

# An Overview of Diagnosis and Management of Appendicitis Complications: Literature Review

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## Abstract

**Background:** Appendicitis' complications are variable and range according to its occurrence pre-operatively or postoperatively. Pre-operative complications are often due to delay in diagnosis, non-monitoring of conservative management, or predisposing factors such as obesity, older age, and pregnancy. The complications that occur post-operatively often revolve around wound site infection and abscess formation. Nevertheless, attention to changes in a patient's condition is central to rapid diagnosis and management of complications. **Objectives:** We focus in this paper on appendicitis complications, and only relevant studies would be discussed. **Methodology:** PubMed database was used for articles selection, papers on appendicular complications were obtained and reviewed. **Conclusion:** Acute appendicitis is a very common inflammatory condition liable to complications in both conservative and surgical approaches to its management. As a result, every surgeon shall know these complications combined with a low threshold for suspicion. This will be paramount in managing these cases since some can be fatal and early treatment can be lifesaving. Thorough knowledge about the management options including recent breakthroughs and indications for each step is important nowadays and will provide better outcomes overall.

**Keywords:** Appendicitis complications, abscess, postoperative complications, perforation, diagnosis, management.

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## Introduction

Appendicitis' complications are variable and range according to its occurrence pre-operatively or postoperatively. Pre-operative complications are often due to delay in diagnosis, non-monitoring of conservative management, or predisposing factors such as obesity, older age, and pregnancy. The complications that occur post-operatively often revolve around wound site infection and abscess formation. Further complications include finding normal appendicitis with another underlying diagnosis such as a Meckel's diverticulum or an ovarian torsion.

The appendix sits in the right iliac fossa, due to the normal rotation of the gut around the superior mesenteric artery. Therefore, left-sided appendicitis should clue into either intestinal malrotation or another differential such as diverticulitis. Intraoperatively, the appendix is commonly in the retrocausal position, due to the caecum's rotation on itself. Retrocaecal appendicitis may present with or without abdominal tenderness. The second most common variant is a pelvic appendix; which presents with diarrhea as it irritates the adjacent rectum, or increased urinary voiding if irritating the bladder. Nerve injuries may occur during open appendectomy, for example during a laterally extended Lanz incision the ilioinguinal nerve may be inadvertently cut, leading to postoperative loss of sensation on the anterior scrotum and penis.

Other rarer complications such as cancerous appendix are also possible and histopathology should always be taken in selected cases.

In patients with inflammatory bowel disease, such as Crohn's, the surgical approach to the appendix should be minimally intrusive as not to cause a flare of the disease, eventually, these patients recover well postoperatively. Nevertheless, attention to changes in a patient's condition is central to rapid diagnosis and management of complications.

## Methodology

PubMed database was used for articles selection, and the following keys used in the mesh ("Appendicitis Complications"[Mesh])

AND (“Diagnosis”[Mesh]) OR ‘Management’ [Mesh]). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; appendicitis complications, diagnosis, management. Exclusion criteria were all other articles that did not have one or more of these topics as their primary endpoint.

**Review**

Appendicitis sits at the apex of differential diagnoses of an acute abdomen, yet while research continues to unravel more of the appendix’s functionality, there remains more to be discovered from a previously thought-to-be redundant organ. The old school of thought is surgery is the definitive treatment for appendicitis, however, this is slowly but surely changing. Especially with the current SARS-CoV-2 pandemic, surgeons have opted to reserve appendectomies for resistant cases, showing that a conservative approach can be held for the majority of appendicitis cases. (Ielpo et al., 2020; Alshammari, 2020; Lestari, et al., 2020). On the other hand, other findings show an increase in complicated appendicitis cases due to patients not presenting to the hospital during the pandemic. (Orthopoulos et al., 2020; Sundus, et al., 2018; Alzahrani, et al., 2019).

Conservative approaches are recommended because not everyone presenting with right iliac fossa pain is an appendicitis case, and studies have shown that the high rate of negative appendectomy might be due to the low sensitivity of ultrasonography. Compare this to the computerized tomography (CT) method, which is almost equivalent in terms of sensitivity to clinical diagnosis. (Rait et al., 2020) However, a CT scan is not always available and a combination of clinical suspicion with ultrasonography would be a suitable alternative. (Geerdink et al., 2020) Also, laparoscopic or open surgery is debated as the definitive diagnosis method for appendicitis, as CT and magnetic resonance imaging (MRI) have shown better adaptation to the current pandemic situation. (Ganesh et al., 2020) Rarely, certain conditions may mimic appendicitis’ abdominal pain presentation such as intraperitoneal focal fat infarction.

