lesion size, and location were also recorded. Blinded to the clinical outcome, 2 radiologists independently assessed for the presence of a joint effusion, bone marrow edema, perilesional sclerosis, T2-weighted signal and cyst-like signal at the interface, cortical discontinuity, cartilage change, and intra-articular bodies. Clinical and surgical findings were utilized to classify lesion stability. Mann-Whitney U, Chi-square, Fisher's exact, and Cochran-Armitage tests were used to compare demographic and MRI findings between children with stable and unstable lesions.
Results: There were 36 stable (16 boys and 20 girls, 12.7 ± 3.9 years) and 12 unstable (4 boys and 8 girls, 14.2 ± 1.6 years) OCD lesions. Children with unstable lesions were significantly older (p=0.04) than those with stable lesions, but no differences in sex (p=0.74) or laterality (p=0.51). Children who were skeletally immature (p=0.01) and who reported preceding injury (p=0.02) were more likely to have stable lesions. None of the MRI features were found to be significantly different between stable and unstable OCD lesions, which included location (coronal, p=0.11; sagittal, p=1.00), the presence of a joint effusion (p=0.27), bone marrow edema (p=0.17), perilesional sclerosis (p=0.70), T2-weighted signal (p=0.16) and cyst-like signal (p=0.48) at the interface, cortical discontinuity (p=0.51), cartilage changes (p=0.19), or intra-articular body (p=0.25).
Conclusions: None of the MRI findings predicted OCD stability in the ankle joint. Younger age and skeletal immaturity were predictive of stable OCD lesions.

Poster #: SCI-025

To Evaluate the Role of 18F-FDG PET/CT Versus Conventional Imaging for Initial Staging and Follow-Up of Pediatric Sarcomas

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Purpose or Case Report: The purpose of this study was to compare the diagnostic performance of 18F-FDG PET/CT and conventional imaging for staging and follow-up of pediatric osteosarcoma and skeletal Ewing sarcoma.
Methods & Materials: We evaluated the sensitivity, specificity, and accuracy of PET/CT and other conventional imaging (CT, MRI, bone scanning) modalities for sites of disease and number of lesions. Diagnostic benefit, defined as better characterization of lesions, was evaluated on a per-scan basis, comparing PET/CT and conventional imaging
Results: A total of 103 lesions were characterized by imaging in 31 patients (10, osteosarcoma; 21, Ewing sarcoma). For osteosarcoma patients PET/CT was available only at follow-up, where it proved more accurate than conventional imaging for

the detection of bone lesions (accuracy, 95% vs 67% for CT and 86% for MRI) and complementary to CT in evaluating lung nodules (sensitivity, 84% vs 94%; specificity, 79% vs 71%) with diagnostic benefit in 18% of examinations. In patients with Ewing sarcoma, PET/CT tended to perform better during follow-up than at initial staging (accuracy, 85% vs 69%). For lung findings, PET/CT was more specific than CT but was less sensitive. The diagnostic benefit of PET/CT was greater at staging (28%) than during followup (9%). On a per-patient basis, PET/CT provided diagnostic benefit in 11 of 22 patients with Ewing sarcoma and four of 10 patients with osteosarcoma at least once during clinical management
Conclusions: FDG PET/CT provides diagnostic benefit in Ewing sarcoma and osteosarcoma, with the exception of small lung nodules. Prospective studies are needed to define the best imaging algorithm and combination of tests in the staging and follow-up of patients with pediatric bone sarcoma.

Poster #: SCI-026 - *Withdrawn*

Poster #: SCI-027

Pediatric Intra-articular Soft Tissue Masses of the Knee: Prevalence, Imaging Features, and Etiologies

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Purpose or Case Report: The prevalence, imaging features, and etiologies of pediatric intra-articular soft tissue masses are not well described in the literature. Therefore, intra-articular masses can present diagnostic dilemmas for pediatric radiologists. The purpose of this study was to further evaluate pediatric intra-articular soft tissue masses. Our hypothesis was that intra-articular masses have a limited differential diagnosis and are mostly benign.
Methods & Materials: In this IRB-approved retrospective study, we reviewed all knee MRIs performed at our institution between 2001 – 2019 (n = 3915). Our inclusion criteria were knee MRIs with an intra-articular soft tissue mass. Our exclusion criteria were cases with no masses or intra-articular lesions with clear radiologic diagnoses (e.g. ganglion cyst, venous malformation). Multiple radiologic characteristics were evaluated (size, focality, joint involvement, T1/T2/post-contrast features, radiographic correlate, calcification, and bone destruction). Radiologic diagnoses and pathologically confirmed diagnoses were collected when available. The authors re-reviewed the MRI studies that met the inclusion/exclusion criteria.
Results: 26/3915 (<1%) cases were identified that satisfied the inclusion/exclusion criteria of the study. 20/26 underwent biopsy. Patient age ranged from 7 months to 19 years with a mean of 11 years. Histologic diagnoses included pigmented villonodular synovitis (PVNS) (7/20, 35%), venous malformations (2/20, 10%), inflammatory arthritis (2/20, 10%), synovial sarcoma (1/20, 5%), kaposiform hemangioendothelioma (1/20, 5%), giant cell tumor of tendon sheath (1/20, 5%), PTEN hamartoma (1/20, 5%), nodular fasciitis (1/20, 5%), tuberculous osteomyelitis (1/20, 5%), synovial osteochondromatosis (1/20, 5%), benign myofibroblastic lesion (1/20, 5%), and benign synovial tissue (1/20, 5%). Of the 6 remaining cases without biopsies, suspected radiologic diagnoses included PVNS (3/6, 50%), juvenile idiopathic arthritis (2/6, 33%), and hemarthrosis (1/6, 17%). 19/20 (95%) of the lesions were benign. 1/20 (5%) were malignant (synovial sarcoma). The most frequent diagnosis was PVNS. 5/10 (50%) of the PVNS cases were focal and 5/10 (50%) were multifocal. All PVNS cases (10/10, 100%) had hypo-intense signal on T2.
Conclusions: Intra-articular soft tissue masses of the knee in children are rare, with a prevalence of <1% in our study. Nonetheless, it is important to be aware that the majority (>95%) are likely to be benign with PVNS being the most likely diagnosis.

Poster #: SCI-028

Can Radiology Technologists be Trained to Measure Leg Length Discrepancies as Accurately as Pediatric Radiologists?

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Purpose or Case Report: **Background:** Leg length discrepancy studies are labor intensive, yet cognitively simple, studies that represent inefficient use of the pediatric radiologists' time and expertise.**Objective:** The purpose of this study was to demonstrate that measuring and calculating leg length discrepancies do not require radiologist expertise. We hypothesized that radiology technologists could be trained to quantify leg length discrepancies and that their performance would be statistically equivalent to that of board-certified, fellowship trained pediatric radiologists.
Methods & Materials: We recruited 4 radiology technologists to participate in a 30-minute tutorial and supervised case-based practice session. Subsequently, they independently measured and calculated leg length discrepancies on 10 unknown cases. Their performance was compared to the radiologists' reports as the reference standard. After one week, the technologists repeated their measurements on the same cases, which were resorted to simulate new cases. Intraclass correlation analyses measured agreement of the measurements were performed with the reference standard and those obtained one week later.
Results: Among the 4 technologists, the intraclass correlation coefficient (ICC) between session 1 and the reference standard was 0.93 ($p<0.001$). The ICC between session 2 and the reference standard was 0.92 ($p<0.001$). The ICC between session 1 and session 2 was 0.96 ($p<0.001$). Given a high ICC between session 1 and session 2, the technologists' measurements were averaged and a difference score computed for the average measurements and reference standard. Across raters, the range of difference values (absolute value) ranged from 0 to 1.05 cm (mean difference = 0.39 cm).
Conclusions: Radiology technologists can be rapidly trained to measure and calculate leg length discrepancies as accurately as board-certified pediatric radiologists. Delegation of this time-consuming task to technologists or radiology assistants will permit radiologists to spend time on more cognitively demanding studies requiring subspecialty training.

Poster #: SCI-029

Are We Accurately Detecting Isolated Salter-Harris Type I Fractures in Radiographs? A Comparison of Radiograph and MRI Predictive Value

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Purpose or Case Report: To validate the necessity of an MRI when there is high clinical concern of epiphyseal injury with normal radiographic findings
Methods & Materials: A five-year retrospective Picture Archiving and Communication System (PACS) query was conducted between January 2014 and December 2018 at a local institution for patients with suspected physeal injury who had MRI and radiographs within 2 weeks. The search yielded 41 patients. Imaging review of MRI and radiographs were performed by two radiologists and characterized by descriptive factors.
Results: Of the 41 fractures confirmed by MRI only 15 radiographs showed a fracture or suspected fracture, yielding a sensitivity of 36%. In the subgroup where physeal widening was seen on MRI, only 63% were called on radiographs with a sensitivity of 38% and a positive predictive value of 66%. The sensitivity of the radiographs would even be lower in the context of isolated physeal edema, marrow edema or periosteal hematoma
Conclusions: MRI remains the most accurate modality for the diagnosis of Salter-Harris I fractures. For patients with persistent pain or loss of function with normal initial radiograph findings, MRI should be the next step in diagnostic care.

Poster #: SCI-030 - *Withdrawn*

Poster #: SCI-031

Interhypothalamic Adhesions: A Form of Grey Matter Heterotopia?

