

ROCKY MOUNTAIN PEDIATRIC SURGERY

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Appendicitis

What Is the Appendix and Appendicitis?

The vermiform ("worm-shaped") appendix is a thin tube of bowel attached to the beginning of the large intestine or colon. This first part of the colon is called the cecum, and is situated in the right lower region (or "quadrant") of the abdomen. Although attached to the cecum, the appendix has the ability to rotate freely, and while frequently found below and in front of the cecum, it can also be hidden behind the cecum, down in the pelvis, or even tucked up near the gallbladder. The appendix has no function in the human, but if infected requires surgical removal.

One in every 13 to 14 individuals in the US will develop appendicitis in their lifetime. While children of any age can develop appendicitis, there seem to be two "peaks" in the ages, centered around 9 and 18 years. Many common diseases (gastroenteritis, streptococcal throat infection, upper respiratory tract infections, etc.) share the same symptoms as appendicitis. Thus, it is not unusual to see over 30% of appendicitis present already ruptured (perforated) even if the patient has been evaluated by medical personnel. The risk of perforation seems even higher in younger children, probably because they have more trouble conveying their symptoms.

What Causes Appendicitis?

The appendix is essentially a hollow tube, blind at one end and opening into the cecum at the other end. As long as the appendix is able to discharge the mucus it produces and eliminate any fecal material that enters it, there is no problem.

Appendicitis occurs when something blocks the opening and the material in the tube cannot empty. While there are many causes, the most common obstruction occurs when a piece of hard stool gets caught at the neck of the appendix. Occasionally, lymph tissue that is normally in the wall of the intestine enlarges (probably in response to a viral infection) and obstructs the lumen. Very rarely, a tumor may be found as the source of obstruction.

However it happens, the obstruction causes an increase in pressure from the trapped mucus and the gas produced by the bacteria. Bacteria overgrow and then invade the lining of the appendix and causes inflammation. This inflammation leads to more swelling, more infection, and decreased blood flow to the appendix. Eventually this cycle of inflammation, swelling, and pressure will weaken the wall of the appendix and it ruptures, spilling infected fluid into the abdomen. If the infected material remains confined to the area of the appendix then an abscess forms. The danger of bacteria gaining access into the blood stream and causing sepsis is always a concern whether the perforation is contained or not.

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What are the Signs and Symptoms of Appendicitis?

The most common symptom of appendicitis is abdominal pain, usually beginning in the umbilical (bellybutton) region and then migrating to the right lower portion of the abdomen. The child may lose his/her appetite and may feel warm indicating a mild fever. After 24 to 48 hours, the pain worsens as does the fever. Vomiting (and occasionally diarrhea) may be seen. Activity is painful, and the child may prefer to lie in a fetal position, and, when walking, adopt a characteristic hunch and limp. If the appendix should rupture, there may be a short period when the pain appears to lessen but this is short lived and the pain returns in much greater intensity. A high fever with chills may occur. Pain may occur with urination.

The primary finding is pain with pressure on the right lower quadrant of the abdomen. The tenderness may be in the flank if the appendix is located behind the cecum. Occasionally, pain seems rather non-localized if the appendix hangs into the pelvis. Depending on the location, flexing and outwardly rotating the leg may worsen the pain. Inflammation of the appendix may cause abdominal pain if one jars the heel of the right foot. If the appendix has been ruptured for several days, an abscess mass may be felt in the abdomen or on rectal examination.

What Other Illnesses Can Look Like Appendicitis?

Many diseases mimic appendicitis. The most common is gastroenteritis, usually of viral origin. It presents with diarrhea, abdominal pain, vomiting and fever. Streptococcal pharyngitis and upper respiratory infections cause a generalized lymph node enlargement which may cause pain in the lower abdomen. Pneumonia may also produce abdominal pain. In female patients, the menstrual cycle, ovarian cysts, and pelvic inflammatory disease all have abdominal pain with or without fever. Urinary tract infections cause pain in the flank similar to the pain caused by a retrocecal appendix. There are also unusual disorders such as Meckel's diverticulitis, pancreatitis, perforated peptic ulcers, and inflammatory bowel diseases which present with abdominal pain. Thus, while appendicitis is common, definitive diagnosis can be challenging. Sometimes the most appropriate and safest method of diagnosis is surgery.

What Studies need to be performed to Diagnose Appendicitis?

- **Often laboratory tests are helpful in diagnosis, but the results cannot definitively identify appendicitis.** Often blood is drawn to determine the white blood count which may indicate the severity of an infection as well as help distinguish between bacterial and viral processes. The blood level (hemoglobin/hematocrit) and blood chemistries will indicate if there are hydration and electrolyte imbalances, which can accompany illness and may require treatment prior to surgery. A urinalysis may be performed to rule out urinary tract infections and assess the level of dehydration.
 - **X-ray and Ultrasound studies** may include three views of the abdomen looking for a "fecalith", a calcified piece of stool blocking the appendix, seen approximately 30% of the time, and free air which indicates perforation. Ultrasound of the abdomen may identify the fecalith with an enlarged appendix or should the appendix be ruptured, the site of an abscess. Ovarian cysts may be detected by ultrasound. One advantage of ultrasound is that it avoids radiation.
 - **The most definitive study is the computerized tomography (CAT scan).** This allows an examination of all the abdominal organs and is particularly useful in appendicitis. Unfortunately it requires radiation exposure, injection of dye, and the instillation of intestinal contrast material. For this reason, we recommend that CAT scans be reserved for cases where the diagnosis is unclear or where the result could change the treatment.
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- **No laboratory value or x-ray examination is foolproof.** We do not have definitive tests for appendicitis. The physical examination often provides the most important information and the most obvious reason to pursue surgery.

