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@seton.org.

This Month: We have discussed lots of cases addressing abdominal pain in children. The differential is quite long. When the clinical picture isn’t fitting with the usual diagnosis, it’s time to take a step back and broaden the differential, as you’ll see in this month’s case, brought to us by one of our PEM Fellows, Dr Katie Berg.

These cases have been removed of identifying information. These cases are intended for peer review and educational purposes only.
Case History

What’s with all the abdominal pain? There certainly has been a lot of patients with this complaint over the past week, and the next chart you pick up is no exception. You note that the patient is a 17 year old male with 12 hours of acute left sided abdominal pain. There has been no history of fever, vomiting, diarrhea, bloody stools, dysuria, or hematuria. He denies trauma. The pain has been waxing and waning, but can be quite severe. He states he even was on the verge of tears because of it. He tried Motrin, which helped some but did not revolve the pain completely. He states that he has never had this type of pain in the past. He states the pain is relieved by remaining still or laying on his right side. The pain itself if described as sharp, although sometimes crampy. He also tells you that he had a bowel movement several hours ago and this did not relieve the pain; he denies constipation.

You see from his chart that the patient has had an appendectomy a few years ago. He also has been treated for substance abuse. When you enter the room, you note that he appears very uncomfortable. He is grimacing from pain, which he describes as sharp and located on the left side. He is afebrile; his vitals are actually normal for his age; his weight is 100 kg. Strange, considering the pain he seems to be in (ie no tachycardia). Overall, his exam is unimpressive except for his abdominal examination. He is exquisitely tender to the left upper and left lower quadrants. He is guarding; there is no rebound, hepatosplenomegaly, or masses. His genital examination is normal. He does not have any CVA tenderness.

What’s going on here? This patient has very impressive left sided abdominal pain. Could he have a renal stone? Perhaps he has something wrong with his spleen, but he denies trauma and there is no history of sickle cell disease or coagulopathy. You don’t think that this is related to a urogenital issue, such was testicular torsion. Could be drug seeking? He does have a history of substance abuse.

As you start to think about what you might need to work this patient up, you consider whether or not he needs imaging.

Left Sided Abdominal Pain: Pediatric Considerations

The differential can actually by somewhat broad in children with left sided abdominal pain. Most of the time, constipation is the culprit, especially in pediatric patients. It’s helpful to think in broad terms about the differential diagnosis:

1. Gastrointestinal - constipation, colitis, inflammatory bowel disease, diverticulitis (older population, usually adults).
2. Genitourinary - renal stone, UTI, ovarian issue (torsion, cyst), testicular issue (referred pain from torsion), pregnancy (including ectopic), Pelvic Inflammatory Disease/STI, uterine disease (fibroids).
3. Trauma - splenic injury, bowel injury/hematoma, bowel perforation, retroperitoneal hemorrhage.
4. Other - psoas abscess, abdominal wall abscess, myositis.
Since 2013, Star Wars Day has been officially celebrated by the Walt Disney Company with events at Disney World and Disneyland. Disney, of course, owns the rights to Star Wars since 2012.

In 2011, the first Star Wars Day celebration took place in Ontario, Canada. Activities included a trivia contest, costume contest (of course) and web tribute films. Kinda wish I had gone...

So, you obtain IV access and given the patient some IV fluids as well as carefully giving him pain medications. You also obtain some basic bloodwork, since you’re placing an IV and the patient's oral intake has not been great today.

You decide to try some plain radiography of the abdomen; maybe he’s just really constipated. The films are shown on the left.

Obviously, because of the child’s age and size, several images are needed to get a complete view. The bowel gas pattern is nonspecific and non obstructive (red arrows); there is no pneumatosis. There is a normal amount of stool, no mass effect or obvious masses. He does have some minimal scoliosis (blue arrow). The visualized portions of the bases of the lungs look normal. The ribs are normal. The bones of the pelvis and the visualized portions of the femoral head and femur look normal.

Hmm… You go back to the patient and re-examine him, now that he’s had a little bit of pain medication. He is still in pretty bad shape; his pain, in fact, is pretty exquisite still, despite appropriate pain control. You decide to go back and take a look at the patient’s bloodwork, which has now resulted.

<table>
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<tr>
<th>Range</th>
<th>Color Coding</th>
<th>Additive</th>
<th>Type</th>
<th>Blood Draw</th>
<th>Tube Size (mm)</th>
<th>Clinical Use</th>
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<tr>
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<td>Red</td>
<td>Plain (No Additive)</td>
<td>Vacuum &amp; Non - Vacuum</td>
<td>4 ml</td>
<td>13 x 75</td>
<td>Serum Biochemistry, Drug Monitoring &amp; Sarum Immunology Test</td>
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<td>Yellow</td>
<td>Clot Activator with Gel</td>
<td>Vacuum &amp; Non - Vacuum</td>
<td>4 ml</td>
<td>13 x 75</td>
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<td>Purple</td>
<td>K3 EDTA K2 EDTA</td>
<td>Vacuum &amp; Non - Vacuum</td>
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<td>13 x 75</td>
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<td>2 ml</td>
<td>13 x 75</td>
<td>Glucose Test (Analysis of Blood Sugar)</td>
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<td>2 ml</td>
<td>13 x 75</td>
<td>Emergency Biochemistry &amp; Plasma Biochemistry Test</td>
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The patient’s blood results are somewhat unremarkable, but he does have a slightly interesting finding. You had obtained a CBC, CMP, and Lipase. All of this is normal except for a slightly elevated CBC (15, 600) with a very slight left shift (68% neutrophils). Still in pain…

