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RESEARCH ARTICLE

RECENT TRENDS IN ACUTE APPENDICITIS

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ABSTRACT

Appendicitis is the most common cause of acute abdomen in emergency department. The etiology of acute appendicitis is still debatable. There have been few advancements in the past few decades. Diagnosis a patient suffering from acute appendicitis with is important for management of patient. Any patient presenting with an acute abdomen differential diagnosis of acute appendicitis is always there. Many methods in abdominal examination and scoring systems have been described in literature for evaluating a case of appendicitis. Even though appendectomy has been the mainstay treatment for appendicitis, antibiotics have also been gaining popularity in the present case scenario. We discuss existing knowledge and evolving strategies in management of patients with acute appendicitis.

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INTRODUCTION

Appendicitis is a frequent reason for emergency hospital admission and remains the most common indication for emergency surgery worldwide (Sammalkorpi, 2014). The lifetime risk of developing appendicitis is 8.6% for males and 6.7% for females, with the highest incidence in the second and third decades. Appendicitis remains the commonest nonobstetric surgical emergency during pregnancy and childhood (Flexer, 2014 and Rautio, 2000). It is located at the base of the caecum with an average length of 6 to 9 cm, however, it can vary in length from 1 to 30 cm. Patient having acute appendicitis usually presents as gradual or sudden onset of vague periumbilical or epigastric pain followed by anorexia, nausea, and vomiting. Sometimes associated with suprapubic pain and urinary symptoms in pelvic appendicitis. These symptoms are followed by fever suggesting progression to systemic inflammatory process. Tachycardia arises due to sympathetic response to abdominal pain and fever. Many methods in abdominal examination have been described in literature for evaluating a case of appendicitis. These include tenderness at McBurney point first described by Charles McBurney. But, the exact point of maximum tenderness may vary in different patients (Arora, 2015). Rebound tenderness, Dunphy sign, Rovsing sign, psoas sign and many more tests have been described in literature.

Laboratory investigations typically include a Complete blood count and urine analysis. Based on clinical findings and laboratory reports, The Alvarado score and Appendicitis Inflammatory Response score (Figure 1), stratify patients as low, moderate, or high risk and can help in making a timely diagnosis (Alvarado, 1986). The first and the most common used radiological modality in a suspected case of appendicitis is Ultrasonography (USG). It has advantage of being readily available and cheap, with no radiation hazard, but has limitation due to operator dependence and has a specificity of 83% and a sensitivity of 78% for diagnosing acute appendicitis (Snyder, 2018). CT scan of the abdomen on the other hand has an advantage of having specificity of 90% and a sensitivity of 94% for diagnosing acute appendicitis, but drawbacks being higher cost and exposure of the patient to ionizing radiation (Rosen, 2011 and Doria, 2009). In female patients of reproductive age, urinary pregnancy test should be the first investigation to rule out any possible ectopic pregnancy, followed by transvaginal USG to visualise any ovarian pathology. Early diagnostic laparoscopy has gained popularity, leading to better diagnosis in patients with an equivocal findings and has shown early discharge from hospital as compared to observation alone (Maggio, 2008 and Morino, 2006).

Microbiomes in appendicitis: Analysis has been done in literature showing the bacteriology of the appendix in acute appendicitis as a possible factor for causing acute appendicitis.

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Clinical risk score		
	Alvarado score	AIR score
Symptoms		
Nausea or vomiting	1	
Vomiting		1
Anorexia	1	
Migration of pain to the right lower quadrant	1	
Signs		
Pain in right lower quadrant	2	1
Rebound tenderness or muscular defence	1	
Light		1
Medium		2
Strong		3
Body temperature >37.5°C	1	
Body temperature >38.5°C		1
Laboratory tests		
Leucocytosis shift	1	
Polymorphonuclear leucocytes		
70–84%		1
≥85%		2
White blood cell count		
>10.0 × 10 ⁹ /L	2	
10.0–14.9 × 10 ⁹ /L		1
≥15.0 × 10 ⁹ /L		2
C-reactive protein concentration		
10–49 g/L		1
≥50 g/L		2
Total score	10	12

