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Research Article

## SURGICAL APPROACH TO ACUTE APPENDICITIS

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### Abstract

**Background:** Acute appendicitis affects 5.7-57/ per 100,000 individuals each year, mostly prevalent in the pediatric population, making it a common gastrointestinal disease. Appendicitis presents colicky central abdominal pain around the umbilicus this is proceeded by nausea and vomiting; the pain location would travel to the right iliac fossa. Rebound tenderness is noticed in physical examination, but not recommended. Surgical removal of the appendix remains the gold standard in management of appendicitis.  
**Methodology:** We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: appendicitis, appendectomy, clinical presentation of appendicitis, investigation of appendicitis, appendectomy, conservative management of appendicitis  
**Aim:** In this review, we aim to study the clinical presentation of acute appendicitis, the methods of investigation and the best approach to manage it surgically, as well as non-surgically.  
**Conclusion:** Acute appendicitis is one of the most common gastrointestinal conditions that usually present in the emergencies. The prevalence is higher in pediatric age group. It is a clinical diagnosis but confirmed with CT and US in order to rule out the other many possible differential diagnoses. The management is mostly surgical, either open appendectomy or laparoscopic appendectomy. More research is being done in devising effective methods of non-surgical management, especially in children, using antibiotics to reduce the cost and morbidity associated with surgery.

**Keywords:** Acute Appendicitis, Acute Abdomen, Abdominal Surgery

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**INTRODUCTION:**

Acute appendicitis affects 5.7-57/ per 100,000 individuals each year, mostly prevalent in the pediatric population, making it a common gastrointestinal disease. There is a big variation in rates of incidence is based upon differences in ethnicity, age, sex, weight of patient, and also the season of the year. On history taking, appendicitis presents colicky central abdominal pain around the umbilicus this is proceeded by nausea and vomiting, the pain location would travel to the right iliac fossa. Rebound tenderness is present but it is not recommended to avoid distressing the patient. The pain is usually exacerbated by the movement exacerbates, cough might induce a localized pain in the right iliac fossa. Since in most cases of appendicitis, the condition is an irreversible progressive disease which eventually leads to perforation, surgical removal of the appendix remains the gold standard in management of appendicitis [1].

**METHODOLOGY:**

- **Data Sources and Search terms**

We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: appendicitis, appendectomy, clinical presentation of appendicitis, investigation of appendicitis, appendectomy, conservative management of appendicitis

- **Data Extraction**

Two reviewers have independently reviewed the studies, abstracted data, and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

The study was approved by the ethical board of King Abdulaziz University Hospital

**Clinical Approach:**

The clinical presentation of acute appendicitis is very important in the early diagnosis and prognosis.

**History**

On history taking the abdominal pain is the primary presenting symptom of patients with acute appendicitis. It is a sequence that starts with colicky central abdominal pain around the umbilicus this is proceeded by nausea and vomiting, the pain location would travel to the right iliac fossa (first described by Murphy) but it is not sensitive sign and presents only

in less than 40% of patients [2]. In the typical case, the patient complains of a peri-umbilical colicky pain, which increases during the first 20 hours, and become constant and sharp, and travels to the right iliac fossa. Initially the pain represents a referred pain resulting from the innervation of the viscera of the midgut, and the localized pain is due to the involvement and irritation of the parietal peritoneum layer after progression of the inflammatory process. A predominant symptom is the sudden loss of appetite and is coexist with the abdominal pain, as well as constipation and nausea. If the patient develops severe vomiting, this means that the patient might have generalized peritonitis which is a serious complication of appendicitis, however, it is rarely a major feature in simple acute appendicitis. A recent meta-analysis of the symptoms and signs associated with a presentation of acute appendicitis was unable to identify any one diagnostic finding but showed that a the referred pain was associated with a diagnosis of acute appendicitis [3].

This most common clinical presentation can differ by the age of the patient and the anatomical position of the appendix. In old and young patients, the diagnosis is more challenging the patient mostly has non-specific symptoms, often with subtle clinical signs. Infants and young children often seem withdrawn, and elderly people might present with confusion. A high index of suspicion for acute appendicitis is required in such patients [3].