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Purpose or Case Report: The presence of a thin midline band or nodule like grey matter structure traversing the hypothalamic region on magnetic resonance imaging (MRI) is a recently reported neuroimaging finding. This has been termed as interhypothalamic adhesion (IHA). To date, no histopathological correlation has been published on the precise nature of IHA and whether it represents a developmental anomaly, cerebral malformation or the sequela of cerebral insult. We aim to look at a cohort of patients with IHA and determine its association with other cerebral anomalies seen in these cases.
Methods & Materials: Cases of IHA seen on brain MRIs at a single tertiary paediatric centre on 1.5T and 3T performed from September 2001 and September 2019 were compiled from a search of MRI reports on the local radiology information system. Cases were subsequently evaluated on available T1 and T2 weighted sequences in multiple planes on the local PACS viewer (Fuji Synapse) by two fellowship trained consultant paediatric radiologists. Basic demographic and clinical information was recorded for each patient. The signal of IHA were compared to normal cerebral grey matter. The presence of brain malformations were recorded in five broad categories of grey matter heterotopia, midline defects, brainstem anomalies, cerebellar anomalies, focal cortical dysplasia and cerebral ventriclular dysplasia.
Results: A total of 16 cases of IHA were identified. Of these 56% (9/16) were male with patients ranging from day 1 of life to 7 years of age at the time of scanning (mean age 2.6 years). Grey matter heterotopia was associated with IHA in all cases (100%). Midline abnormalities were present in 87.5% (14/16) cases, almost all involving the corpuds callosum. Posterior fossa abnormalities were present in 31.3% (5/16). Dilated or dysplastic ventricles were also present in 31.3% (5/16). Focal cortical dysplasia was present in 43.8% (7/16), almost entirely comprised of polymicrogyria. Correlating the signal characteristics of IHA to normal deep and cortical grey matter confirmed that IHA followed grey matter signal on both T1 and T2 sequences in all cases.
Conclusions: In our cohort IHA was seen to be associated with grey matter heterotopia in all cases and these lesions remained isointense to grey matter on all sequences. This raises the possibility of whether these lesions may in themselves represent a previously unrecognised form of grey matter heterotopia. Further studies will be required.

Poster #: SCI-032

Pediatric Theranostic Applications of Dotatate: Early Clinical Experience

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Purpose or Case Report: Though pediatric use of both ^{68}Gallium Dotatate and ^{177}Lutetium is off label, the advantages they offer over FDA approved agents has led to their preliminary use in a variety of pediatric clinical scenarios. The purpose of this poster is to present the range of potential diagnostic and therapeutic applications of ^{68}Gallium Dotatate in children.
Methods & Materials: Case examples were gathered by retrospective chart review focusing on ^{68}Gallium Dotatate use in the pediatric population. Project approval from the XXX Institutional Review Board was obtained prior to data collection. Individual patient charts were reviewed to obtain relevant data including demographics, type of neuroendocrine tumor, age of diagnosis, presence/absence of predisposing hereditary syndromes, and treatment course and imaging studies were reviewed.
Results: Though its use is considered off label in children, there are several advantages of ^{68}Gallium Dotatate PET/CT over traditional Octreoscan and MIBG scanning of neuroendocrine tumors, NET, in children. Dotatate has a far greater affinity for the somatostatin receptors these tumors often express than Octreotide which results in a greater target to background ratio and better lesion conspicuity. The various potential diagnostic uses of ^{68}Gallium Dotatate PET/CT in children include initial staging and follow-up of NET, including neuroblastoma, esthesioneuroblastoma, paragangliom/pheochromocytoma, pulmonary and gastrointestinal carcinoid tumors and well as screening in patient groups susceptible to the development of

NET, such as SDH and MEN syndromes, are discussed and examples of each are provided. Additionally, examples of its role in proton beam treatment planning are presented. Lastly, examples of radiotherapy for MIBG-negative neuroblastomas or other dotatate-positive malignacies with 177-lutetium labelled dotatate will be presented.
Conclusions: Dotatate-based imaging and therpeutic agents show great promise in the evaluation and treatment of pediatric patients with NET. Though their use is off label, the advantages they have over current standard imaging agents and the potential complimentary role to Iodine-131 MIBG therapy they offer show great promise.

Poster #: SCI-033

Evaluation of Maximum Intensity Projection for Lung Nodules in Pediatric Chest CT

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Purpose or Case Report: The objective of this study was to evaluate the benefits of thin-slab maximum intensity projection (MIP) images for the detection of lung nodules in pediatric chest CT.
Methods & Materials: From July 2018 to September 2019, there were a total of 184 examinations for pediatric oncology patients in CT examinations of the chest or body performed at our hospital.Of these, 17 CT images showed measurable lung nodules, and we retrospectively evaluated them.These 17 CT images were obtained from 9 patients (mean age 8.0±5.6 years, range 0.4-17.5 years), and included repeat CT examinations for follow-up study. All patients were scanned with a 64-detector MDCT scanner (GE Medical Systems, Milwaukee, WI, USA).Two pediatric radiologists independently read chest CT images with a slice thickness of 1.25 mm and 10-mm reconstructed MIP axial images. The number of nodules and image interpretation time (time required for reading, in seconds) were recorded.
Results: There were 54 lung nodules among all cases. There was no significant difference between the number of nodules detected with the MIP images and the 1.25-mm images (81 vs. 74; $P > 0.05$), and sensitivity was not significantly different (75.0% vs. 68.5%). However, MIP images took significantly less time to read (Reader 1: 75.5±29.1 seconds vs. 96.6±31.8 seconds; $P < 0.05$ / Reader 2: 93.8±27.5 seconds vs. 124.6±37.3 seconds; $P < 0.005$) .
Conclusions: Our results suggest that the time required for reading was compressed into less than 75 to 78%.[KS1] With pediatric chest CT, it was shown that 10-mm axial MIP images are superior to conventional images in terms of the interpretation time needed to detect lung nodules.

Poster #: SCI-034

Pediatric Mediastinal Masses: Prebiopsy Evaluation and Outcomes, A 10-year Retrospective Study

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Purpose or Case Report: Evaluate patient demographics, current imaging patterns, extent of disease, and tumor types in pediatric patients with mediastinal masses to assist with developing an imaging algorithm to streamline patient care.
Methods & Materials: Single institutional retrospective chart review of children with mediastinal masses between 2008 and 2018. Charts reviewed for pre-procedure symptoms, imaging characteristics, vascular and airway compression, pathologic results, and complications.
Results: 40 cases (33 initial, 7 residual/recurrent disease) of mediastinal masses in 37 patients were included for review. The median patient age at diagnosis was 15.03 years (IQR 11.67-17.27). In the initial diagnosis group, chest radiograph (n=29, 88%), and CT (n=31, 94%) were the predominant modalities used for prebiopsy evaluation. In the setting of recurrent disease, chest radiography x-ray (6), CT (5) and PET (4) were used to a identify residual/recurrent lesion. Physical signs or symptoms of mediastinal (vascular or airway) compression were present in 12 patients. On imaging, major airway compression was present in 22/33 patients with initial diagnosis and 1/7 patients with recurrent disease. Symptoms corresponded to a 67% PPV for vascular compression and an 83% PPV for airway compression. Major vascular compression was more common in primary disease (21/33) compared to recurrent/residual (2/7). Median interval between mass identification and biopsy was 1 day for the initial diagnosis group, and 4 days for the recurrent/residual disease group. Hodgkin's (18/40, 45%) and Non-Hodgkin's (12/40, 30%) lymphoma were the most common diagnoses. Other pathology included; Ewing sarcoma, aneurysmal bone cyst, Germ Cell Tumor, and neuroblastic tumor. In 4 cases a definitive result was not obtained from image guided biopsy. Bradycardic arrest occurred during a single procedure in a patient with central airway and SVC compression, that responded to CPR and change in patient position to alleviate airway/svc compression.
Conclusions: There is variation in imaging evaluation of initial and recurrent mediastinal masses in preparation for biopsy. Mediastinal compression is frequently present in both initial and recurrent disease, however, are inconsistently predicted by clinical symptoms. We propose an imaging algorithm that factors in radiation exposure, type of disease, patient age, signs and symptoms of vascular or airway compression to provide consistency and guidance for the pediatric and general radiologist.

CASE REPORT, EDUCATIONAL AND SCIENTIFIC POSTERS – SLARP

(S) Indicates a La Sociedad Latino Americana de Radiología Pediátrica (SLARP) program submission. Authors are listed in the order provided. An author listed in bold identifies the presenting author.

Poster #: CR-001 (S)

Heterotaxia Derecha con Secuestro Pulmonar Intralobar y Hernia Hiatal

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Purpose or Case Report: La heterotaxia es una de las formas complejas de cardiopatía congénita. Su incidencia es de 1 cada 5000/7000 nacidos vivos con cardiopatías. Se caracteriza por una amplia variedad de malformaciones cardíacas y extracardíacas originada por una alteración en la rotación axial del corazón durante el período embrionario.Presentamos el caso de un varón de 2 meses de edad a quien se realizó un estudio de angiotomografía cardíaca encontrando heterotaxia derecha con dextrocardia, estenosis infundibular de la arteria pulmonar, cayado aórtico de posición derecha con persistencia del conducto arterioso, drenaje venoso anómalo total intracardíaca y doble salida del ventrículo derecha. Lo inusual del caso fue el hallazgo asociado a secuestro pulmonar intralobar izquierdo y hernia hiatal. Este caso ilustra otros hallazgos en una entidad poco frecuente, además de describir los hallazgos tomográficos y destacar la contribución del método para su diagnóstico y corrección quirúrgica posterior.

Poster #: CR-002 (S)

10 años de Experiencia en Resonancia Fetal en un Hospital Universitario de Chile

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Purpose or Case Report: La Resonancia Magnética fetal (RMF) es una herramienta de mucha utilidad en el estudio de muchas patologías en el período prenatal. En nuestro pais no existen registros oficiales respecto a la incidencia de hallazgos en resonancia fetal. El objetivo principal de este estudio es realizar un análisis descriptivo de diferentes patologías en RMF de una serie de 143 casos realziados en nuestra Institución. Los hallazgos se clasificaron según el tipo de patología y el órgano o área afectada (alteraciones de SNC, hernias diafragmáticas, masas pulmonares, defectos de pared abdominal, alteraciones urinarias, gastrointestinales) y estos datos fueron posteriormente analizados.

