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.

This Month: We see a lot of abdominal pain in the ED and in Pediatric practice. We’ve covered many disease processes previously in the Newsletter presenting with abdominal pain. In this issue, we encounter a child with ALL who is presenting with acute, severe, abdominal pain. Is it surgical? Is it medical? Is it unusual? Read on...

A Special Thanks for Dr Whitney Irwin (PEM Fellow) with contributions to this (and future) issues!
Case History

This is an 11 year old female with a complex medical history. Two years ago she was diagnosed with Acute Lymphoblastic Leukemia. She has been treated and followed by Pediatric Oncology ever since then and, after completing induction chemotherapy and an appropriate protocol to her illness (turns out it was Pre B Cell ALL), she is currently on maintenance therapy. She was recently admitted to Dell Children’s Medical Center for UTI. The causative organism was Enterobacter and at that time, her clinical presentation consistent of back pain, dark colored urine, and fever. She was treated successfully with Ciprofloxacin and did well. She continued on her ALL treatment protocol and she received her latest round of medications about one week ago (Methotrexate and steroids). She also has a history of recurrent HSV stomatitis and is on Valacyclovir.

She presents to the Emergency Department during the evening with a complaint of acute, severe, persistent abdominal pain. The pain is described as generalized. In addition to the abdominal pain, she also developed a fever of 102. She seemed to be less active and told her family she felt dizzy. The family notified EMS who brought the child to the Emergency Department. There has been no cough, congestion, or diarrhea. There are no sick contacts at home. She had been taking po well, but this has diminished over the course of the day and she developed non bilious emesis prior to presentation in the ED. She denies dysuria or hematuria.

In the Emergency Department, you note that the child appears to be very uncomfortable and, while not toxic, clearly is not feeling well. Her vital signs are: Temp 101 HR 110 RR 22 BP 80/50. Her physical examination is remarkable to diffuse abdominal tenderness with some guarding and rebound throughout, but especially on the lower right. There is no obvious hepatosplenomegaly or abdominal masses. There are periods where the pain seems to diminish but it never goes away completely and she is in overall a significant amount of pain. Her perfusion is good, with brisk cap refill. Her lungs are clear and there are no rashes/lesions to her skin. Her port site looks good. The rest of her exam is unremarkable.

Because of the fever and known neutropenia of the child, as well as her vital signs, she placed on the DCMC Sepsis Protocol. You give her an NS bolus, and initiate antibiotic therapy. You also wonder if an imaging test is appropriate. If so, which one? And what are you looking for?
Pediatric Sepsis is a clinical entity that is noted by a constellation of symptoms and is something that pediatric care providers are becoming more aware of. There are several groups that seek to promote the rapid recognition and treatment of a child with sepsis. The more quickly an appropriate treatment regimen is initiated, the more likely a child will survive this potentially catastrophic syndrome.

Children with neutropenia are at particular risk. Below is the DCMC ED Sepsis Pathway:

Antibiotics

Antibiotic choices vary, but for the most part the typical agents that are used are:

1. Ceftriaxone (75 mg/kg)
2. Cefepime (50 mg/kg)
3. Vancomycin (15 mg/kg)

Children are risk stratified according to their underlying conditions, if any, that may affect their immunologic risk (normal, intermediate, or high). Oncology patients usually are given Cefepime (or if they are discharged, Ceftriaxone). Vancomycin is added in ill-appearing children. Patients with cephalosporin allergies are usually given Aztreonam plus Vancomycin; if they are toxic, then Meropenem is given plus Vancomycin. A normal saline bolus is given and may be repeated twice if needed.
The child’s port a cath is accessed by the ED RN staff and fluids are begun. You note that her blood pressure is slightly low, another good reason to utilize the sepsis protocol. You order antibiotics (Cefepime) and contemplate the abdominal pain. Could this be surgical? Could it be infectious? You decide to plain imaging of the abdomen to get an idea if there is free air, obstruction, etc. The results are to the right:

This is a pretty unremarkable supine abdominal view. While it is preferred to have obtained a 2 view study, sometimes this is not practical to obtain. The bowel gas pattern is non obstructive (purple arrows), the visualized lung bases look clear (yellow arrows), and there is some stool (white arrow).

You decide to obtain a CT, since the child is in severe pain. Selected images are shown here. There is inflammation of there cecum and ascending colon (red arrows). There is no abscess or appendicitis. There is no obstruction.