**Physical Examination**

The patient is usually presenting with flush, and a dry tongue as well as bad smell i.e. fetor oris. The presence of pyrexia can reach up to 38°C with tachycardia is not uncommon. On abdominal exam, there is usually localized tenderness and muscular rigidity after the migration and localization of the pain to the right iliac fossa (Murphy sign). Rebound tenderness is present but it is not recommended to avoid distressing the patient. The pain is usually exacerbated by the movement exacerbates, cough might induce a localized pain in the right iliac fossa. The site of maximal tenderness intensity is commonly over McBurney's point, which is located two thirds of the way along a line drawn from the umbilicus to the anterior superior iliac spine. Rectal examination might reveal tenderness, while the vaginal might be normal, although tenderness to the right might be present particularly in a pelvic appendix. Tenderness on rectal examination might be suggestive but is not diagnostic of appendicitis. Percussion tenderness, guarding, and rebound tenderness are the most accurate clinical findings

indicating a diagnosis of acute appendicitis [3].

## INVESTIGATIONS:

### Imaging

The recent advancement in the technology and the availability of imaging modalities such as CT scans have changed the classic approach to diagnose appendicitis. In a study which was published in 2012, 2,871 patients, multi-detector CT's sensitivity was more than 98% and a specificity above 95% [4]. Likewise, in a previous meta-analysis that was published in 2006 of data from 31 studies and includes more than 4300 patients found the sensitivity and specificity of about 95% [5]. A 2011 meta-analysis that included of 28 studies comprising more than 9,300 patients found that the negative appendectomy rate was less than 9% when using CT compared to 16.7% when using clinical evaluation alone [6]. Likewise, this study also showed a significantly higher negative appendectomy rate during the pre-CT era in comparison to the post-CT era (10% vs. 21.5%). However, the incidence of appendiceal perforation which is considered the most critical complication of appendicitis, was calculated as unchanged by the use of CT [6].

In 2007, a systematic review that included 25 studies and more than 9,100 patients, studied the ultrasound relevance in the diagnosis of equivocal acute appendicitis, the study showed a sensitivity of above 83% and a specificity of approximately 95% [7]. This significant improvement in diagnostic accuracy with widespread adoption of CT for appendicitis results in the concerns over increased radiation exposure and long-term risk of malignancy. A common strategy used to prevent the risks is common in the pediatric population, is to perform US as the first radiologic technique in establishing the diagnosis of appendicitis due to the ability to rule in appendicitis in case it is positive. If clear signs of appendicitis are present, then surgery would preferably be done with no need for CT scans.

A study published in 2014 that included 662 patients below 18 years old with suspected appendicitis compared CT with a radiation free US-magnetic resonance imaging (MRI) protocol. The study showed that US-MRI protocol and CT to have no significant differences in time to, perforation rate or length of stay, antibiotic administration, time to perform appendectomy, and negative appendectomy rate [8].

### Laboratory Investigations

The white blood cell (WBC) evaluation in acute appendicitis has been studied extensively. It is usually elevated, However, it is neither sensitive nor specific laboratory marker and is also increased in patients with other inflammatory conditions listed in the differential diagnosis [9].

The C- reactive protein (CRP) is considered as an acute phase reactant that is usually increased in inflammatory conditions. Its diagnostic significance is largely affected by its kinetic properties and its utility as a marker for complicated/advanced appendicitis. CRP levels maybe increased between 7–13 hours after the onset of inflammatory processes, it peaks between 20 and 50 hours, which is later than that of WBC. As a result, CRP does not contribute much to diagnostic utility early in the case of simple appendicitis [10;11].