Poster #: CR-003 (S)

Is it Possible to Diagnose Moebius Syndrome in the Prenatal Stage?

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Purpose or Case Report: To present a case of a disorder that has an infrequent prenatal diagnosis.Moebius syndrome is a rare congenital condition with an estimated incidence of 1/100000 births, characterized by an absence or underdevelopment of the facial and abducens nerve nuclei.In this patient, Moebius syndrome is suspected after completion of a fetal ultrasound in the 23rd week of gestation. Said ultrasound showed facial abnormalities, brain stem hyperechoic foci compatible with calcifications, macrocephaly secondary to ventriculomegaly and bilateral club foot, all signs suggestive of Moebius syndrome.On multiple follow up ultrasounds, an increase in ventriculomegaly is visualized, with possible lissencephaly, mega cisterna magna and a reduction in size and volume of the cerebellar vermis. All these findings are later confirmed with a fetal MRI.

Poster #: CR-004 (S)

Hamartoma Mesenquimatoso del Hígado: Debemos Tenerlo en Cuenta.

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Purpose or Case Report: Liver tumors account for 1-4% of all pediatrics malignancies. Most primary liver tumours in children are malignant, but one-third are benign. Mesenchymal hamartoma of the liver, though rare is the second most frequent benign liver mass in children. Generally occurs in children less than 2 years of age with a male preponderance (male: female, 2:1). We report a case of mesenchymal hamartoma of the liver in an 11 month-old female presented at the emergency department with abdominal distension of two months of evolution associated with intermittent vomiting, diarrhea and chronic malnutrition. Abnormal labs included elevated alpha-fetoprotein levels (15006 ng/ml) and non detectable beta Human Chorionic Gonadotrophin. The liver function was normal. Imaging demonstrated an abnormal abdominal X-ray, with soft tissues mass enlargement and displacement of bowel. An ultrasound revealed a mixed mass (cystic-solid) liver in segment VII. On colour-Doppler flow imaging, there was evidence of increased vascularity. Contrast-enhanced CT scan of the abdomen in arterial and venous phases showed a large cystic mass in the left lobe of the liver, with peripheral solid tissue, very vascularized in both vascular secuences. Percutaneous biopsy was done and pathology confirmed mesenchymal hamartoma. The patient underwent left hepatectomy. The patient evolved successfully.
Conclusions: Presentamos este caso clínico porque es una enfermedad rara, con un amplio espectro de apariencias de imágenes, capaz de múltiples síntomas simulares benignas y malignas, presentando múltiples diagnósticos diferenciales. También es importante recordar la relación con el sarcoma embrionario indiferenciado. Por todo esto consideramos que el radiólogo debe tener en cuenta esta patología, lograr un diagnóstico temprano y un tratamiento preciso.

Poster #: CR-005 (S)

Tuberculosis Abdominal: un Enemigo Aún Presente

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Purpose or Case Report: El abdomen es el sitio más común de tuberculosis extraperitoneal, siendo las linfadenopatías mesentéricas y peripancréaticas, la manifestación más frecuente en hasta el 55-65% de pacientes. La tomografia es el principal método de imagen usado para su evaluación.La presencia de obstrucción biliar, gastrointestinal o genitourinaria sugiere un diagnóstico alternativo.
Methods & Materials: Se revisó la historia clínica de la paciente incluyendo notas clínicas, exámenes de laboratorio, pruebas de patología y tratamiento instaurado. Los estudios de imagen incluyen particularmente radiografias, tomografia computada y ultrasonido.
Results: Se revisó la historia clínica de la paciente incluyendo notas clínicas, exámenes de laboratorio, pruebas de patología y tratamiento instaurado. Los estudios de imagen incluyen particularmente radiografias, tomografia computada y ultrasonido.
Conclusions: Cuando los ganglios linfáticos conforman un gran conglomerado, pueden causar obstrucción local, como muestra de una presentación atípica. La tuberculosis es conocida como la gran simuladora, por esto el radiólogo debe reconocer el patrón de linfadenitis abdominal por su morfología y localización, para encaminar un mejor abordaje clínico y terapéutico.

Poster #: CR-006 (S)

Afalia una Rara Anomalía Genital, a Propósito de un Caso

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Purpose or Case Report: El caso se presenta por tratarse de una patología poco frecuente que debemos conocer ya que los hallazgos por imagen definen su tratamiento. Objetivos: Repasar la embriología de los genitales externos masculinos. Conocer la epidemiologia de esta malformación. Reconocer las claves diagnosticas de la agenesia de pene por imagen y su clasificación.La agenesia de pene se presenta en aproximadamente 1 de cada 10 a 30 millones de recién nacidos vivos, se realiza evaluación clínica y radiológica para su clasificación y propuesta de tratamiento. Se requiere descartar otras malformaciones asociadas (renales, cardiacas, etc.), así como también es importante del abordaje multidisciplinario para el adecuado desarrollo físico y emocional del paciente.
Methods & Materials: Se presenta informacion relevante de la historia clinica y los hallazgos en el expediente radiologico del paciente.Se trata de paciente masculino actualmente de 3 años de edad, a la exploración física realizada al nacimiento se identifica ausencia de pene, se le realiza resonancia de pelvis como parte del abordaje de esta patología.
Results: Por resonancia magnetica se confirma la falta de desarrollo de los cuerpos cavernosos, vejiga con cambios postquirúrgicos por cistostomía y fistula recto-vesical desde la pared anterior del recto, clasificándolo como tipo pre-esfinteriano.
Conclusions: Es importante evaluación por imagen en los casos de agenesia de pene y la búsqueda intencionada de anomalías asociadas ya que dan la pauta para el pronóstico y tratamiento quirúrgico, en búsqueda de mejorar la calidad de vida.

Poster #: CR-007 (S)

Abdominal Pain of Rare Origin

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Purpose or Case Report: Introduction: Accessory spleen is an abnormality represented by ectopic splenic tissue detached from the main body of the spleen. Torsion is a possible complication and it occurs exceptionally. Clinically it is characterized by a nonspecific acute or recurrent abdominal pain.Case: A 12 years old female with recurrent abdominal pain and palpable mass on her left iliac fossa, that has been noticed a month before consultation. At the emergency service she was checked and complementary exams were requested.US: In the left iliac fossa it was found a solid, rounded formation, with well-defined edges, which moved when the patient changed her position. It showed positive Doppler examination except for a focal hypoechogenic area, which was not vascularized. The structure reminded the spleen echogenicity. CT: normal spleen parenchyma, shape and edges. At left iliac fossa, next to the lower pole of the kidney, a rounded well-defined image which showed heterogeneous EV enhancement with no opacification of the lower corner due to ischemia areas was seen. This image had a vascular hilum that connected to the main spleen vascular hilum. Further images where taken changing the patient position, where the movement of the mass was corroborated.As a result of this exams we realized that the recurrent abdominal pain of the girl was due to an ectopic spleen that has been torsioned - detorsioned several times.Conclusions: Usually, accessory spleen is asymptomatic. Torsion and infarction, rupture with bleeding, and infection with abscess are a very rare complications. Intermittent torsion-detorsion may produce recurrent episodes of abdominal pain caused by short-lasting ischemia of the accessory spleen or from direct mechanical irritation of surrounding organs.To sum up, torsion of an accessory spleen is extremely rare and is still a diagnostic dilemma. So we should consider this any time a patient with abdominal pain (acute or recurrent) comes to us and other diagnosis failed to explain it.

Poster #: CR-008 (S) - *Withdrawn*

Poster #: CR-009 (S)

Lipoma Subgaleal Infantil

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Purpose or Case Report: El lipoma es el tumor mesenquimático más frecuente de partes blandas.Su incidencia en la edad pediátrica es menor al 10% y esta cifra desciende aún más si tenemos en cuenta su localización subperióstica.Presentaremos pacientes menores de 2 años, diagnosticados por ultrasonido.Clínicamente, se presentan como

una masa dura de partes blandas, de superficie lisa, habitualmente en la región frontal.En ecografía se observa tejido adiposo heterotópico, ubicado entre la gálea aponeurótica y el periostio del hueso frontal. De morfología semiesférica, de base plana y de superficie convexa, con su diámetro mayor paralelo a la superficie cutánea. Lesión predominantemente hipoecogénica con finos septos ecogenicos en su interior, siendo éste útimo hallazgo, lo mas caracteristico.

Poster #: CR-010 (S)

Agenesis of Hypodermis. Case Report.

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Purpose or Case Report: The noninvasive, fast and accessible character of ultrasound has made it one of the most requested imaging procedures in Dermatology. The use of high frequency transducers has allowed significant advances in lesion characterization.The objective is to present a case of an exceptional condition, not yet described in the field of dermatological imaging. We are referring to agenesis of hypodermis.This patient is 4 years old and presents with an area of depression on the skin of the right scapular region, associated with a purple erythematous macula.A Doppler ultrasound is performed in the skin which showed complete absence of hypodermis, with partial replacement of vascular structures. The rest of the anatomy of the skin was of normal characteristics.

