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ACUTE APPENDICITIS

Developed by Christina Ray and Dr. Troy Turner for PedsCases.com.
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Introduction

Hello and welcome to Peds Cases Podcasts. My name is Christina. I am a medical student at the University of Alberta, and today I will be discussing acute appendicitis. This podcast was made with the help of Dr. Troy Turner, a pediatric emergency physician at the Stollery Children's Hospital.

The learning objectives for this podcast include:

1. Discuss the epidemiology, the pathophysiology and complications of appendicitis
2. Describe clinical presentation of appendicitis in children
3. Review the differential diagnosis of acute abdominal pain in children
4. Present an approach to investigating a pediatric patient with suspected appendicitis, including scoring systems
5. Briefly review the management of appendicitis

Let's start with a case:

You are a 4th year clinical clerk on your pediatric emergency elective. Henry, a 5-year-old boy is brought in by his mother with complaints of tummy pain and a low-grade fever. Upon further questioning, his mother states he began complaining of stomach pain yesterday morning and his forehead felt a little warm, but otherwise he seemed to be alright. He didn't eat much at dinner that night because he said he felt sick and went to bed. He then woke her up early this morning vomiting and holding onto his stomach in the lower right area, so she decided to bring him to the emergency room.

Etiology and Epidemiology

Before we continue with the case, let's discuss the epidemiology and etiology of appendicitis. Acute abdominal pain is one of the most common presentations in the emergency room (1) and appendicitis should always be considered on the differential, as it is one of the most common indications for abdominal surgery in children (2 - 3). The average lifetime risk of developing appendicitis is 7-9% and it peaks in the late teens (3 - 4). While acute appendicitis is fairly uncommon in preschool age children and infants, it is still very important to consider in your differential diagnosis (3).

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The appendix is a small tube-like structure extending off the first part of the large intestine called the cecum (3); inflammation of this structure is what we call appendicitis. In many cases, appendicitis is caused by non-specific obstruction of the appendix, such as a fecolith (which is a stone made of feces), or a rotation/twist of the appendix (3). Just like the rest of the GI tract, the appendix is filled with normal bacterial flora; however, when it gets blocked, bacteria can proliferate and break down the mucosal layer, invading the walls of the appendix leading to inflammation (3).

Complications

The prompt diagnosis of appendicitis is important to prevent complications that may arise such as perforation or intraperitoneal abscess formation which are known to cause increased morbidity and mortality (5). One study found that younger age, longer duration of symptoms and elevated C-reactive protein are highly associated with increased risk of perforated appendix (2).

Clinical Presentation

Let's now talk a bit more about its presentation in children. Typically, appendicitis presents over hours to days. Early symptoms include anorexia, followed by periumbilical or epigastric pain that migrates to the lower right quadrant. It is important to be aware that the tip of the appendix may be retrocecal or pelvic, so the patient may not present with pain in the classic location instead presenting with flank or upper right quadrant pain. Associated symptoms include nausea and emesis, which tend to come after the onset of abdominal pain, and low-grade fever (3). Diarrhea is a common symptom of appendicitis in children <5 years old (2).

Looking at our case, there are a few key clinical features that should make you put appendicitis on your differential diagnosis for Henry: an acute presentation of fever, anorexia, periumbilical pain that migrates to the lower right quadrant and vomiting (6). In this case, Henry presents with all of these features making the diagnosis more likely, however, many of these symptoms are common to other etiologies (1). For example, diarrhea is a common symptom of appendicitis in children <5 years old, but also common to gastroenteritis (2). Combine these common features with the difficulty in performing a history and physical exam on a young child that cannot verbalize their pain, the diagnosis of appendicitis can often be difficult (1).

If the child is old enough to answer, some helpful questions to ask on history to elicit these findings could include: "Do you feel hungry? Have you eaten any meals recently? Is the amount you have eaten in the last day different from how much you normally eat? (anorexia). Can you point with one finger to where it hurts? (periumbilical or RLQ pain). Did the bumps on the road driving to the hospital cause pain? Have you thrown up recently? (vomiting) (7).

Physical Exam

After getting the history from Henry's mom, you move on to the physical exam. How will you approach the physical examination?

Start the examination by assessing the general appearance of the child to determine whether the child looks well or unwell (8). A full set of vital signs, including temperature should always be taken in a child presenting with acute abdominal pain (7). Pay close attention to the heart rate and blood pressure. Tachycardia may be due to pain and/or dehydration. Hypotension may indicate a more severe clinical presentation due to dehydration, or potentially perforation. While the primary goal of the abdominal exam is to identify the location of the pain, you must use a systematic approach to ensure a key finding is not missed (7). Start with inspection of the abdomen, looking for any bulging flanks or visible peristalsis (8). Next move to auscultation and percussion of the abdomen, assessing bowel sounds and hyperresonance or tenderness respectively (8). Next, move on to palpation, starting with light then deep palpation in all quadrants of the abdomen (7). Signs we look for on palpation include rigidity, an involuntary contraction of the abdominal muscles (which indicates widespread peritonitis) or rebound tenderness, an increase in pain when the examiners hand is quickly removed from the abdomen (which indicates focal peritonitis). If these maneuvers are likely to cause too much pain, shaking the bed or having the patient cough can also elicit signs of peritonitis (7-8). It is important to note that the signs of peritonitis are often not present with early disease and instead may indicate complications such as perforation (2). Pain at McBurney's point, one-third of the distance between the anterior superior iliac spine to the umbilicus can indicate appendicitis (8). Other special tests that may be positive with appendicitis include: Rovsing sign (pressure applied to the lower left quadrant and causes pain in the lower right quadrant), the psoas sign (with patient lying in their left side, extend right hip - it is positive if it causes pain in the lower right quadrant indicating a retrocecal appendix) and obturator sign (flexion and internal rotation of the right hip causes pain if positive indicating pelvic appendicitis) (2, 8).