Ever wonder what the various colors of specimen tubes are used for? Well, wonder no more. Here’s a handy guide to the most common ones:
The actor who played Obi-Wan Kenobi, Alec Guinness, thought of the Star Wars films as “fairy-tale rubbish.”

Despite this, he negotiated a deal to earn 2% of the gross box office receipts for the movies he appeared in, earning him over $95 million. FROM: buzzfeed.com

Like evil? Well, May 5th has come to be called “Revenge of the Fifth” Day, a pun on the Star Wars movie Revenge of the Sith. Good lord, when will it all stop?

Imaging in Pediatric Abdominal Pain:

We have covered imaging the pediatric patient with suspected appendicitis and other abdominal pain conditions. In this situation, it is highly unlikely that this child has appendicitis. For one thing, he has had an appendectomy in the past. For another, the history and physical examination are not consistent with appendicitis.

There are several options available when one considers imaging the pediatric patient with abdominal pain. For all patients, the decision to image should be based on history and physical examination. When appropriate, laboratory tests can help guide imaging choice as well. Often, based on all of these factors, imaging may NOT be needed.

Plain Radiography - easy, quick, painless, and yes, useful. Plain radiographs can provide information about what a patient’s bowel gas pattern looks like (normal vs abnormal/obstructive), stool burden, the presence of free air, and radio-opaque foreign bodies.

Ultrasound - also quick, available and painless. Great modality for looking for appendicitis (first choice), and intussusception in the younger population. US is also the first choice when there is suspected ovarian torsion or cysts, or testicular torsion, and is great for renal stones. It can also be useful in trauma (Editor’s Note: this can been covered in prior issues of the newsletter).

CT - available in most centers, but, of course, utilized ionizing radiation. Nonetheless, CT is useful for detecting trauma (hemorrhage, abdominal organ injury), can suggest ovarian torsion (an ovary that looks enlarged and ill-defined), find ovarian cysts, detect bowel inflammation (colitis, IBS), and abdominal masses. IV contrast is needed for the majority of studies (renal stones excluded), though, requiring and IV. The patient also needs to be as still as possible for an optimum study.

Due to the child’s persistent, unrelenting, and what appears to be severe pain, you decide to order a CT with IV contrast of the abdomen and pelvis. Selected images are seen to the left and below.

What?!? This 17 year old male has a CT examination that is consistent with diverticulitis. That’s somewhat unusual in this population. The question now, of course, is what to do next. Can he go home with outpatient management or does he need admission? How does one manage pediatric diverticulitis? Read on and find out….
Mark Hamill was in a bad car accident before filming started on Star Wars: Episode V - The Empire Strikes Back, causing severe facial trauma. The scene in which Luke Skywalker is mauled by a Wampa was added to account for the scarring on his face. FROM: buzzed.com

Anakin Skywalker/Darth Vader meets six of the nine diagnostic criteria for Borderline Personality Disorder, which is one more than is required to make the diagnosis. FROM: buzzfeed.com

**Diverticulosis vs Diverticulitis**

Diverticular disease is a significant cause of hospitalizations, but is not common in the pediatric population. A diverticulum is a protrusion of the colonic wall. Diverticular disease may be symptomatic or asymptomatic.

**Diverticulosis** - This is age dependent and increases dramatically with age (up to 60% prevalence by age 60 years). Western nations have a higher rate of diverticulosis worldwide and most diverticula are limited to the sigmoid colon, but they can be found in other parts of the colon. In Asian populations, diverticular disease is often found on the right side and can mimic appendicitis. While diverticula from any portion of the colon may bleed, right sided diverticula tend to bleed more seriously. Diverticula will develop at weak points along the colon, where the vasa recta penetrate the colon muscle layer. As diverticula herniates, then bleeding can results due to the vessel being positioned over the diverticula because the lumina of the vessel is thickened (intimal layer) and thinned (medial layer).

**Diverticulitis** - Up to 15% of patients with diverticulosis will develop diverticulitis. This will increase with age, just as the prevalence of diverticulosis does. Also like diverticulosis, diverticulitis is much more common on the left side in Western nations, and on the right side in Asian nations. The underlying pathology of the development of diverticulitis is micro-perforation of a diverticulum. Diverticular obstruction was also once thought to be a cause of diverticulitis, but this is now considered a rare event. The perforation is usually small and localized.