Poster #: CR-011 (S)

Brodie's Abscess in a Child Investigating Cancer: A Case Report

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Purpose or Case Report: A four-year-old girl was referred to our service to investigate a mass in her left forearm. About a year before she had cellulitis in the same place which was treated and resolved with antibiotics. A month previous to our consult she notices a soft tissue swelling in her left forearm and a pediatrician referred her to an oncologist for investigation.On physical examination, she presented with a medial bulging in her left forearm with local pain and no inflammatory signs. There was no history of fever.The plain radiograph showed a lytic lesion oriented along the axis of the ulna surrounded by fading sclerosis. In the Computed Tomography there was a lytic lesion with periosteal new bone formation.The diagnosis was Brodie's abscess which is a form of subacute osteomyelitis. It is a collection of purulent material surrounded by granulation tissue and reparative sclerotic bone. Staphylococcal Aureus is the most common organism to lead to this entity but any pyogenic organism can cause it. Osteomyelitis is the result of bone infection being the trabecular and cortical involved. It can be spread by exogenous and contiguous or endogenous due to hematogenous spread.

Poster #: CR-012 (S) - ***Withdrawn***

Poster #: CR-013 (S)

Respiratory Distress in a Full-term Newborn: Chest X-ray Rules Out the Usual Suspects.

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Purpose or Case Report: Demonstrate a rare cause of respiratory distress in a full-term newborn to illustrate the importance of chest radiography (CXR) in guiding the work up.
Methods & Materials: The patient's electronic medical record was reviewed including clinical notes, diagnostic imaging, treatment, and surgical pathology. Diagnostic imaging studies reviewed include CXR, CT and MRI.
Results: Full term newborn presents with delayed crying and subsequent respiratory distress. (CXR): hyperinflated left lung with normal vascularity, rightward shift of the mediastinum and atelectasis of the right lung. Chest CT: right lung atelectasis, hyperexpanded left lung, severe narrowing left bronchus, and mediastinal shift. Patient continued with respiratory failure and was transferred to our institution with the diagnosis of distal tracheal and bronchial stenosis with a hypoplastic right lung.Bronchoscopy: 90% occlusion of the left main bronchus by a blueish, pulsatile structure. Subsequent review of outside CT showed no vascular abnormality or external compression in this area, but a low attenuation area was noted near the carina. Chest MRI: well-circumscribed, T2 bright lesion abutting the carina, main stem bronchi, narrowing the left. The lesion was dark on T1, showed no arterial, venous or delayed enhancement. Bronchogenic cyst was the main diagnostic consideration. After excision, flexible bronchoscopy, showed mild narrowing but no obstruction of the left bronchus. The patient was extubated but required airway support for several days before discharge on room air.
Conclusions: Respiratory distress in a newborn is a common perinatal symptom resulting in a CXR to aid in the differential diagnosis. In this case the CXR showed a hyperexpanded left lung with normal vascularity. Causes for this appearance are limited: Small contralateral lung from hypoplasia or atelectasis, or hyper-inflated lung from air trapping. Bronchoscopy demonstrated compression of the left bronchus by a lesion which was further delineated by MRI as a bronchogenic cyst resulting in a ball valve effect. This was likely present in utero, leading to hyperexpansion of the left lung and extrinsic compression of the right lung which may be hypoplastic.A bronchogenic cyst is a bud of normal embryonal tissue, which is separated from the ventral foregut. Bronchogenic cysts are a relatively common incidental finding and is usually seen in the mediastinum or hilum, near the airways. There are few reports in the literature of airway obstruction due to a bronchogenic cyst.

Poster #: CR-014 (S)

Quiste Broncogénico Cutáneo Infantil

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Purpose or Case Report: El quiste broncogénico es una anomalía congénita, poco frecuente, que se origina del árbol traqueobronquial primitivo.Alteraciones en la migración de células durante el desarrollo, permite que se formen quistes revestidos por epitelio respiratorio.Las presentaciones extrapulmonares son muy infrecuentes.Daremos a conocer casos de pacientes pediátricos, diagnosticados con quiste broncogénico cutaneo, mediante ultrasonido dermatológico

Poster #: EDU-001 (S)

Resonancia Magnética Cardiaca en la Evaluación del Circuito Fontán: Más Alla de la Anatomía y la Función Cardiaca

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Purpose or Case Report: El circuito Fontan es el resultado de una serie de procedimientos paliativos que resultan en la anastomosis directa de las venas sistémicas a las arterias pulmonares, sin pasar por cavidades cardiacas. Los avances en las técnicas quirúrgicas han llevado a mejorar los resultados a largo plazo y una mayor esperanza de vida en los pacientes con corrección univentricular. Esto se debe en parte a las imágenes preoperatorias que identifican múltiples parámetros correlacionados con los resultados postquirúrgicos. La resonancia magnética cardiaca (RMC) ha sido utilizada con éxito durante años para evaluar pacientes con ventrículo único, es una excelente herramienta no invasiva para evaluar la anatomía, la función ventricular y el flujo. El propósito de este póster educacional es utilizar una presentación gráfica y cargada de imágenes de RMC de pacientes evaluados con circuito Fontan o pre Fontan para familiarizar al lector con las secuencias básicas y avanzadas utilizadas, las características anatómicas identificadas en los diferentes estadios de la cirugía, los cálculos hemodinámicos obtenidos a partir de las secuencias de contraste de fase y los tipos de anatomía linfática en los pacientes evaluados en nuestra institución.
Methods & Materials: Se reaizó una revisión restrospectiva de todos los pacientes con historia de paliación mediante cirugía de Glenn o Fontan de 2017 a la fecha en quienes se llevó a cabo una resonancia magnética cardiaca. La RMC se realizó en un sistema Siemens 3-T Skyra (Siemens Medical Solutions, Malvern, Pennsylvania) con datos analizados utilizando el paquete de análisis estándar de Siemens. El protocolo CMR es como se describe:Imágenes contiguas, SSFP estáticas axiales y HASTE para examinar la anatomía cardiovascular.Imágenes Cine SSFP en 3 cámaras, eje corto, y axialesMapeo de velocidad codificado en contraste de fase a través del plano de las cavas, ramas pulmonares, válvulas semilunares y venas pulmonares y tubo de FontánAngiorresonancia 3D posgadolinioRealce tardíoT2 W en coronal en torax y abdomen
Results: La RMC obtiene datos no disponibles para otras modalidades, como la anatomía 3D, evaluación del flujo colateral aortopulmonar y la evaluación de la anatomía linfática previo a la cirugía de Fontán y al momento de la presencia de complicaciones.
Conclusions: En grupos selectos de pacientes con ventrículo único, las modalidades de imagen no invasivas como la RMC pueden ser suficientes para la evaluación de pacientes con circuito Fontán.

Poster #: EDU-002 (S) - *Withdrawn*

Poster #: EDU-003 (S)

Ciliopatías: A Propósito de un Caso

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Purpose or Case Report: Las ciliopatás son un grupo de enfermedades que afcetan los genes que codifican proteínas que se localizan en los cilios primarios. Cualquier defecto en la estructura o en la función del cilio primario puede conducir a fenotipos quísticos. Dichos fenotipos son muy heterogéneos, y las características ciliopáticas pueden manifestarse por la variación de un solo lucus. En éste trabajo presentaremos un síndrome de Zellwger, entidad poco frecuente que se caracteriza por defectos en la migración neuronal, rasgos craneofaciales dismórficos, convulsiones, quistes renales y disfunción hepática.
Conclusions: En el presente caso se sospecha de un Síndrome de Zellweger, la ecografía permite plantear su diagnóstico diferencial desde etapas tempranas siendo la RM fetal el complemento fundamental desde el punto de vista imagenológico, aunque su diagnóstico definitivo sea en la etapa postnatal

Poster #: EDU-004 (S)

Variantes en la Presentacion Ecografica del Pilomatrixoma

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Purpose or Case Report: Representa una de las patologías más requeridas en los exámenes de ultrasonido de la piel, solicitados por médicos pediatras clínicos o dermatólogos.Habitualmente se realiza el diagnostico ecográfico ante la presencia de un nódulo cutáneo con calcificaciones; pero ello no es siempre así.En este poster educativo, mostraremos los cinco (5) tipos de pilomatrixoma que se pueden identificar al ultasonido Doppler

Poster #: EDU-005 (S)

Ultrasound Findings in Biliary Atresia: A Practical Guide

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Purpose or Case Report: -To review the etiopathogenesis of biliary atresia;-To review the techinique, describing and ilustratins typical and atypical sonographic findings ob biliary atresia, comparing them to the normal anatomy, to help the radiologist in the differencial diagnosisof cholestasis;-To correlate the sonographic findings with laparoscopic cholangiography.
Methods & Materials: We retrospectively reviewed the clinical data, US and cholangiographic findings of infants with the final

diagnosis of biliary atresia in order to find common and uncommon sonographic findings of the disease. The images were retrieved from ultrasound examinations performed by an experienced pediatric radiologist evaluating infants with cholestasis, with posterior confirmations of diagnosis.
Results: We select the most illustrative images of the findings of biliary atresia sonographic evaluation:-atretic gallbladder, lobular/ irregular contour and incomplete ecoghenic mucosal lining with an indistinct wall (gallblader ghost triad)-triangular cord sign-enlarged caliber of the hepatic artery-hepatic subcapsular flow during Doppler evaluation
Conclusions: The combined sonographic findings of biliary atresia present a high diagnostic accuracy rate. Their knowledge by pediatric radiologist is of great importance, especially considering that early diagnosis leads to early treatment, with better prognosis.

