Welcome to the DCMC Emergency Department Radiology Case of the Month!

In conjunction with our Pediatric Radiology specialists from ARA, we hope you enjoy these monthly radiological highlights from the case files of the Emergency Department at DCMC. These cases are meant to highlight important chief complaints, cases, and radiology findings that we all encounter every day.

If you enjoy these reviews, we invite you to check out Pediatric Emergency Medicine Fellowship Radiology rounds, which are offered quarterly and are held with the outstanding support of the Pediatric Radiology specialists at Austin Radiologic Association.

If you have any questions or feedback regarding the Case of the Month format, feel free to email Robert Vezzetti, MD at rmvezzetti@ascension.org.

Conference Schedule: May 2018

2nd - 9:00 Peds Neuroimaging………………Dr Munns, Vezzetti, Leake
10:00 Head Injuries……………………Drs Singh and Kienstra
11:00 QI: ED Throughput…………………Drs Harrison and Iyer

9th - 8:00 Bioterrorism…………………Drs Munns and Remick
9:00 Disaster Simulation………………….Simulation Faculty

16th - 9:00 Environmental Toxins…………………Drs Fusco and Earp
10:00 Wheezing Beyond Asthma…………………Dr Allen
11:00 TBD
12:00 ED Staff Meeting

23rd - 9:00 Assessing/Enhancing Causality…………Dr Wilkinson
10:00 TBD
11:00 TBD

30th - 9:00 M&M……………………………Drs Schunk and Gorn
10:00 Board Review: Cardiology………………Dr Ruttan
12:00 Research Update……………………Dr Wilkinson

Guest Radiologist: Dr David Leake, MD
Pediatric Neuroradiology

Simulations are held at the Seton CEC.
Lectures are held at DCMC Command Rooms 3&4.
Locations subject to change.
All are welcome!

This Month: Urinary tract infections are common in children and generally nothing unusual. But when is imaging indicated for pediatric urinary tract infections? What imaging modality needs to be used? This month we answer those questions and more as we look at UTI imaging in pediatrics....
Case History

Summer is basically here in the Pediatric Emergency Department...lots of fractures, contusions, lacerations, etc. Kinda nice, since you aren’t seeing much of the dreaded flu and upper respiratory stuff that has been your life for the past few months. At any rate, your shift is progressing nicely and you pick up the next chart. It’s a 17 year old male referred to you by his pediatrician for a urinary tract infection. What? You read on and find out that the mother told the Emergency Department Triage Nurse that the child was referred to a Pediatric Urologist for chronic urinary tract infections over the past few months but they have made an appointment yet. What?

You walk in to the room and note the viral signs on the chart: Temp of 97.5 Hr of 60 RR of 16 BP of 106/65. Ok, so far so good. You speak to the mother and patient together (at first). It seems that he is a completely healthy child who is fully immunized. There is suspicion that he may be slightly developmentally delayed per the mother, because it “takes him a while to understand some things” and she states that he is undergoing a new battery of testing at school (his last testing indicated that he was slightly below average compared to his peers in his class with reading and math) but has not been referred to a Developmental Pediatrician for evaluation. He began having dysuria and lower abdominal pain one month ago. At that time he was seen by his pediatrician who obtained a urinalysis, revealing, they say, a urinary tract infection. He was placed on antibiotics (the mother does not know which one) which he took for 10 days. He improved for a day or two, but then his symptoms returned. He was then placed on another round of antibiotics (again the mother does not know which ones but she states it was a pink medicine – you’re guessing Amoxicillin) which he took to 10 days. Again, he seemed to improve very briefly and again his symptoms returned. He has had subjective fevers; there is no report of generalized abdominal pain, back pain, vomiting, weight loss, or diarrhea. He has been eating well and otherwise states that he feels fine. You ask the mother to step out of the room and speak to the patient, asking direct questions. He denies penile discharge or bleeding/hematuria. He denies being sexually active and denies any trauma. He does endorse continued dysuria. You examine him and note that his abdominal examination is unremarkable (no masses, tenderness, rebound, or guarding; no CVA tenderness) but he does have suprapubic tenderness to palpation. His genital examination reveals a Tanner Stage V; he is not circumcised but he does not have paraphimosis or phimosis. There is no bleeding, discharge, or lesions noted. He has a normal testicular examination.