Applying a supportive approach of nil-per-os and intravenous hydration is not associated with complications, studies have related increased risk of complicated appendicitis with factors such as older age, smoking, and previous surgery. (Abdul Jawad et al., 2020) Furthermore, prescribing post-operative antibiotics for uncomplicated cases of appendicitis is not associated with better outcomes. (Lawless et al., 2020) Acute appendicitis would present depending on the age and anatomical location of the appendix. There are common gastrointestinal signs of appendicitis, such as aversion to food in children and vomiting in adults (See Table 1). However, not all patients present with the classical symptoms of epigastric pain shifting to the right iliac fossa. This is important as acute appendicitis is a clinical diagnosis, and failure to diagnose it would lead to deadly complications. More recently, non-specific appendicitis is more accurately diagnosed with contrast-enhanced computerized tomography. Possible complications would arise if the diagnosis of acute appendicitis is ambiguous or delayed, which occurs at extremes of age and pregnancy. (See Table 2)

**Table 1:** Clinical Signs of Acute Appendicitis

Sign	Description
Pointing	Points at epigastrium and slides towards right iliac fossa
McBurney	Point of maximum tenderness in the right iliac fossa
Rovsing	Deep palpation of the left iliac fossa causes pain in the right iliac fossa
Psoas	The right hip is in a flexed position for pain relief
Obturator	Pain in the hypogastrium when the hip is flexed and internally rotated
Dunphy	Abdominal pain on coughing
Markle	Pain in the right iliac fossa after a sudden drop from standing on toes to heels
Blumberg	Rebound tenderness at the right iliac fossa
Aure-rosanova	Pain on finger palpation in the right inferior lumbar triangle
Sitkovitsky	Increased pain in the right iliac fossa when lying on the left side of the body
Cutaneous hyperaesthesia	Triangle of skin hyperaesthesia with the apex pointing towards the right iliac fossa

In pregnancy, the most common extrauterine acute abdominal condition in pregnancy 1:2000; the severity of appendicitis is certainly greater. The incidence of perforation of the appendix during pregnancy is as high as 25%; if the diagnosis is delayed this may rise to 66%. (Balogun et al., 2019) As the uterus enlarges, it displaces the appendix upwards, and therefore although pain from appendicitis in the 1st trimester is felt in the right iliac fossa, it is felt more centrally in the second trimester and the right upper quadrant or more generally in the third trimester. The normal WCC in pregnancy can be as high as 15,000/mm<sup>3</sup>; this increased reference range limits the usefulness of an elevated WCC in pregnancy. However, a left shift should alert to the possibility of an inflammatory condition such as appendicitis in pregnancy. (Gentles et al., 2020) Diagnostic laparoscopy may be indicated in some cases but may be technically difficult beyond 26 weeks of pregnancy. Fetal loss occurs in 5% to 20% if perforated appendix at operation.

In children, it is advisable to perform an early-on appendectomy for cases of suspected perforation without abscess formation, as this has shown mild rates of complications and hospital stay in this age group. (Veeralakshmanan et al., 2020) In an adult, the postoperative management of perforated appendicitis that has been managed surgically would be to initiate a regular diet usually in 5–7 days if tolerable.

**Table 2:** Appendicitis Complications in different patient group

	Potential Complications	Reason	Differential
Infants	Perforation, postoperative morbidity,	Diffuse peritonitis occurs with underdeveloped omentum (diagnosis is rare in this age, so often missed)	intussusception, mesenteric adenitis, Meckel's diverticulitis
Elderly	Gangrene, perforation	lax abdominal wall and/or abdominal obesity, comorbid conditions	intestinal obstruction, diverticulitis, colonic carcinoma
Pregnancy	fetal loss, perforation	Non-specific symptoms	ovarian torsion, pyelonephritis, tubal pregnancy,