These CT findings are consistent with typhilitis, otherwise known as neutropenic enterocolitis. This child needs to be admitted and begun on IV antibiotics. Her blood pressure is concerning, so IV fluids need to be continued as well. Typhilitis is
Abdominal Pain: Differential Diagnosis for this Patient

As always, there are other disease entities to consider in this child. Certainly appendicitis is a concern, especially since the child’s pain appears to be primarily on the right. Additionally intestinal obstruction can present in this manner. Finally, consider good ol’ viral illness, which can cause abdominal pain due to enlarged lymph nodes (mesenteric adenitis).

Neutropenic Enterocolitis

This illness occurs, as you would guess, primarily in neutropenic patients. It can be life-threatening. It's pathogenesis is not completely understood, but may be multifactorial:

1. Mucosal injury by cytotoxic drugs.
2. Profound neutropenia.
3. Microorganism invasion

Originally, this condition was described in children who underwent induction chemotherapy but has been reported in patients with any condition that lends to neutropenia, including immunodeficiency disorders and even drug-induced neutropenia. The true incidence is unknown, though, the condition seems to have been increasing with the use of cytotoxic agents to treat malignancies. Cytotoxic agents can damage the gastrointestinal mucosa, which is a direct risk factor for the development of enterocolitis.

Organisms associated with neutropenic enterocolitis include gram-negative bacilli, gram-positive cocci, anaerobes, and Candida. Pseudomonas and Escherichia coli can be particularly virulent. Clostridium septicum has been associated with a fulminant course and is associated with a high mortality rate (well, with a name like C. septicum, what would one expect?).

The cecum is usually involved, with extension to the ascending colon. There is bowel wall thickening, edema, and, in some cases, necrosis. This produces symptoms of fever and abdominal pain. The location of the pain is often right sided/right lower quadrant, but this depends on the location of the inflammation. There is often nausea, emesis, diarrhea; paralytic ileum can also be present but not typically. Many patients also have stomatitis or other oral lesions (as our patient did).

Imaging

CT is the gold imaging standard. Findings include bowel wall thickening, bowel dilatation, pneumatosis, and mucosal enhancement. IV contrast is indicated in these patients.

Plain Radiographs are usually nonspecific, but can identify dilate bowel loops, edema, and pneumatosis.

Management

Usually medical (IV antibiotics, bowel rest, hydration), but in cases of an abscess, free air, bleeding, or clinical deterioration, surgical exploration for possible resection is indicated.
Case References


Teaching Points

1. In children with known neutropenia who present with fever an abdominal pain, consider a variety of etiologies, including viral syndrome/mesenteric adenitis, appendicitis, and neutropenic colitis.
2. Neutropenic colitis, aka typhilitis, can be a life-threatening disease that needs prompt evaluation, recognition, and treatment. The exact etiology remains not well understood, but mucosal edema and inflammation are an underlying issue.
3. Polymicrobial infection is typical of neutropenic colitis. Antimicrobial regimens should be active against a variety of bacteria, including Pseudomonas species, E coli, and anaerobic organisms. Cefepime plus Metronidazole is a good initial regimen.
4. Imaging for children with suspected neutropenic colitis can include plain radiography, but abdominal/pelvis CT with IV contrast is the gold standard.
5. Additional treatment includes IV fluid hydration and bowel rest. Length of antimicrobial treatment is dependent upon resolution/improvement of the child’s neutropenia, pain, and ability to tolerate po (usually 14 weeks oral antimicrobials after IV therapy).

Case Resolution

This child was admitted to the Pediatric Oncology unit after IV fluid resuscitation, which resulted in improvement in her blood pressure. Her WBC count on admission was 0.3 (ANC of 42), with H&H of 5.2/14.5 and a platelet count of 61. She was continued on Cefepime, but Flagyl IV was also added to her antimicrobial regimen. She was also placed on bowel rest. Her fever persisted, and repeat blood cultures were obtained, but after the second day of hospitalization, the fever subsided. Pediatric Infectious Disease was also consulted to help guide antimicrobial therapy. In addition to the aforementioned medications, she was started on Acyclovir, due to her oral lesions (and her history of recurrent HSV stomatitis). She was slowly advanced to clear liquids and TPN was begun while waiting for her counts to improve. She was able to advance her diet. Her abdominal pain resolved and she remained afebrile. Her counts did improve and she was able to advance her diet further, tolerating po well without abdominal pain. Her cultures remained negative. There was no diarrhea, so still cultures were not available.