What is the Treatment Course for Appendicitis?

Classic History and Physical Findings of Appendicitis

- Your surgeon may only get blood work, deciding to forego imaging studies. Generally, children with appendicitis are somewhat dehydrated and require 2 to 4 hours (or more) of rehydration before surgery. Antibiotics may be given in suspected cases of rupture. It is far safer to properly prepare the child with fluids and antibiotics than to rush to an operation.

Unlikely Appendicitis

- **Your child may be allowed to go home.** Obviously, should the pain persists or worsens, the child must be reevaluated.
- Your child may also be admitted on an observational status and the abdominal examination, laboratory tests, and imaging studies repeated in 6 to 8 hours. Almost without exception, appendicitis is a progressive disease and, without antibiotics, will progress and worsen.
- Antibiotics should be avoided until the diagnosis of appendicitis is determined as antibiotics will modify the course of illness, mask an infection, and could delay definitive therapy.

What is the Surgical Treatment?

- **The two methods for removing an appendix include open or laparoscopic surgery.** We recommend laparoscopy since the small incisions minimize pain and speed recovery.
 - On rare occasions, if the intestine is markedly distended, or a long-standing perforation has caused intestinal adhesions to the abdominal wall, or an abscess obscures the tissue planes, an open procedure may be needed. In the great majority of cases, the operation will be performed laparoscopically. This procedure involves placing three small incisions. The surgery is performed using long instruments and observed by a fiber optic camera. Your pediatric surgeon is well experienced in performing laparoscopic appendectomies, and most operations take 20 to 60 minutes.
- **If the appendix is simply inflamed, not ruptured,** then it is removed. The child is discharged when oral intake is adequate. Most children need around 24 hours in the hospital.
- **If the appendix is perforated and infection has leaked into the abdomen,** the appendix is removed and the fluid is suctioned away. These patients require a longer hospitalization to receive IV antibiotics and observation. Patients may have a restricted diet initially that is gradually expanded as they tolerate more solid foods. Hospitalization times range from 48 hours to a week or more.
- **In unusual circumstances, the ruptured appendix has formed an abscess in the pelvis or abdomen of such size as to preclude the immediate removal of the appendix.** In such instances, the abscess may be first drained, either abdominally or transrectally, and allowed to resolve. Once the fever has settled and drainage stopped, the drain is removed. At a later date (usually about 6 weeks), an appendectomy is performed (called an "interval appendectomy") as recurrent appendicitis is possible. During this period, antibiotics are usually administered through a PICC line.

What are the Post-Operative Complications and Long-term Concerns?

- **Any child undergoing general anesthesia and surgery has the small risk of reaction to the anesthesia and medications, bleeding, and infection.** The laparoscopic technique also has the very small risk of bowel
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injury and other organ injury. The major complication after appendectomy is infection, either of the incision (a wound infection) or within the abdomen (a postoperative abscess).

- Parents are always cautioned to contact our office if the child develops a fever, vomiting, new abdominal pain or other symptoms after leaving the hospital. If the wounds appear red or if pus is seen in the wounds, the child should be seen. While an intra-abdominal abscess is most common after perforated appendicitis, an abscess can form in any patient who has had appendicitis. Should an abscess develop, it must be drained. Often abscesses (if appropriately located) may be drained by the radiologist without the need for repeat surgery and general anesthesia.
- **Any surgery or significant perforation may cause scars**, also known as adhesions, to form within the abdomen. This is normal for everyone. Unfortunately, such scars may cause intestinal obstruction (<3%), which will be reflected by yellow green vomiting and which can manifest days, weeks, or years after the operation. Any child with green vomiting should be evaluated by a surgeon.
- **In general, approximately 10% of children who undergo an operation for appendicitis will not have appendicitis.** This reflects the difficulty in making a definitive diagnosis of appendicitis when there are many other diseases which mimic its symptoms, signs, and physical findings. Again, we do not have one blood test or one x-ray study that is 100% accurate in diagnosis. The complications of appendicitis is perforation, abscess formation, and sepsis which can be life threatening. In order to prevent these complications, appendicitis needs to be caught at its early stage. When operating early, one must accept that the occasional patient who has all of the characteristic symptoms, signs, physical findings, and even imaging findings, may not have appendicitis. However, if one waits until the diagnosis of appendicitis is obvious; it may be too late to prevent perforation or abscess.
- **Appendicitis, while a common disease, can cause serious illness.** Sometimes the patient with perforated appendicitis and an abscess has a slow recovery, testing the patience of anxious parents. Nevertheless, unless the child has some immune deficiency and succumbs to an overwhelming infection, patients with appendicitis, regardless of severity, ultimately do well.

***Disclaimer:** Your child's condition is unique. The information contained on this web site is not intended to substitute for advice from a doctor or nurse. If you are unsure about any aspect of your patient's care, please contact us at 303-839-6001, or talk to your pediatrician.*

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