

## Patient Care > Appendicitis

### Introduction

**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. There are no non-surgical treatments for appendicitis.

**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.

### Cause

The appendix is essentially a hollow tube, blind at one end and opening into the cecum. As long as the appendix is able to discharge the mucus it produces and any fecal material that enters the appendix also leaves, there is no problem. Appendicitis occurs when something blocks the opening and the material in the lumen cannot empty. While there are many causes, the most common is a piece of hard stool getting caught at the neck of the appendix. Similarly, other foreign bodies may also obstruct the opening. Occasionally, lymph tissue that is normally in the wall of the intestine enlarges (probably in response to a viral infection) and encroaches on 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-which 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.

### Symptoms & Signs

**The most common symptom of appendicitis is abdominal pain, usually beginning in the umbilical 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. Moving hurts, 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 on palpation of the abdomen in the right lower quadrant. The tenderness may be in the flank if the appendix is located behind the cecum. Occasionally, pain seems rather nonlocalized if the appendix hangs into the pelvis. Depending on 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.

## Differential Diagnosis

**A myriad of 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 just as a retrocecal appendix would. These are the common disorders which make diagnosis of appendicitis difficult. There are also unusual disorders as Meckel's diverticulitis, pancreatitis, perforated peptic ulcers, and inflammatory bowel diseases, etc. which present with abdominal pain. Thus, while appendicitis is common, definitive diagnosis can be challenging; sometimes the surest, safest method is to operate.

## Laboratory and X-Ray Studies

**Initially, blood is drawn to determine the white blood count** which may indicate the severity of the infection as well if the infection is of bacterial or viral origin. The blood level (hemoglobin/hematocrit) and blood chemistries will give an indication of hydration and electrolyte imbalance which will need correction for surgery. The urinalysis may indicate a urinary tract infection and the level of dehydration.

**X-ray 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 (indicating perforation). The chest x-ray may reveal a pneumonia. Ultrasound of the abdomen could find 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.

**No laboratory value or x-ray examination is foolproof.** We do not have a definitive test for appendicitis. The physical examination is often the determining factor of recommending surgery.

## Treatment

**If your child has the classic history and physical findings of appendicitis,** your surgeon may only get blood work, deciding to forego x-ray studies. Generally, children with appendicitis are somewhat dehydrated and require 2 to 4 hours (or more) of rehydration before surgery. An antibiotic or antibiotics may be given depending on the level of suspicion if the appendix has ruptured. It is far safer to properly prepare the child with fluids and antibiotics than to rush to operation.

**If the diagnosis of appendicitis is unlikely, the 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 determinations, and x-ray 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, mask appendicitis, and delay definitive therapy.

**The surgical treatment of appendicitis may be performed open or by [laparoscopy](#).** We recommend laparoscopy since the tiny 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 may be performed laparoscopically. This procedure involves placing three small incisions, the largest being 10 mm (~1/2 in). The surgery is performed using long instruments and observed by an fiberoptic camera. Your pediatric surgeon is well experienced in performing laparoscopic appendectomies, and most operations take 20 to 50 minutes.

**If the appendix is simply inflamed**, i.e. in an early stage of infection, the appendix is removed. One to three doses of antibiotics are given after the operation, and the child is discharged when oral intake is adequate. Most children need around 24 hours in the hospital.

**If the appendix is gangrenous**, that is, the full thickness of the wall of the appendix is necrotic (dead) or perforated, then the appendix is removed, and any fluid is washed away. After the operation, the child remains in the hospital receiving intravenous antibiotics until: there has been no fever for 48 hours and the patient can eat and the child has had a stool and pain is controlled with oral pain medicine.

**If the appendix be perforated and an abscess has formed**, the appendix is removed, the fluid suctioned away, and soft plastic drains are left in the remaining abscess cavity. The purpose of a drain is to allow any residual infected material to come to the outside thereby preventing a new abscess. Drains remain in place about 4 days; when little or no fluid is draining, the drains are removed.

**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, an appendectomy is performed (called an "interval appendectomy") as recurrent appendicitis is possible after three weeks. During this period antibiotics are usually administered through a central line.

### **Post-operative Complications and Long Term Problems:**

**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 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 scar**, also know as adhesions to form within the abdomen. This is normal for everyone. Unfortunately, such scars may cause (< 3%) intestinal obstruction, 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.**

**It is general experience that approximately 10% of children operated upon 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 the occasional patient who has all the right symptoms, signs, physical findings, and even x-ray findings, but still 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 be a bad disease.** Sometimes the patient with perforated appendicitis and an abscess has a slow recovery, trying the patience of anxious parents. Nevertheless, unless the child has some immune deficiency and succumbs to an overwhelming infection, patients with appendicitis in all degrees 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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