Appendicular mass occurs when the omentum wraps around the inflamed appendix, which is the abdominal response to inflammatory disturbance. The management of an appendicular mass is to resuscitate and monitor the patient for any signs of systemic inflammatory response syndrome. The regimen used is known as Ochsner-Sherren conservative regimen, where most patients would improve within 48 hours. If, however, they begin to develop noticeable disturbance in their vital signs, or the abdominal pain increases in severity, or the appendicular mass increases in size, then the regimen should be stopped. An increase in appendicular mass' size should alert the surgeon to suspicion of Crohn's disease or colorectal carcinoma. After the episode has passed, an elective appendectomy should be planned within 6–8 weeks, as the risk of recurrent appendicitis increases, and often without the potential protection of the omental patch. (Bonadio et al., 2017)

#### *Crohn's disease*

Patients with inflammatory bowel disease and concomitant appendicitis are not always managed surgically. This is because in patients with Crohn's terminal ileitis (ileocaecal involvement), the risk of an enterocutaneous fistula—due to the inflammatory process—is increased. In addition to a non-interventional approach, appendicitis would be managed with intravenous antibiotics and corticosteroids. The occurrence of a fistula after an appendectomy is rare, however, it is more common to occur in patients with a background of Crohn's disease. The most common intestinal location is the sigmoid, followed by the terminal ileum. A high index of suspicion is needed in patients with acute flares of Crohn's disease, such as not to mistake appendicitis for an appendiceal Crohn's inflammation. (Han et al., 2014)

The follow-up of this subgroup of patients is not always necessary, as most patients recover steadily and surely during the post-operative period. (Park et al., 2019)

#### *Wound Infection and Abscess Formation*

Complicated surgical wound post-appendectomy leading to abscess formation is typically managed by aggressive antibiotic use. Recent evidence has shown no perceived benefit from antibiotic intake over one week. (Panshin et al., 2020) Surgical site infection is often the most common operative complication in appendicitis cases. (Balogun et al., 2019) Pelvic abscess would present as spiking pyrexia several days after the initial episode of appendicitis. It is necessary to perform transrectal drainage under general anesthetic or radiologically guided percutaneous drainage of the pelvic abscess. Portal pyaemia is one of the very serious complications of gangrenous appendicitis associated with high fever, rigors, and jaundice. If left untreated, this would inevitably lead to septicaemia and the rapid development of multiple intra-hepatic abscesses. The definitive management is to give antibiotics, closely followed by percutaneous drainage of the abscess.

Laparoscopic appendectomy is often preferred in patients at risk of abscess development, such as diabetic patients. (Fernández-Moreno et al., 2020) In addition to accurately diagnosing appendicitis, the laparoscopic approach allows the surgeon the ability to inspect the entire abdominal cavity when a normal appendix is found. The laparoscopic approach can also be used to treat other intra-abdominal surgical pathologies and, therefore, reduces the need for extending or converting to a conventional laparotomy incision. Cosmesis is generally better with the laparoscopic technique owing to smaller wound size.

In-ward patients, as with other post-operative patients who are immobilized for extended periods, are at risk of venous thrombosis and embolism; populations at risk include the elderly and women on oral contraceptive pills. Fecal fistulas are managed using conservative low residue enteral nutrition. In the late postoperative period, an adhesive intestinal obstruction complication may ensue. Chronic pain in the right iliac fossa is attributed to adhesion formation after appendectomy, so it would be best to perform a laparoscopic intervention, especially if we are suspecting perforation. (Korndorffer et al., 2010)

#### *Adhesive intestinal obstruction*

During the late postoperative period, patients may return with unrelenting right iliac fossa pain at the site of the operation, with the occasional presentation of absolute constipation. The surgeon with enough laparoscopic expertise can confirm the presence of at least one band adhesion causing the intestinal obstruction. An adynamic ileus, especially after an intraoperative diagnosis of gangrenous appendicitis, should not persist for more than 4–5 days, often the patient develops a fever when intrabdominal sepsis occurs. Other rare complications of appendicitis are pseudomyxoma peritonei and ileus, which could lead to strangulation and emergency return to theatre. (Kashimoto et al.,

2020) Loss of peristalsis could also be caused by operative intervention in appendicectomy.

## Conclusion

Acute appendicitis is a very common inflammatory condition liable to complications in both conservative and surgical approaches to its management. Moreover, since the disease can affect all ages, the complications are variable and thus the overall approach shall be tailored accordingly. As a result, every surgeon shall know these complications combined with a low threshold for suspicion. This will be paramount in managing these cases since some can be fatal and early treatment can be lifesaving. Thorough knowledge about the management options including recent breakthroughs and indications for each step is important nowadays and will provide better outcomes overall.

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