Poster #: EDU-006 (S)

3D Modeling: Towards Precision Medicine

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Purpose or Case Report: Detailed understanding of complex patients in CT and MRI can be challenging, particularly to non-radiologists. 3D modeling is a new language available to radiologists through which relevant details from an imaging study can be presented to readers in a straight-forward, easier to interpret way. Our Innovation Department in Pediatric Radiology has included 3D models in current practice. We briefly present how this models are built, some cases and a short review of 3D models contribution to a better practice of medicine.
Methods & Materials: 3D models are three-dimensional images built from 2D CT or MRI, by sequentially segmenting the anatomic structures to be displayed (i.e lungs, trachea and bronchi). Each segmented structure is displayed in a color keeping the anatomic relations. Users can hide or show each structure, display it in transparent or solid mode and rotate it 360 degrees. The segmenting process should be performed or closely supervised by radiologists since errors in segmentation will translate into errors in the final displayed model.
Results: They are meant to complement 2D images for diagnosis. They are particularly useful in understanding tumors with complex relations, congenital malformations and complex fractures. Precise landmarking of tumors, the study of vessels, normal variants and anatomy distortion are the clue to account for potential complications and plan accordingly. 3D models reduce mistakes, increase treatment precision and lower complication rates. 3D modeling also allows quantitative analysis, such as the % of tumor that can be safely removed, or the % of healthy liver that will remain after surgery. This is perhaps one of the most game changing contributions of 3D modeling to treatment planning, since it avoids unnecessary procedures and gives the chance of surgery to children previously considered inoperable.3D models have taken radiology and medical images to a new level in treatment planning. 3D model-derived products such as patient-specific surgical instruments and guides are a new addition to the operating room. They are also great for teaching and of invaluable help in communicating with the child's families.
Conclusions: 3D models potente data analysis from medical images by improving the way data is presented to readers. They render bi-dimensional gray-scaled images which mainly radiologists can interpret into familiar three-dimensional anthropomorphic structures, allowing any reader to understand what they see.

Poster #: EDU-007 (S)

CT Imaging in Low and Low-middle Income Countries: A Pictorial Review of Cases Received in the World Federation of Pediatric Imaging (WFPI) Tele-radiology Platform

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Purpose or Case Report: CT can be a powerful tool for the evaluation of the chest and abdominal pathology in children. While not as commonly used as in the USA, CT studies represented approximately 15% of cases received from low- and lower-middle income Countries for expert second opinion by a pediatric radiologist in the WFPI teleradiology platform, over the last 4 years. This pictorial review lists the indications, details the technical parameters, and exemplifies imaging findings of CT studies from this setting.
Methods & Materials: Retrospective analysis of sequential CT studies from WFPI teleradiology referral sites in low and low-middle income countries around the globe in the period October 2014- September 2019 (total of over 104 CT scans), including:1. Review of the scans indications and technical parameters 2. Representation of illustrative CT cases that serve as an introductory guide for radiologists and trainees involved or planning to enroll in international outreach activities
Results: The spectrum of cases that can be expected while working in outreach projects abroad are presented.
Conclusions: By the end of this review, participants would have gained familiarity with a gamut of infectious diseases, as well as complications and advance stages of disease that are common in places with lower CT utilization and/or limited access to radiology services.

Poster #: EDU-008 (S) - *Withdrawn*

Poster #: EDU-009 (S)

Challenging Vascular Malformations: Diagnostic Classification and Treatment Approach

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Purpose or Case Report: Comprehensive radiologic evaluation and accurate diagnosis of vascular malformations is vital to guide optimal treatment. Technical approaches and sclerotic agents used by interventional radiology vary by the type of malformation, anatomic location, and architecture of the malformation. Proper pre-procedural characterization of hard-to-treat lesions impacts procedural success and long-term outcomes.Most vascular malformations located superficially on the extremities and trunk, and can be evaluated with ultrasound and color Doppler. However, evaluation can be complicated by unusual locations and difficulty in characterization, requiring MRI and/or MRA. We present interesting pediatric vascular malformations challenging for both imaging diagnosis and

treatment.The objectives of this poster include:1. To review the classification and nomenclature of vascular malformations. 2. To present multimodal imaging findings of vascular malformations. 3. To discuss diagnostic imaging approaches of vascular malformations.modalities used. 4. To describe the treatment approaches for these malformations and outcomes including technical considerations and follow up.

Poster #: EDU-010 (S)

Vascular Anomalies: Diagnostic Approach and Endovascular Treatment

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Purpose or Case Report: Vascular abnormalities are commonly observed in pediatric patients, with an estimated prevalence of at least 4.5%.The current classification scheme for vascular anomalies was developed in 2014 by ISSVA (International Society for the Study of Vascular Abnormalities) and is based on the work of Mulliken and Glowacki of 1982.This classification emphasizes the fundamental difference between vascular tumors and vascular malformations.The diagnosis of vascular abnormalities is based on clinical history and physical examination.**US:** Screening, proper characterization; **TC:** It allows assessing the extent of the lesion and the relationship with adjacent structures; **MRI:** It's the ideal imaging study and reflects its histological composition.The most commons anomalies are: **Hemangiomas:**The most frequent vascular tumors are lobed and highly vascular lesions.They have significant enhancement to the administration of contrast medium, but only moderate T2 hyperintensity that reflects their highly cellular nature.**Venous Malformation:** Malformed venous channels with slow blood flow with thrombosis and flebolite formation. Important, often heterogeneous and peripheral enhancement with central progression. Hyperintense T2 signal reflects low cellularity. **Lymphatic malformations:** Dilated lymphatic channels and cysts. They can be macro or microcystic. Macrocystic variants appear as cysts with a very bright T2 signal and minimal enhancement (if any), bleeding is a common complication with liquid-liquid level formation. **Arteriovenous Malformations:**The main finding is empty flow due to high flow, which infiltrate the tissues without evidence of a free mass.There may be a mild enhancement and T2 hyperintensity that reflects tissue edema. **Treatment:** In most cases, conservative treatment is recommended, but when a patient suffers from clinical complications sclerotherapy of the nidus becomes mandatory. A multidisciplinary approach is needed. **Sclerosing agents: Alcohol 98%:** Strong endothelial damage, high response rate, less expensive, easy to obtain. Painful during the procedure, high complication rate, penetrative effect on the deep vascular layer. **Ethanolamine oleate:** Excellent thrombogenic effect, chemical damage to the vascular wall, less toxic effect than absolute ethanol. It can induce acute renal failure due to hemolytic effect, less endothelial damage than absolute ethanol. **Polidocanol:** Overhydration of endothelial cells, almost painless procedure. May induce reversible cardiac arrest.

Poster #: EDU-011 (S) - *Withdrawn*

Poster #: EDU-012 (S)

Artrogryposis Multiplex Congenital: Radiological Aspect to Know

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Purpose or Case Report: The objective of this review is to summarize the earliest radiological findings of AMC (arthrogryposis multiplex congenital), detail the most frequently affected joints, identify associated syndromes, and expose the radiological findings in children whose therapy was delayed.
Methods & Materials: From December 2013 to May 2019, 171 children with AMC were treated at our facilities. We've reviewed clinical notes, laboratory data, radiological exams, and surgeries performed. The first consultation average was 4.9 years. Patients ages ranged from neonates to 18-year-olds, being 14-year-olds the average. A higher incidence was seen in males, with a ratio of 2:1. Other syndromes have also been associated with this entity. In our findings, we were able to identify 15 different associated syndromes.
Results: Arthrogryposis is characterized by multiple joint contractures in dorsal muscles and limbs starting in newborns, which limit the movement of at least 3 different joints. Histologic examination shows muscle degeneration and disorganization of myofibrils, which are replaced by fibrous and fatty tissues.The earliest radiological findings in our research were echinus varus foot and congenital hip dislocation, in accordance with the literature. Other compromised areas included knees (with hyperextension and high patella), lower limbs (with tubular aspect), dislocated wrists and hands with digital flexion and retraction, semi-flexed elbows, scoliosis, and dolichocephaly.Osteopenia, lower limb deformity, degenerative signs, and joint incongruities were identified in patients with late therapy onset.
Conclusions: The role of radiological images is fundamental for a detailed description of these alterations, which allow early diagnosis and favor an integral evaluation in order to improve these children's life quality and their environment.

Poster #: EDU-013 (S)

Ultrasound Characteristics of Superficial Soft Tissue Extremity Lesions

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Purpose or Case Report: The purpose of this educational presentation is to demonstrate ultrasound technique and characteristic sonographic findings of common superficial pediatric extremity soft tissue lesions. We also offer advice on how to differentiate benign from malignant lestions. Children frequently present with unexplained “lumps and bumps” on their extremities. These lesions are often invisible on radiography; MRI might require use of sedation; and CT exposes the child to radiation and often requires iodinated contrast. Ultrasound (US) is a cost-effective, radiation-free, and dynamic method to evaluate superficial soft tissue lesions.We discuss choice of transducer based on lesion location. We

explain why a multifrequency transducer, which allows for the evaluation of both superficial (higher frequency spectrum of the transducer) and deeper (lower frequency spectrum of the transducer) components of the lesion is important. The use of compound imaging is explained, as multiple angles of insonation are combined to provide a more complete image of the structure being interrogated. For lesions involving the hands or feet, we explain the water-bath technique. Water is an excellent medium for ultrasound waves and will minimize artifacts from air and inadequate surface contact that plague evaluation of the distal extremities.We then discuss characteristic sonographic appearance of the following conditions: vascular anomalies, osteomyelitis and subperiosteal abscess, hematoma, subcutaneous granuloma annulare, Pilomatricoma, lipoma, ganglion and Baker cyst, muscle hernia, osteochondroma, foreign bodies, and malignant conditions.