**Meckel’s Diverticulum** - the most common congenital abnormality of the small intestine. The underlying pathology is incompletely obliteration of the omphalomesenteric duct. These diverticula can be asymptomatic, but the most common complication of a Meckel’s is bleeding. Most Meckel’s diverticula occur on the anti mesenteric border of the ileum. The famous Rule of Two’s is used to remember some pathological aspects of Meckel’s Diverticulum: 2 feet from the ileocecal valve, 2 cm wide, often presents around or before 2 years of age, and is found in approximately 2% of the population. This typically presents with painless rectal bleeding.

**Risk Factors for Diverticulosis**

Diet - the role of diet is not clear, but research has suggested that a low fiber diet puts one at risk. The same is true for red meat. Seeds/nuts are not associated with the development of diverticular disease!

Obesity - has been associated with an increase in the development of diverticular disease.

Lack of physical exercise.
The phrase “I have a bad feeling about this” is said in every film.

FROM: buzzfeed.com

Imaging Choices and Treatment: Diverticulosis and Diverticulitis

Diverticulosis can be found on IV contrast enhanced CT scanning. They are usually outlined by gas and the colon may have thickened appearance.

**Diverticulosis**

Diverticulosis is usually found incidentally on an imaging test or colonoscopy done for other reasons. Since diverticulosis can be (and usually is) asymptomatic, no treatment is required. Some gastroenterologists recommend a modified diet containing high fiber content and the avoidance of certain foods (nuts and seeds for example), in order to help avoid the development of diverticulitis, but there is not much literature to support this practice.

**Diverticulitis**

Diverticulitis is usually found on an IV contrast-enhanced CT scan of the abdomen. In Pediatrics, this can may be done for other reasons, as in our patient, where he had a CT because of persistent and rather unusual pain. CT is the imaging modality of choice for diagnosing diverticulitis. Features on a CT scan include:

1. Segmental thickening of the bowel wall.
2. Colonic wall enhancement.
3. Diverticular perforation.

There is proposed classification of Acute Diverticulitis:

- **Stage 1a:** phlegmon
- **Stage 1b:** diverticulitis with pericolic or mesenteric abscess
- **Stage 2:** diverticulitis with walled off pelvic abscess
- **Stage 3:** diverticulitis with generalized purulent peritonitis
- **Stage 4:** diverticulitis with generalized faecal peritonitis

This is called the Hinchey Classification.

Treatment for localized disease includes IV antibiotics and IV fluids. In patients with more complex disease or if the patient has progressively worsening symptoms, then surgery is indicated. Both inpatient and outpatient treatment options. Patients with complex disease (abscess, perforation) or patients who are ill-appearing, or can't tolerate po, or whose pain can't be managed without IV medications should be admitted.

**Imaging Choices and Treatment: Diverticulosis and Diverticulitis**

Johann Meckel (1781 - 1833) was an anatomist, zoologist, and pathologist, who was also a pioneer in the science of teratology. Not only is he associated with Meckel’s Diverticulum, he is also described (along with Johann Gruber), Meckel-Gruber Syndrome.
Teaching Points

1. Left sided abdominal pain often has a limited differential in pediatric patients and, while constipation is a common etiology for this symptom, keep in mind less common causes, especially in the context of severe or uncontrollable pain.

2. Diverticulosis is more common in the older population, but can present in children. Diverticula are sac-like protrusions of the colonic wall. Mickey diverticulum is the more common manifestation of diverticular disease in children, the cardinal symptom of which is painless rectal bleeding.

3. The development of diverticula (non Meckel’s) is likely multifactorial. The role of diet is still yet to be determined, but obesity and lack of exercise seem to be involved.

4. Diverticulitis is a complication of diverticulosis. This condition may be managed either with an outpatient or inpatient plan. Bowel rest, hydration, and antibiotics (oral include Amoxicillin, Bactrim + Metronidazole, or Ciprofloxacin + Metronidazole; IV include Zosyn or Cefotaxime + Metronidazole). In complicated cases (ie perforation), surgery is indicated.

5. Imaging options for diverticulosis include CT scanning, which can identify perforations and abscesses. CT is usually reserved for cases of perforation, etc.

References


Case Resolution

The child was admitted to the Pediatric Inpatient Service, since his pain was difficult to manage, despite appropriate IV medications. He was placed on bowel rest, IV fluids, and IV antibiotics (Zosyn). A Pediatric Gastroenterology consult was obtained. Given the history, physical examination, and CT findings, the diagnosis of diverticulitis was supported. After adequate hydration, the child’s pain improved and he was able to ambulate, as well as take oral fluids. His diet was advanced as tolerated and he was also transitioned over to oral antibiotics (Augmentin). He was able to be discharged on the second hospital day with instructions to complete a total 2 week course of antibiotics, and Pediatric Gastroenterology followup.

Teaching Points

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5. Imaging options for diverticulosis include CT scanning, which can identify perforations and abscesses. Diverticula can be seen on contrast enemas as well. Imaging options for Meckel’s Diverticulum include a Meckel’s scan, and in some cases, CT with IV contrast.

References


9. radiopaedia.org, internet content.