A granulocyte count ranges normally between 2500–6000. A moderate elevation in PMN greater than  $7 \times 10^9$  cells/L showed a sensitivity between 70–90%, the specificity was approximately between 50–75% in diagnosis of acute appendicitis [12]. Interleukins might have a role as well, the interleukin 6 (IL-6) is a cytokine that has a vital role in the stimulation of the acute inflammatory response [13]. A study was conducted in 2011 of more than 270 patients aged between 3–18 with suspected appendicitis showed the IL-6 levels increase early appendicitis, and mean concentration also increases with the degree of inflammation [14]. Serum Amyloid A (SAA) is considered as non-specific inflammatory marker. A study conducted in 2005 that involved more than 40 patients with a mean age of 10 years and confirmed appendicitis on surgery calculated a sensitivity of more than 80%, a specificity of more than 80% as well. Interestingly, 42 patients with acute appendicitis had increased SAA levels, whereas only 14 of the 42 had normal WBC values and 9 of the 42 showed normal CRP values. They additionally showed SAA had an early and more dynamic elevation in inflammatory conditions in comparison to that of WBC and CRP [15]. So, SAA might be helpful in the diagnosis of early appendicitis.

### Differential Diagnoses of Acute Appendicitis

The differential diagnosis of appendicitis is the same as any acute abdomen, it includes the following (table 1) [16].

Surgical	Urological	Gynecological	Medical
<ul style="list-style-type: none"> <li>• Intestinal obstruction</li> <li>• Intussusception</li> <li>• Acute cholecystitis</li> <li>• Perforated peptic ulcer</li> <li>• Mesenteric adenitis</li> <li>• Meckel's diverticulitis</li> <li>• Colonic/appendicular diverticulitis</li> <li>• Pancreatitis</li> <li>• Rectus sheath hematoma</li> </ul>	<ul style="list-style-type: none"> <li>• Right ureteric colic</li> <li>• Right pyelonephritis</li> <li>• Urinary tract infection</li> </ul>	<ul style="list-style-type: none"> <li>• Ectopic pregnancy</li> <li>• Ruptured ovarian follicle</li> <li>• Torted ovarian cyst</li> <li>• Salpingitis/pelvic inflammatory disease</li> </ul>	<ul style="list-style-type: none"> <li>• Gastroenteritis</li> <li>• Pneumonia</li> <li>• Terminal ileitis</li> <li>• Diabetic ketoacidosis</li> <li>• Preherpetic pain on the right 10th and 11th dorsal nerves</li> <li>• Porphyria</li> </ul>

Table 1: Differential Diagnosis of Appendicitis

### Surgical Management

Appendectomy is the standard surgical procedure in acute appendectomy. It is important to study the complications related to this procedure. In a new retrospective study found there was no significant difference in complications between early less than 12 hours after presentation or later 12-24 hours appendectomy [17]. Perforation is a serious complication. The average rate of perforation is between 15% and 40% especially after 35 hours from the start of symptoms and the risk of perforation is about 5% for every 12 hour period [18]. When a diagnosis is established, appendectomy should be done as soon as possible without any dues.

Open appendectomy is performed by splitting of muscle gridiron incision over McBurney's point made perpendicular to a line connecting the umbilicus and anterior superior iliac spine or through a more cosmetically acceptable Lanz's incision. The percentages of open procedures done has decreased with the increased use of laparoscopic techniques. Compared with open surgery, a recent systematic review showed that laparoscopic appendectomy (LA) in adults decreases results in less complications such as wound infections, postoperative pain, length of hospital stay, and time taken to return to work, although the number of intra-abdominal abscesses were still high after the laparoscopic approach [19]. But this view is contracting a more recent study, which showed no significant differences between the two procedures except higher quality of life scores at two weeks in the laparoscopic group [20]. In children, LA decreased the incidence of wound infections and the length of hospital stay in comparison to open surgery, but there was no statistical significant differences in postoperative pain, time to mobilization, or proportion of intra-abdominal abscesses were seen [19].

Likewise, some advantages of LA in adult patients include but not limited to less pain, fine cosmetics, shorter hospital stay, faster recovery, less wound infection, and lower cost, compared with conventional open surgery were found before the 2000 [21]. A common postoperative complication are also lower in LA than in conventional open surgery [22]. So, LA has is now considered the standard surgery of choice internationally [23]. In spite of the fact of the operative time, including buried sutures, might be longer in LA, there were no significant statistical differences in the rate of severe morbidity/mortality between open and laparoscopic appendectomies [24]. Nowadays, natural orifice transluminal endoscopic surgery is also considered safer and more feasible [25].