Poster #: EDU-014 (S)

Understanding the Graf Method and the Diagnosis of Hip Development Dysplasia

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Purpose or Case Report: Hip ultrasonography is now considered the main method for screening, diagnosing and monitoring the treatment of development dysplasia of hip (DDH) in children, considering the advantages of the method and the excellent characterization of the anatomical elements of the infant hip which, at this stage of life, consists largely of cartilage. In 1980, Reinhard Graf, an Austrian pediatric orthopedist published child hip study work from about 20,000 stillbirths. He evaluated and studied through hip ultrasound the hip joint and determined in a single coronal section the hip classification. The purpose of this article is to explain in a didactic and detailed way the method of Graf, focusing on the reference points for its realization and proper interpretation.
Methods & Materials: A systematic literature review was performed, as well as compiled from the personal files database, exposing the detailed method and its difficulties.
Conclusions: Teaching messages: Evaluation of the pediatric patient with hip developmental dysplasia can be challenging, even for the subspecialty-trained radiologist. As the diagnosis and classification of the dislocated hips depend on the doctor who performs and interprets the exam, an article was made explaining in a didactic and detailed way the method of Graf, focusing on the reference points for its execution and proper interpretation. The detailed knowledge of the sonographic anatomy and the recognition of the main anatomical points allows to avoid the pitfalls and favors the accurate diagnosis

Poster #: EDU-015 (S)

Escala de Loes para Adrenoleucodistrofia Ligada al X: En Donde Debemos Buscar?

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Purpose or Case Report: Identificar los patrones anatómicos de afección de la mielina descritos por Loes y cols. mediante Resonancia Magnética.Identificar las estructuras anatómicas y la localización de los tractos afectados para establecer el puntaje de severidad acorde a la escala de Loes.
Methods & Materials: Mediante el uso de imágenes de cortes axiales y sagitales de resonancia magnética cerebral se delimitaron las áreas anatómicas según los 5 patrones descritos por Loes y colaboradores en los que se pueden encontrar las zonas de desmielinización mediante RM: 1: parieto-occipital; 2: frontal; 3: tracto corticoespinal; 4: cerebelar; 5: parieto-occipital y frontal concomitante; la identificación de estos patrones, además de la puntuación de la severidad al momento del diagnóstico pueden predecir la progresión y la posibilidad de buena respuesta al tratamiento mediante el transplante de médula ósea. Esta herramienta fué utilizada en tres pacientes pediátricos con sospecha clìnica de la enfermedad que fue confirmada posteriormente, para saber si en el momento del diagnóstico eran candidatos a transplante de médula ósea.
Results: Utilizar estos mapas ilustrados en cortes de resonancia magnética permiten identificar mas facilmente los sitios afectados por destrucción de la sustancia blanca para una mejor estadificación de la enfermedad al momento del diagnóstico o de la primera consulta en nuestra institución y ha permitido la identificación del patrón anatómico presente en cada paciente.
Conclusions: La escala de Loes es considerada el gold estándar para evaluación inicial y seguimiento en el paciente con X-ALD y en combinación con una adecuada identificación del patrón anatómico puede predecir el curso de la enfermedad y es de utilidad en la selecciòn de candidatos a transplante de médula ósea.

Poster #: EDU-016 (S)

Neurosonographic Characterization of the Major Intracranial Vascularity of the Extremely Low Gestational Age Infants

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Purpose or Case Report: Extremely low gestational age (ELGA) infants are those born before 23 + 6 weeks of gestation. These infants are prone to multiple complications. Frequent complications affect the brain. Transfontanellar brain ultrasound (US) is the standard of care imaging modality to assess the brain during the first weeks of life. An appropriate ultrasound technique includes assessment of the brain in gray scale, color and spectral Doppler. Doppler US should be interpreted in correlation with the neonate's clinical and systemic hemodynamic state, postnatal age, blood gas concentrations, respiratory or cardiovascular complications, amongst others. Prior literature focuses on the sonographic characteristics of premature, near term and term infants. However, Doppler US characterization of the intracranial vessels of ELGA infants is lacking. The purpose of this exhibit is to describe the resistive index (RI) and peak systolic velocities (PSV) of the anterior cerebral artery and the PSV of the superior sagittal sinus of a cohort of ELGA infants, and to assess their correlation with complications encountered in these infants.
Methods & Materials: In this exhibit, we included the sonographic patterns and evolution of the main intracranial vascularity of 25 ELGA infants born between 22 + 0 weeks and

23 + 6 weeks of gestation, from baseline at birth and a follow up of 90 serial US exams. This educational exhibit is organized as follows: 1) a short description, advantages and limitations of the Doppler US technique; 2) a systematic approach to assess the intracranial vessels with focus on the anterior cerebral artery and superior sagittal sinus; 3) provide a series of plots of the evolution of the Spectral Doppler changes in these vessels overtime; 4) A series of illustrative cases of normal and abnormal sonographic appearances of the vessels in ELGA infants and their correlation with hemodynamic alterations or complications.

Poster #: EDU-017 (S)

Neurosonography of the Extremely Low Gestational Age Infants: Normal Developmental Anatomy, Interval Growth and Complications.

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Purpose or Case Report: Extremely low gestational age (ELGA) infants are those born before 23 + 6 weeks of gestation. Continued advances on therapy and supportive care in the neonatal intensive units have allowed for an improved survival of these infants. Transfontanellar brain ultrasound (US) is the standard of care imaging modality to assess the integrity of the brain during the first weeks of postnatal life, as it provides a closer direct look to the brain. The purpose of this exhibit is to illustrate detailed US characteristics of the normal development and complications of the evolving premature brain of ELGA infants.
Methods & Materials: The sonographic characteristics and evolution of the brain developmental anatomy of 25 infants born between 22 + 0 weeks and 23 + 6 weeks of gestation were assessed, from baseline at birth and follow up with serial subsequent US exams. This educational exhibit will describe indications, advantages and limitations of the US technique and will provide a systematic approach to assess the normal development of brain structures, including a series of plots of interval growth of the developing brain.
Results: This investigation encompasses brain biometry, including a review of cortical development and appearance of sulci and major fissures, evolution of cortical rim, robust sonographic assessment of neuronal migration and basic organization of the cerebral hemisphere, white matter changes, size of corpus callosum, cerebellar and vermis diameters, hemispheric width, ventricular anterior horns and atrial width with ventricular frontal horn ratios and index, thalamo-occipital distance, evolution of Sylvian fissure, and evidence of anatomic variants, amongst others. Finally, we characterize the sonographic brain complications encountered in these infants.
Conclusions: This exhibit provides a systematic approach to review the premature brain in ELGA infants, assessing normal sonographic appearances and their evolution over time. It also provides reference values for intracranial anatomic landmarks. Familiarization of the normal sonographic appearances, during brain development, allows for prompt recognition of brain injury patterns in the extremely premature brain.

Poster #: EDU-018 (S)

Normal and Abnormal Mielinization Patterns

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Purpose or Case Report: Myelination it's a dynamic process through which a lipoprotein sheath that covers the axons develops. It begins at the 4th month of gestation and reaches its maximum at 24 months and occurs from caudal to rostral, from dorsal to ventral, from central to peripheral. Normal myelination by MRI: Sequences: T1 - key sequence to evaluate myelination <1 year. The signal reflects the presence of proteins; T2 - key sequence to evaluate myelination 1 and 2 years. As the myelin sheaths thicken the surrounding interstitial water moves; FLAIR, DP, DTI - complementary sequences. T1WI: RN-Brain stem, optical tracts, anterior commissure, ventral thalamus, posterior limb of the internal capsule, rolandic and perirolandic gyrus; 2 months - deep white matter and anterior limb of internal capsule; 4 months - Splenium, optical radiations become more evident, cerebellar white matter; 6 months - Genu, body and splenus of the corpus callosum; 8 months - U fibers in occipital lobes progressing slowly to frontal and temporal at one year of age; 10-12 months - Appearance of myelination with adult pattern in T1WI. T2WI: RN-Dorsal brain stem, posterior limb of the internal capsule, ventral thalamus, perirolandic gyrus; 2 months - Posterior internal capsule arm, semiovale centrum and optical tracts; 4 months - Optical radiation and subcortical white matter; 6 months - Splenium; 8 months - Genu, body and splenic corpus callosum, anterior arm of the internal capsule; 12 months - cerebellar white matter and occipital subcortical U fibers; 18 months - Frontal white matter. Some residual hyperintense signals around the trigons of the lateral ventricles; 36 months - Myelination appearance with adult pattern in T2WI. Myelination Terminal Zones: Normal variant of development; Zones of incomplete myelination; Hyperintense, bilateral and symmetric foci in dorsolateral WM to the atrium of the lateral ventricle. Abnormal Patterns: Delayed myelination - Situations in which myelination is slow but present.Usually bilateral and symmetric; Hypermyelination - Rare pathology, it can be local or generalized. Sturge Webber, epilepsy and late sequelae of perinatal hypoxia; Hypomyelinization - Permanent deficit of the myelin deposit. Unlike the delay of myelination these do not present myelination over time. It can be seen as normal myelination in T1 but with deficit in T2. **White matter diseases: Demyelinating diseases** - They are acquired and have destruction of normal myelin; **Demyelinating diseases -** Hereditary enzyme deficiency that causes abnormal myelin formation, destruction or turnover.

Poster #: EDU-019 (S)

Tuberculosis in Childhood: From Head to Toe

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Purpose or Case Report: - To review the ethiopathogenesis of tuberculosis (TB);- To discuss clinical and epidemiological

variables, as well the radiological findings seen in radiography, ultrasound (US), computed tomography (CT) and magnetic resonance (MR) imaging performed due to clinical suspicion of TB;- To review and widely ilustrated in this paper the imaging findings in TB.
Methods & Materials: We retrospectively reviewed the clinical data, radiography, US, CT and MR findings of infants with the final diagnosis of tuberculosis in order to find common and uncommon radiological findings of the disease.
Results: We select the most ilustrative images in TB such as:- lung cavitated lesions;- lymph nodes enlargement with central necrosis;- bronchial tree fistulas;- tuberculous spondylodiscitis;- tuberculous meningitis;- abdominal tuberculosis with lymph nodes conglomerates with extensive areas of necrosis that had complicated with gastrointestinal tract fistulas; - bone tuberculosis
Conclusions: -Tuberculosis is a global public health problem and can affect any organ of the body;-TB demonstrates a variety of clinical and radiological features depending on the organ site involved and has a know propensity for dissemination from its primary site. Thus, TB can mimic a number of other disease entities, and it is important to be familiar with the various radiological features of tuberculosis to ensure accurate diagnosis.