In order to rule out other causes of acute abdominal pain, a pelvic examination should be done in sexually active females and a genital examination in males (7).

Your physical examination of Henry yields the following: no bulging or visible peristalsis, normal bowel sounds, tenderness at McBurney's point and rebound tenderness in the lower right quadrant. He also has a temperature of 39°C.

Differential Diagnosis

Now that we have a thorough history and physical exam, we need to consider other possible diagnoses that could be responsible for Henry's presentation. The differential will change depending on the age and the gender of the child (7). For example, in a 16-year-old female presenting with acute abdominal pain, you would want to consider gynecological causes like ectopic pregnancy, ovarian cyst rupture or pelvic inflammatory disease; in a 5 year old boy presenting with the same symptoms, gastroenteritis, urinary tract infection, testicular torsion, obstructed hernia or intussusception should be considered (3). Depending on the location, severity and character of the pain, other etiologies to consider include mesenteric adenitis,

constipation, bowel obstruction/perforation, inflammatory bowel disease, or pancreatitis. Remember, abdominal pain may be due to extra-abdominal causes like a lower lobe pneumonia, sickle cell disease, Henoch Schoenlein purpura, or diabetic ketoacidosis.

Investigations

If the findings on the physical exam are suggestive, a complete blood count (CBC) and C-Reactive protein (CRP) should be ordered (2). While the CRP and white blood cell count may be elevated in appendicitis, they are non-specific findings and thus are not diagnostic (2). There is controversy surrounding the use of CRP in diagnosing appendicitis and some authorities recommend that it not be ordered routinely (9). Urinalysis should be done to rule out urinary tract infection. Hyperbilirubinemia can be a helpful indicator for complications such as perforation. Another important cause of periumbilical abdominal pain is pancreatitis, so you may consider ordering a serum lipase to rule this out (8). Acute appendicitis is a clinical diagnosis; however, blood work may be used as an adjunct, and to rule out other etiologies. Imaging can also be helpful in the diagnosis if the physical exam findings are not reliable.

Modalities such as ultrasound, CT or in some cases MRI can be used (6). While ultrasound is readily available and low cost, it is user dependent and may not be adequate to detect appendicitis (4). CT is more sensitive and specific, but there is always a risk associated with exposing a child to ionizing radiation (6). In the end, whether or not you get imaging depends on the examination of the child and the surgical team you will be working with to manage the patient (Dr. Turner).

Risk scores have been developed to help estimate whether a child has appendicitis such as the Alvarado score and the Pediatric Appendix Score (PAS) (4). These scores help stratify patients into low, medium or high-risk groups, which help determine the next steps for management -- low risk can be investigated for non-appendicular causes, medium for further observation and high risk can have surgical assessment sooner (3). Studies have found that these risk scores in isolation are not sensitive or specific but can help identify patients that may benefit from further imaging (6).

Many pediatric emergency rooms have management pathways available as a resource to help walk you through the next steps of management. For example, Sick Kids Hospital in Toronto has a pathway once the diagnosis of appendicitis has been made (12) and the Children's Hospital of Philadelphia has one you can follow when appendicitis is suspected but has not been diagnosed (13).

Management and Treatment

Once the diagnosis of appendicitis has been made or you have a high clinical suspicion, pediatric general surgery should be consulted. The patient should be made NPO to prevent delays in surgical intervention and antibiotics are started prior to surgery. (4). Of note, there is evidence that if a child has received antibiotics prior to the diagnosis, it can change their clinical presentation, therefore making it more challenging to diagnose (14). The treatment for

appendicitis is a laparoscopic appendectomy, but it may be converted to an open surgery in some cases (4). If there was a complication such as perforation or abscess formation, the patient may need to complete a course of oral antibiotics after surgery. Post-surgical complications can include surgical site infection, intra-abdominal abscess formation, bowel obstruction or sepsis (4). Thorough patient and family education of the signs and symptoms of these complications should occur prior to discharge.

Henry is assessed by the surgical team and they agree that he should have an appendectomy. Antibiotic prophylaxis is given, and he is taken to the OR. He stayed in hospital for 4 days and was then discharged home and told to follow up with the surgeon in 3 weeks. There are no complications following the surgery and he lives a normal healthy life.

Conclusion

Let's review some of the important facts discussed in this podcast on appendicitis

1. The appendix is a tube-like structure connected to the cecum and when it gets blocked, bacteria can proliferate leading to inflammation. Complications include perforation and peritoneal abscess formation.
2. The classic presenting symptoms of appendicitis include anorexia, vomiting, fever and periumbilical pain that migrates to the right lower quadrant
3. It is important to keep a broad differential diagnosis in mind when seeing a child with abdominal pain. Consider gastrointestinal, genitourinary and gynecological etiologies, making sure that the differential is tailored to the age of the patient.
4. Appendicitis is a clinical diagnosis. Investigations such as a CBC, CRP or imaging modalities such as ultrasound or CT, may be used as adjunct.
5. Appendicitis is most commonly treated with a laparoscopic appendectomy.

Thanks for tuning in, I hope this podcast makes you more confident when approaching a pediatric patient with suspected appendicitis. This concludes the podcast.

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