Risk of appendicitis		
Alvarado score 1–4 AIR score 0–4 Low risk	Alvarado score 5–6 AIR score 5–8 Intermediate risk	Alvarado score 7–10 AIR score 9–10 High risk

Figure 1. Appendicitis inflammatory response scoring for suspected acute appendicitis

The appendix in times of necessity serves as a reservoir for repopulation of microbiomes of the gastrointestinal tract. In literature, development of acute appendicitis has been classically described due to creation of a blind pouch by luminal obstruction of the appendix by either a hypertrophic lymphoid tissue or fecolith (Rogers, 2016). The blind pouch created serves as a breeding ground for bacteria, which in turn causes acute appendicitis (Roberts, 1988). Many recent investigations, such as gene sequence analysis, allow a better assessment of the microbiomes.

In few studies, *Fusobacterium* presence has been shown to correspond to disease severity (including severity of inflammation and risk of perforation) (Swidsinski, 2011). Further investigations have shown *Fusobacterium* association causing decrease in the *Bacteroides* population (Jackson, 2014). However Study done by Salo *et al.* showed appendicitis to be actually a inflammatory disease and corresponds to changes in immune function (Salo, 2017). Immunology role of the appendix has been depicted by the fact that few epidemiological studies have shown a lower risk of developing ulcerative colitis after appendectomy but a higher

risk of developing Crohn's disease after appendectomy (Frisch, 2009; Kaplan, 2007).

Treatment strategies: Appendicitis is one of the most frequent causes for acute abdominal pain leading to presentation to the Emergency department. However, there is no fixed defined treatment protocol for acute appendicitis. Different centres follow institution wise protocol for managing a patient of acute appendicitis.

Non-operative management: Recently due to advancement in field of pharmacology and microbiology nonoperative management of acute appendicitis has been regaining popularity and this has been supported by several studies but not without controversy. APPAC study, a randomized, prospective controlled study was done by Salminen *et al.* compared nonoperative management versus surgery using ertapenem as antibiotic of choice initially, followed by levofloxacin with metronidazole. The study showed a 73% successful treatment in patients who were kept on non operative management within the first year. The cost of surgical intervention was almost twice as compared to nonoperative management. This was due to more sick leaves taken by patients in operative group, leading the authors to conclude surgical intervention has greater societal costs (Salminen, 2015). Another prespective study was done by DiSaverio and coworkers, in which 159 patients who had acute appendicitis on clinical assessment were kept on follow up. The patients were treated with amoxicillin/clavulanate for up to 7 days. The study reported a failure rate of 12 % with a 14 % recurrence rate (DiSaverio, 2014). Additional studies and meta-analyses in literature have shown nonoperative management to be successful in around 70%. But patients should be aware of a failure rate of 25-30 % at 1 year requiring readmission or surgery (Varadhan, 2012; Findlay, 2016). According to various studies there is some evidence to stratify appendicitis into Uncomplicated and complicated appendicitis. The cases which are categorised as complicated should undergo a surgical intervention (Helling, 2017). Preoperative intra-abdominal or pelvic abscess occurs in 4% patients of acute appendicitis and should always be kept in mind in patients with a palpable mass. Meta-analyses of retrospective studies advocate conservative treatment in the form of antibiotics along with percutaneous drainage of abscess if needed, with 1% possibility of patients subsequently be found to have malignancy. An interval appendectomy may be performed in very young children and elderly patients, after successful nonoperative management of appendicitis or an appendiceal abscess. These subsets of population are more prone to present as perforation in emergency, because of inability to independently seek medical attention and communicate effectively. Also, elderly patients have a weak immune system with comorbid conditions, they are less likely to tolerate a second episode of acute appendicitis and have a high risk of progress to sepsis (Andersson, 2007).

SURGICAL APPROACHES

Timing of Surgery: There still remains a controversy in relation to timing of surgery, especially since disease presentation can vary.