Poster #: EDU-020 (S)

Pulmonary Manifestations of Cystic Fibrosiss: Jump into Bhalla Score and Brasfield Score Systems

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Purpose or Case Report: Cystic fibrosis (CF) is caused by autosomal-recessive mutations in the CF transmembrane regulator (CFTR) gene. Results in production of abnormally viscous mucus and secretions in the lungs of patients. It is the most common genetic disorder leading to chronic pulmonary disease in children. In the lung, the cystic fibrosis transmembrane regulator (CFTR) is a protein responsible for efflux of chloride and inhibition of the sodium channel's activity which controls the influx of sodium. Pulmonary manifestations of CF includes: Bronchiectasis; Pneumothorax; Recurrent bacterial infection; Pulmonary arterial hypertension. **Chest XRAY:** is inferior to CT for the assessment of patients with known bronchiectasis. Nevertheless, radiography remains a useful modality for assessing the pulmonary complications associated with bronchiectasis, because of its low cost, availability, low radiation dose, and speed of acquisition. **Brasfield scoring system:** The score is based on conventional chest radiographic findings and has been reported to have good correlation with pulmonary function.There is a maximum score of 25 with points subtracted based on the score from each of the following categories: **Air trapping:** generalized pulmonary overdistension (sternal bowing, depression of diaphragms, or thoracic kyphosis); **Linear markings** Linear opacification due to prominence of bronchi; may be seen as parallel line densities, branching, or “end-on” circular densities (bronchial wall thickening); **Nodular cystic lesions:** multiple discrete rounded densities ≥0.5 cm in diameter, with either radiopaque or radiolucent centers (bronchiectasis); does not refer to irregular linear markings; confluent nodules not classified as large lesion; **Large lesions:** segmental or lobar atelectasis or consolidation, including acute pneumonia; **General severity:** impression of overall severity on chest x-ray. **HRCT** has become indispensable in the monitoring of CF patients and is used to guide therapy and assess response to treatment, as it not only correlates with lung function tests.Scans are repeated every 6 to 18 months depending on the clinical course. **BHALLA SCORE SYSTEM:** Bhalla system can assess the degree of lung involvement and the evolution of the damages caused by lung disease based on various radiological findings. It values: Bronchiectasias; Peribronchial thickening; Extent of bronchiectasias; Extent of mucous plugs; Abscesses or sacculations; Bronchial generations affected; Number of bullae; Extent of emphysema; Collapse or consolidation.

Poster #: EDU-021 (S)

La Física detras de una Quemadura por Radiofrecuencia en Estudios por Resonancia Magnetica

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Purpose or Case Report: En este trabajo se expone la instrumentacion basica que tiene un equipo de resonancia magnetica. Los cables que pudieran utilizarse durante un estudio de RM, como oximetros, monitores fisiologicos, o dispositivos electronicos. Se explica la variacion de los campos magneticos de RF al utilizar secuencias de pulsos, el mecanismo de induccion de corriente en el tejido humano. Y se dan recomendaciones para prevenir accidentes y probables quemaduras asociadas a procedimientos mal realizados durante un estudio de RM.

Poster #: EDU-022 (S)

Imaging Gently: A Review of Pediatric Emergency Ultrasound

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Purpose or Case Report: The use of computed tomography (CT) in radiology has risen dramatically over the past 2 decades. Over 7 million pediatric CT studies per year are performed in the United States. Children are particularly at risk for the cumulative adverse lifetime effects of ionizing radiation. It is associated with a small but significant increase in lifetime risk of fatal cancer. For this reason, the campaign of “Imaging Gently” was created, whose purpose is to raise awareness of the opportunities to lower radiation dose in the imaging of children. Minimizing the dose in children is a high priority in pediatric radiology, and as a result the use of modalities utilizing non-ionizing radiation is encouraged.For the reasons discussed above, ultrasound is often the first line tool in the diagnosis of pediatric emergencies. The purpose of this educational article is to further discuss “imaging gently” and the importance of utilizing non-ionizing radiation such as ultrasound to diagnose various pediatric emergencies. These emergencies include but are not limited to acute appendicitis, hypertrophic pyloric stenosis, intussusception, testicular torsion, and ovarian torsion. The imaging technique, pertinent findings, differential diagnosis, imaging pitfalls and treatment will be discussed. Image-rich examples of each diagnosis will be provided.

Poster #: SCI-001 (S)

Distribución de Hierro Hepático en Pacientes Pediátricos Utilizando la Segmentación de Couinaud Usando Imágenes de Resonancia Magnética

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Purpose or Case Report: El hígado es el principal sitio de almacenamiento de hierro en humanos, y la concentración de hierro en el hígado se correlaciona estrechamente con las reservas de hierro en todo el cuerpo. La técnica de resonancia magnética (MR) es capaz de separar las señales de agua y grasa para cuantificar la infiltración de hierro y grasa en el hígado. Esto permite obtener una mejor cuantificación del hierro y observar la relación que existe con el índice de masa corporal (IMC). En este trabajo se propone una medición de acuerdo a lo propuesto por la divisón anatomica por **Couinaud.**
Methods & Materials: Se obtuvieron imágenes de 15 voluntarios sanos usando un equipo de resonancia magnética nuclear de 3 Tesla, una antena de RF de abdomen de 18 canales. Se hicieron mediciones en ROIs (region de interes) de manera aleatoria sobre la región hepática, y posteriormente usando la segmentación propuesta por Couinaud. El proceso se repitió para los 15 pacientes en ambas imágenes (en fase (EF) y fuera de fase(FF)), manteniendo los ROI's en la misma posición para cada paciente.
Results: Se observa que los valores distan mucho dependiendo de la zona de medición, esto claramente nos indica que la concentración de hierro no es homogénea en el hígado, la principal distribución de hierro al hígado es a través de la vena porta. Situaciones como la trombosis, la compresión o la derivación de la vena porta que disminuyen el flujo venoso portal dan como resultado una deposición desigual de hierro en diferentes segmentos. Esto ha llevado a malos diagnósticos en la medición del hierro hepático, como ya se había mencionado el estándar para la cuantificación de hierro hepático es la biopsia, sin embargo, debido a las diferentes complicaciones en los pacientes, no se tiene una certeza absoluta de que la biopsia se esté haciendo en el lugar adecuado, además de que es un método invasivo, complicado y muy incómodo para el paciente.
Conclusions: Se observa que existe una estrecha relación entre el índice de hierro hepático y el IMC, ya que niveles muy bajos de hierro indica que el paciente se encuentra por debajo de su masa corporal normal. Esto puede traer graves consecuencias como la anemia ferropénica. Es por esto que la cuantificación de hierro por medio de la RM usando la segmentación de Couinaud, muestra ser un método eficiente, seguro, no invasivo y sobre todo personalizado para obtener una cuantificación precisa de la distribución de hierro en el hígado de cada paciente.

Poster #: SCI-002 (S)

An Uncommon Complication in a Common Study

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Purpose or Case Report: The lower GI study with water soluble contrast, is used to evaluate the remnant colon. The population to study includes patient with anorectal malformation, stenosis due to necrotizing enterocolitis, bowel resections or to plan the ostomy closure.There are scarce adverse effects reported in the literature.Case: We present a 7-month-old boy with operated cardiopathy and the prior story of necrotizing enterocolitis with bowel perforation a few days after the birth, with surgical intervention resolution. By the time of the study, our patient had ileostomy and colostomy in plan of reconnection, for that reason, the GI study was planned.The patient was lying down face up in the table. Plane X Ray of the abdomen was taken as a first move of the examination (normal air distribution, no abnormal radiopacities). Then a probe with a balloon was introduced in to the distal ostomy and the balloon was inflated with 5 ml of air to prevent the loose of the probe. A syringe of 20 ml was connected, and the solution was injected (1/3 ml Triyosom GI* and 2/3 ml water) with a moderated hydrostatic pressure. During the injection fluoroscopy was given and images of the distal colon were seen. No fistulas or loose of contrast was evidenced, neither contrast out of anus was seen, as a result of stenosis in that point. We emptied the distal colon by taking out the contrast. 3 hours after the practice the patient started vomiting, abdominal distention and signs of sepsis. He was admitted at the emergency. Finally, he died 6 hours after the GI study had been performed. Analytic results of the blood: 2/2 positive to Gram Negative. Autopsy informed: no GI signs of bacterial translocation. *Meglumina diatrizoato-diatrizoico acido.
Conclusions: We assume the death as an unwanted consequence of the GI study. We reviewed all the distal colon studies that were performed in the last 5 years in our hospital, we looked for any complication after 4 days of the GI study. We found 180 patient that underwent the procedure and only 7 of them present any complication. They were admitted and put into ATB treatment. Only one death, our patient. We still don't know what was the event that caused the bacteremia in the patient, if the concentration of the contrast or the hydrostatic pressure during the infusion. Considering this event we protocolized the following up of every child that undergo a GI study: The patient must be in observation room during 6 hours after the study is done.