A 17 year old with apparently recurring UTI. Odd. Does he need imaging? If so, what?

The Duke and Duchess of Cambridge recent had a child and congratulations to them! Until recently, though, the laws of succession gave male heirs to the crown priority. Not any more! The Succession to the Crown Act of 2013 modified centuries of law: this new baby is behind his older sister Charlotte for the crown of the UK (but in front of Uncle Harry).
Fun Facts: UTI
Urinary tract infections are a common problem in Pediatric patients, especially girls. The reported prevalence of UTI can be tricky, because depending on which patients are selected, how a urine specimen is collected, and which laboratory testing method is used, this will vary substantially. For example, bag urine specimens are known to provide false positive rates of infection. Interestingly, while females account for the majority of UTI’s, there is a male preponderance among premature infants and in the first 3 months of life. The rate of infection among female children age 1 to 5 years old has been reported to be up to 3%. There is a reported rate of asymptomatic bacteruria among school aged children of up to 3% in girls and 0.2% in boys, which does not necessarily represent true infection, since children with UTI in this age range typically have fever. Overall fever associated with UTI varies by age: < 8 weeks 7.5%; < 1 year 5.3%, < 2 years 4.1%, < 5 years 1.2%. Uncircumcised boys during the first year of life have a 10 fold increase in the risk for UTI. Neonates and young infants tend to have upper tract disease (pyelonephritis for example) and older infants and children tend to have lower tract disease (cystitis, for example).

Etiologic Agents of Pediatric Urinary Tract Infection:
E coli is by far the most common bacterial gent causing pediatric UTI, accounting for 70% - 90% of infections. There are other bacterial agents though. Proteus species is more common in older male patients; Pseudomonas species can be seen (especially in children with chronic illness or indwelling catheters. In this population, Staphylococcus species can cause infection); Staphylococcus saprophyticus emerge as important pathogens in female by young adulthood. Don't forget that not all apparent urinary infections are due to bacteria. Adenoviral infections are a common cause of infection, especially hemorrhagic cystitis.

Risk Factors for UTI
Colonization of the urethra with bacteria (typically gastrointestinal) is the initial event of a UTI. These bacteria then ascend from the preurethral space to the bladder and kidneys. Not every child with periurethral bacteria, though, develops infection. Who does develop and infection depends on several risk factors:

Host Risk Factors
1. Inadequate bladder drainage.
2. Anatomic abnormalities/urine flow obstruction.
3. Indwelling catheters.

Bacterial Factors
1. Antigen properties (K and O).
2. Adhesion expression.
3. Aerobactin expression (promotes bacterial growth).

Imaging Studies:
Urinary tract abnormalities are seen in roughly 35% to 50% of infants with UTI, particularly in infants < 3 months of age. Pelviectasis and mild hydronephrosis are the most common findings.

Renal Ultrasoundography - the first step in radiologic evaluation of a child with UTI. The timing is sometimes a matter of debate, but most recommendations is after the initiate of treatment and the child has improved (1-2 days). This modality is excellent at evaluating renal anatomy as well as the presence of hydronephrosis. A normal US does not exclude renal scaring or VUR.

Voiding Cystourethrogram (VCUG) - this study is performed in any patient with abnormal ultrasound findings. There is debate about whether this exam needs to be done on patients who have normal ultrasound findings. Studies have shown that the prevalence of VUR in children with normal renal US findings is very low. In children with non- E coli infections, VUR rate is higher and these children should have a VCUG done. Children who did not have a VCUG done with a first time UTI but have a second UTI should have a VCUG done.

Renal Cortical Scintigraphy (DMSA Scan) - this imaging modality can be used to identify cortical scaring. It is not helpful, generally speaking, in an acute evaluation of a UTI but can be used to followup abnormal US findings if they are suggestive of renal damage or for severe VUR.