Surgeons should be careful of a potentially higher incidence of intraabdominal abscess formation following LA. The use of endobags (Rüsch MemoBag; Teleflex, Wayne, PA, United States), inversion of the appendiceal stump, and carefully conducted local irrigation of the abdomen in the supine position might decrease the incidence of abscess formation [26]. Peritoneal lavage during surgery is considered an effective, safe, and simple the management of generalized peritonitis. Irrigation of the abdominal cavity is important method, done with more than 10 L of saline, and a cut-off level of saline volume to avoid intraabdominal abscess formation after surgery is 12 L. A drain pathway through the abdominal wall is adequately made at the right abdomen, to avoid a drain dislocation [27;28].

### Post-operative Complications

Time is very critical factor in the management of acute appendicitis because the severity of pathophysiology and the complication rate in adult patients with AA are time-dependent, so it is suggested that delaying appendectomy is unsafe and

dangerous. Mortality due to AA is difficult to observe, and the mortality rate after appendectomy is almost 0% [29]. But, the rates of morbidity and mortality are obviously elevated in older patients, male patients, and patients with steroid use, baseline disease, active pneumonitis, and a bleeding tendency [30]. The perioperative injection of antibiotics should be considered to reduce complications, including SSI [31]. Postoperative complications are also less common in LA than in conventional open surgery [32].

### Non-surgical Management

Noteworthy, non-operative management has costs less so it has a cost advantage over routine interval/delayed appendectomy after initial successful conservative management [33]. Patients who recover from conservative treatment of an appendiceal mass should undergo colonoscopy or barium enema to detect any underlying diseases and to rule out coexistent colorectal cancer [34].

Laparoscopic surgery by experienced surgeons is a safe and feasible first-line treatment for appendiceal abscess. In addition, laparoscopic surgery has been associated with fewer readmissions and fewer additional interventions than conservative treatment with a comparable hospital stay [35]. Non-operative management is well tolerated and efficacious in select patients, particularly in children. Patients who initially receive conservative treatments do not require surgical intervention, and AA should no longer be regarded as an indication for interval/delayed appendectomy. Routine interval/delayed appendectomy benefits less than 21% of patients [36]. The majority of recurrence occurs in the first 6 months [36], but the rate decreases to about 2% at 1 year [37]. Significantly, AA develops in a progressive and irreversible pathway, even if the clinical course of AA can be temporarily changed by intentional antibiotics. The length of hospital stays and postoperative complications increase with advanced pathology during antibiotic treatment.

A gradual, adapted antibiotic therapy in non-operative treatment of an appendiceal abscess and mass is effective. It is found that there is no significant predictive factor of failure of first-line antibiotics [38]. Monotherapy with a second-generation, broad-spectrum cephalosporin, such as cefotetan, administered twice a day, is an economical and effective adjunctive regimen [39]. A third-generation cephalosporin could be used but is not recommended yet [40].

### Appendectomy in Pregnant Women

The most common non-obstetric emergency needing surgery in pregnancy is appendicitis, with an approximately incidence of 0.10 to 2 per 1000 pregnancies [41]. Previous studies have shown an equal incidence in pregnant and non-pregnant women, but a recent large scale case-control study has suggested a reduction in the incidence of appendicitis during pregnancy, especially during the third trimester [42].

Displacement of the appendix by the gravid uterus means that the presentation is often atypical or can be mistaken for the onset of labor. Nausea and vomiting are often present, with associated tenderness located anywhere on the right-hand side of the abdomen.

Maternal mortality is negligible in cases of simple appendicitis but rises to 4% with advanced gestation and perforation. Fetal mortality ranges from 0-1% in simple appendicitis to 20-35% in cases of perforation [39].

### CONCLUSION:

Acute appendicitis is one of the most common gastrointestinal conditions that usually present in the emergencies. The prevalence is higher in pediatric age group. It is a clinical diagnosis but confirmed with CT and US in order to rule out the other many possible differential diagnosis. The management is mostly surgical, either open appendectomy or laparoscopic appendectomy. More research is being done in devising effective methods of non-surgical management, especially in children, using antibiotics to reduce the cost and morbidity associated with surgery.

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