Poster #: SCI-003 (S)

Quantification of the Fat in the Thigh Muscle of Pediatric Patients with Muscular Dystrophy by Magnetic Resonance Imaging

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Purpose or Case Report: Quantify the amount of fat in the different muscles to look for a pattern of degeneration in Duchenne's dystrophy.
Methods & Materials: Ten patients with Duchenne distrophy and eight healthy volunteers were examined as follows: all subjects were scanned while in the supine position with thighs relaxed and parallel to the magnet magnetic field direction. Images were acquired on a 3T MRI Scanner. The regions of interest (ROI) were drawn on each patient's thigh muscles. Eleven ROIs in the thigh were chosen, one for each muscle: lateral vast, intermediate vast, rectus femoris, medial vast, Sartori, long adduct, graceful, magnum adduct, semimembranous, semitendinous and biceps femoris.
Results: By applying the 2-point Dixon method, for

quantification of fat with images in phase and out of phase, exploiting the fact of the precession difference of hydrogen protons from water and fat. It was observed that the method is very useful to be able to quantify the fat of the muscles, and to be able to track the progression of muscle degeneration
Conclusions: The magnetic resonance imaging technique is non-invasive, compared to the biopsy that is currently performed to diagnose muscular dystrophy. In this work, the average fat percentage of each thigh of each patient with a diagnosis of muscular dystrophy has been compared. This has been achieved thanks to the different response of hydrogen nuclei found in fat, compared to hydrogen nuclei found in water molecules, when they are excited with selective pulse sequences that allow magnifying the difference. between both tissues. Two different softwares have been used to measure the percentage of fat associated with each muscle, and it is observed that they are very similar, although it can be emphasized that ImageJ is more accurate, since the desired region of interest can be measured, that is to say You can select the entire muscle region, therefore, the Dixon 2-point method is reliable for fat quantification.

Poster #: SCI-004 (S)

Pubofemoral Distance as a Screening Method for Diagnosis of Developmental Dysplasia of the Hip

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Purpose or Case Report: Developmental dysplasia of the hip (DDH) is the designation given to a spectrum of structural changes in the developing hip. Ultrasound is the preferred imaging method for screening this condition in newborns and children under 1 year old. Pubofemoral distance (PFD) has been proposed as a new screening method for developmental dysplasia of the hip. The aim of this study is to assess the accuracy of PFD for developmental dysplasia of the hip using the Graf method as reference standard.
Methods & Materials: A prospective single-institution study with 935 hips from 412 children at elevated risk for DDH from 1 day to 9 months of age. The Graf method was performed for diagnosis and classification of the DDH. Hips were divided into two groups according to the Graf type gradation: Group I, considered normal (Graf types Ia, Ib and IIa); and Group II, considered dysplastic (Graf types IIb or greater). In each hip the PFD was measured and the statistical analysis was performed to assess its accuracy.
Results: The sensitivitie and specificities of the indice was analyzed through receiver operating characteristic (ROC) curves. The greater area under curve was 0,63, obtained with the cutoff 3,5 mm for PFD. With this cutoff, values of Sensibility and Specificity were respectively 64% (CI 95% 0,546; 0,726) and 63% (CI 95% 0,597; 0,663).
Conclusions: The cut-off level for instability about PFD is not clear and needs to be established. In our study the cut-off value should be set lower at 3.5 mm.

Poster #: SCI-005 (S)

Caracterización de la región Cortico-Talámica por FA y ADC por Imagen de Resonancia Magnética Nuclear

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Purpose or Case Report: Caracterizar y comparar los parámetros de difusión de la región córtico-talámica, para estudiar su desarrollo en edades tempranas y su posible aplicación en el diagnóstico clínico de enfermedades.
Methods & Materials: Para este trabajo se utilizó un equipo de 1.5 T, con una secuencia de pulsos Fast Echo Planar Diffusion Weighted Imaging que cubren todo el cerebro, TR=7711s, Echo train length 63, 90 flip angle, matriz de adquisición 124x124, 15 direcciones de gradientes no-colineales, con supresión de grasa, 2mm de gap, antena de RF de 8 canales de cráneo con tecnología SENSE. 20 niños sanos con edades de entre 6 y 16 años de edad con una edad media de 12.5 años, se usó el software MedInria. Se analizó FA y ADC.
Results: Los valores de FA generalizados están en los valores de 0.378 u.a. para el paciente de 7 años a 0.444 u.a. para el paciente de 14 años. Para los valores del ADC generalizado se encuentran en el rango de 1.73 mm^2/s para el paciente de 16 años a 2.13 mm^2/s para el paciente de 7 años ,Con el software SPSS, el coeficiente de correlación de Pearson para medir el grado de relación entre los valores de los parámetros de difusión y la edad de los niños. La estadística arrojo un coeficiente de Pearson de 0.491 con una significancia estadística de r = 0.028, lo cual es indica que a medida que la edad aumenta el valor de FA generalizado también aumenta. su correspondiente estadística obtuvo un coeficiente de correlación de Pearson de -0.696 con una significancia estadística de r = 0.001 , lo cual dice que a medida que la edad aumenta, el valor de ADC generalizado disminuye, o bien, se tiene una relación inversamente proporcional.
Conclusions: DTI es una herramienta que permite el análisis de tractos asociados a la materia blanca especializados, tales como el sistema Cortico-Talámico, con la posibilidad de obtener un biomarcador para su posible comparación con los de pacientes no saludables, con lo cual se aplique a la detección de enfermedades en poblaciones pediátricas mexicanas y su desarrollo neurológico, el establecimiento de tractos de la vía Cortico-Talámica da lugar a la necesidad de poder determinar el seguimiento tras las terapias de intervención en el paciente y valorar la efectividad en cuanto a la rehabilitación de pacientes. Al estudiarse la vía Cortico-Talámica, no solo procesos sensoriales están involucrados, sino también procesos pre-motores, motores, límbicos, visuales entre otros procesos asociados con el tálamo.

Poster #: SCI-006 (S)

Biomarcadores de Lenguaje asociados a el Area de Broca y Werknicke por tensor de difusión

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Purpose or Case Report: Los problemas en el desarrollo del lenguaje se han incrementado en anios recientes, se estima que solo en Mexico el siete por ciento de los ninios presenta alteraciones del lenguaje. La caracterizacion de los valores de ADC y FA asociados al area de Broca y Wernicke propuestas por el modelo clasico pueden permitir en un mediano plazo detectar anomalias en el sistema del lenguaje pudiendose utilizar para un diagnostico temprano. Por esta razon nuestro primer objetivo es caracterizar ambos parametros en pacientes sanos que permita establecer valores de control.
Methods & Materials: Se analizaron 34 pacientes entre 4 y 14 anios. Las imagenes fueron obtenidas con un escaner de 1.5 T, con un sistema de gradientes NOVA. Antena de craneo con tecnologia SENSE y 8 canales para imagenes rapidas con una secuencia de eco rapido plana, las imagenes por difusion ponderada cubrieron todo el cerebro. TR = 7711ms, longitud del tren de eco 63, angulo de giro 90, b=1000, 124x124, 15 direcciones de gradientes no colineales con supresion de grasa y brecha de 2mm. Corrientes espurias corregidas mediante el software FSL, caracterizacion de los tractos y medicion de ADC y FA generalizados utilizando el software MedInria. El estudio fue aprobado por la Junta de Revision Etica del Hospital.
Results: Los valores asociados a las zonas segmentadas muestran una correlacion significativa en todas ellas, por encima de 0.6. El coeficiente mas alto se obtuvo para el ADC de Wernicke y Broca en el hemisferio izquierdo, muy cerca de este, se encuentran sus contrapartes en el hemisferio derecho.Los tractos asociados a las segmentaciones realizadas utilizando MedInria.El intervalo caracteristico obtenido para el ADC, en un rango de 1.9 a 2 mm2/s, mientras que para la FA el valor oscila cerca a las 0.4 unidades arbitrarias.
Conclusions: Cambios significativos en el fasiculo arqueado, se han encontrado en algunos casos, sin embargo, consideramos que caracterizar los valores de los parámetros ya mencionados, en ninos controles sanos pueden servir de control, en virtud de que eventualmente las variaciones en éstos se puedan correlacionarse con algunos problemas en el desarrollo del lenguaje.

Poster #: SCI-007 (S)

Quantification of Hepatic Fat in Pediatric Patients Considering Couinaud Segmentation by MRI

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Purpose or Case Report: demonstrate that using the anatomical division of the liver suggested by Couinaud allows a more accurate quantification of the amount of fat.
Methods & Materials: The percentage of liver fat in 18 pediatric patients is measured, 9 of them with a BMI corresponding to the "normal weight" nutrition status and 9 with BMI with "obesity" nutrition status. Axial abdominal images were obtained using a 3.0T Siemens device with an IDEAL-DIXON sequences. It generates 4 images in a single acquisition: only water, only fat, the combination of water and fat in phase and out of phase. Next, the Couinaud segments and non-Couinaud segments are drawn, for each segment a circular region of interest (ROI) of 236.33 mm2.
Results: For normal weight patients the Correlation coefficient between the BMI and the measure considering the Couinaud segments is 0.768 and Correlation coefficient between BMI and measurement without considering Couinaud segments is 0.384. For normal weight patients the Correlation coefficient between the BMI and the measure considering the Couinaud segments is 0.946 and Correlation coefficient between BMI and measurement without considering Couinaud segments is 0.845.
Conclusions: In conclusion, an adequate way of measuring liver fat is using magnetic resonance imaging in phase and out of phase considering the segmentation proposed by Couinaud; such segments represent a way of seeing the liver in anatomically appropriate sections, so when proposing to take measurements in each of the segments displayed in the image, it provides a reference to make a more accurate measurement, unlike when the measurements are not considered. Couinaud segments, where it is exposed to an increase in the percentage of liver fat. It can even be noted that the quality of the measurement increases considering these segments.

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