Open Surgery: Open appendectomies are rarely being performed nowadays as the initial operation of choice. However a surgeon should have complete knowledge and

familiarity with this approach as open procedure may be required if laparoscopy is contraindicated or unavailable and in cases of difficulty due to adhesions for which conversion from laparoscopy to open may be required.

Laparoscopic Surgery: Laparoscopic surgery has become a gold standard surgical procedure for patients requiring appendectomy. A meta-analysis of 33 prospective RCTs, evaluated the operative outcomes in terms of wound infection, operation time, postoperative complications, intra-abdominal abscess, postoperative stay, reoperation rate, and return to normal activity. The study showed statistically significant decrease in incidence of wound infection, length of hospitalization, and postoperative complication, and an early return to work in patients who underwent laparoscopic surgery (Dai, 2017).

Standard laparoscopic appendectomy

Patient is operated in a Trendelenburg position with left arm tucked. Both operating surgeon and camera operator stand on patient's left side. Preoperative Foleys catheter or voiding, provides bladder decompression which aid in exposure and avoid inadvertent injury. Basic principles of triangulation and ergonomics are followed in trocar placement. Most of studies describe placement of the initial port at the umbilicus with two additional port placement is at the discretion of the operating surgeon (El-Dhuwaib, 2004).

Single Incision Laparoscopic Surgery (SILS)

Since the introduction of SILS for cholecystectomy, it has gained popularity for appendectomy too. Multiple studies have demonstrated the feasibility of this technique. SILS has shown satisfactory functional and cosmetic results. However, SILS appendectomy has a longer operative time, more expensive and increased incidence of port site hernia (Antoniu, 2014 and Buckley, 2014).

Natural Orifice Transluminal Surgery (NOTES): NOTES being one of the latest advancement in field of Minimal invasive surgery first described in 2007 has been used for appendectomy and even colon resections. It is technological adaptation of laparoscopy whereby the peritoneal cavity is accessed via a natural orifice: the stomach via the mouth, the vagina in women, or the rectum. The purposed benefits of NOTES are to decrease the risk of wound infections, trocar site hernias and neuropathic scar pain. However, Complications of around 6.5% including conversion to laparoscopy, pouch of Douglas abscesses, other intra-abdominal infections, intraabdominal bleeding, and gastric leak of the gastric clip closure have all been described in literature. Thus, NOTES as a procedure for appendectomy is still controversial and debated.

Pregnancy

Acute appendicitis is the commonest nonobstetric cause of surgical emergency during pregnancy. The main problem for the treating surgeon is to make a confirmatory diagnosis of appendicitis. The displacement of the appendix cause alteration in physical examination. The pregnant female tends to have leukocytosis and therefore the use of same to help make the diagnosis of acute appendicitis is challenged. Radiological imaging to aid in diagnosis are also affected and have their limitations in pregnancy. Ultrasonography and MRI are the

two radiological imaging studies which are helpful and required a well trained radiologists to review the images. Rapid and accurate diagnosis of acute appendicitis in pregnant female is important because of the effect that untreated acute appendicitis can have on the outcome of the pregnancy. Surgical intervention can either be open approach or laparoscopic approach depending on surgeon comfort. Appendectomy can be performed safely in any trimester but most surgeons prefer second trimester. Laparoscopic appendectomy is considered by many to be the standard of care for gravid patients with suspected appendicitis (Barnes, 2004 and Carver, 2005).

Conclusion

Appendicitis because of its high prevalence in society continues to be a frequent cause of emergency surgery. The lifetime risk remains slightly higher in males, although the risk of surgical intervention in males is approximately half that of female patients. Definitive diagnosis continues to remain a challenge still for the surgeons. Various methods of abdominal examination have been described in literature for evaluating a case of appendicitis. Adjuncts, such as advanced imaging technology, haematological investigations are being used to help facilitate this diagnosis. Advanced imaging technology, such as CECT and MRI, have high sensitivity and specificity but are costly to the patient. Nonoperative management continues to be investigated. Nonoperative management has been underappreciated previously but is now seeing a resurgence and may be more cost effective. Appendectomy has been the standard treatment for acute appendicitis for over a century. Various surgical modalities are there for treating a patient with appendicitis.

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