CT - can be used to identify pyelonephritis, but generally not indicated, especially with radiation exposure.
What a strange story. From what you know about UTI, a 17 year old male really shouldn’t have one. Of course, it is always possible. You decide to obtain a urinalysis and, in addition to a urine culture, you also obtain a Gonorrhea and Chlamydia urine test (never trust a teenager, you’ve learned over the years after a few surprises). The results are impressive:

- Nitrite: POSITIVE
- Leukocyte esterase: MODERATE
- Blood: LARGE
- RBC: 6-10
- WBC: 51-100
- Bacteria: Many
- Epithelial Cells: <2
- Negative glucose/bili/ketones
- SG: 1.025
- Protein: 30

Well, that’s pretty consistent with a urinary tract infection, isn’t it? If the past history is accurate, this is his third UTI, or at least a chronic UTI that is not clearing with antibiotics. You decide to order some blood work (basic electrolytes and a CBC) to see if anything is abnormal. The CBC and CMP are normal, including his BUN and Creatinine (13 and 0.8 respectively).

You also decide to obtain imaging and order a renal/bladder ultrasound. (It is common practice at many institutions, including DCMC, to obtain both renal and bladder views, unless specifically stated otherwise). Selected images from this study can be seen to the left, and they are quite surprising. The renal portion of the study was normal and those views are not demonstrated here. What we do see is the bladder portion of the study. There are multiple tubular structures that appears to be lopped throughout the bladder (yellow arrows). It looks consist with catheter tubing (of course, a catheter was NOT placed in this patient, so it can’t be that). There is also bladder wall thickening, consistent with cystitis (green arrows).

Wow! What is that object and what do you need to do next?

**Treatment for Pediatric Urinary Tract Infections**

Initial parenteral antibiotic therapy is indicated for young infants (< 2 months of age), clinical urosepsis, inability to tolerate oral medication, medically complex children, poor followup, failure of prior outpatient treatment. Otherwise, oral therapy is appropriate for most children. A urine culture should be obtained prior to the initiation of therapy. Choice of antibiotic agent can be guided by local resistance patterns; cephalosporins are an excellent first line choice. Be wary of enterococcus (cephalosporins not effective) and ESBL bacteria, especially if these organisms are present in your local population.

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Tradition holds that the birth of a royal baby is announced by an official royal notice that is placed on an easel outside of Buckingham Palace. It remains on display for 24 hours. This tradition dates back at least 1837. The Union Jack was also raised above the palace to mark the occasion. Of course, royal births are also announced via social media these days as well.
Our patient's cystogram - normal; there is no perforation of the bladder.

Teaching Points

1. Urinary tract infections are common in children, with a higher incidence in premature males and males < 3 months of age. After that, females have a higher incidence of UTI.
2. Infants younger than 2 months of age with a UTI should have a full sepsis workup performed, ideally prior to the administration of antibiotics. These infants should also be hospitalized, since data regarding the outpatient management of UTI in infants younger the 2 months of age are lacking.
3. Older infants and children can generally be managed as outpatients. Choice of antibiotics should be based on local resistance patterns. Be wary of enterococcus and ESBL bacteria, as these organisms are resistant to the usual classes of oral antibiotics (ie cephalosporins) used to treat pediatric UTI.
4. Renal ultrasound should be performed on all males and all females less than 2 years of age with UTI. The timing of the ultrasound is debatable but can be done once the child has improved and is responding to treatment (typically after the acute phase of illness). However, if a child is not responding as expected to treatment during the acute phase of illness, then renal ultrasound should be obtained, as perinephric abscesses or pyonephrosis can be detected.
5. Infants younger than 2 months of age, children with an abnormal renal ultrasound, children with a normal renal ultrasound but with a second UTI, or children with non-E coli infections should undergo a VCUG. The timing of the study is also debatable, but can be performed as soon as the child is asymptomatic. In most cases, it is performed immediately after antibiotic therapy is completed.
6. The role of DMSA scanning in pediatrics is not routine but is employed in children with recurrent UTI, or signs of renal damage.

References