



Review Article

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An Overview on Pediatrics Appendicitis Diagnostic and Management Approach

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ABSTRACT

Appendicitis is the inflammation of the vermiform appendix due to the congestion of the lumen or impaction of the stool debris or both. The diagnosis and algorithm of the treatment in the pediatric age group are different in those peers in adults. Specific consideration should be the focus of the treating team to achieve the desired outcomes. We aimed to review the literature looking for the etiology of appendicitis in pediatrics, clinical presentations, diagnosis, and management of this disease. PubMed database was used for articles selection, gathered papers had undergone a thorough review. In conclusion, the steps that need to be taken to reach diagnosis are a combination of physical examination, laboratory findings, along imaging results. Following proposed scoring systems can ease the reaching to the diagnosis, or exclude it. It is especially important as the preschooler cannot properly express their pain and concerns. The non-operative approach is the mainstay of uncomplicated cases, where the operative management is preserved for more difficult cases.

Key words: Appendicitis, Pediatric, Preschooler, Investigation

INTRODUCTION

Appendicitis can be defined as an inflammation of the vermiform appendix; this blindside tube-like structure arises from the caecum which measures around 4.5 cm in neonates and continues to elongate until reaches 9.5 cm by adulthood. The position of the appendix has some normal variation among the population which may lead to slightly different presentations among patients, see **Figure 1**. The diagnosis of appendicitis in the pediatric group can be a mysterious conundrum despite all the imaging advances throughout history, and that is mainly because of the lack of verbal expression the children have, especially in those who are in preschool age [1, 2]. The incident rate of appendicitis has declined, figuratively speaking during the 20th century, the incidence rate of preschoolers declined from 3.6/10,000 to 1.1/10,000, from 18.6/10,000 to 6.8/10,000 in children between 5 and 9 years, and 29.2/10,000 to 19.3/10,000 in children between 10 and 14 years [3].

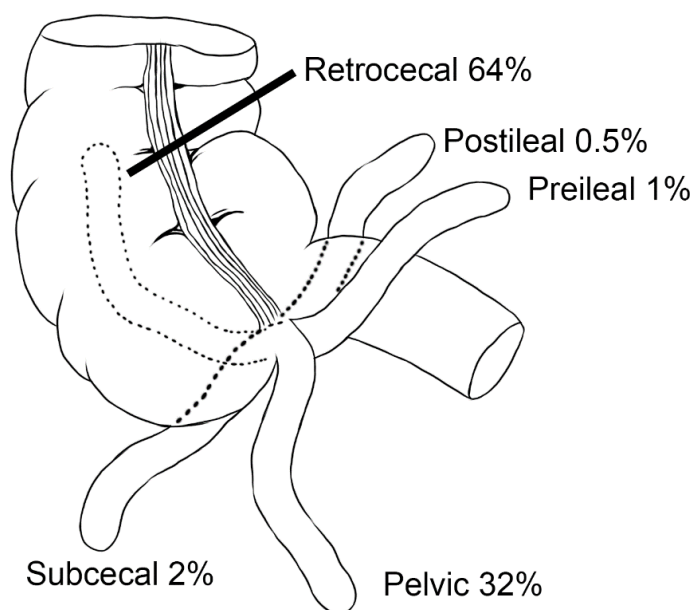


Figure 1. Different variations of the vermiform appendix.

MATERIALS AND METHODS

PubMed database was used for the selection process of relevant articles, and the following keys used in the mesh ((“Pediatric appendicitis”[Mesh]) AND (“Diagnosis”[Mesh] OR “Management”[Mesh] OR “etiology”[Mesh] OR “clinical presentation”[Mesh])). For the inclusion criteria, the articles were selected based on including one of the following: pediatric appendicitis or appendicitis in pediatrics, pediatric appendicitis etiology, evaluation, management, and diagnosis. Exclusion criteria were all other articles that did not meet the criteria by not having any of the inclusion criteria results’ in their topic.

RESULTS AND DISCUSSION

The exact etiology and pathological journey of acute appendicitis remain not fully explored, yet one thing is shared in common between different etiology which is lumen obstruction. In preschool ages, the most common cause of lumen obstruction is lymphoid hyperplasia followed, with lower odds, by fecolith. The submucosa of the appendix contains a lot of lymphoid tissue that continues to grow in size and reaches its peak at the teenage years, hence the higher incidence rate in that age group. This hyperplastic conversion of the lymphoid tissue can also be triggered by infectious diseases, such as gastroenteritis, respiratory infections, measles, and others. Fecoliths are formed by stacking of the faecal matter debris inside the lumen of the appendix, subsequently, the impaction is exacerbated by the lumen secretion and provides an environment for bacterial growth. The swelling of the appendix hinders both the arterial and venous blood supply leading eventually to thrombosis and ischemia [4, 5].

Clinical presentation

Neonates, the first month of life

In this age group, the etiology is usually not a standalone issue, it is rather an extension of another ongoing disease, such as thrombotic event, hernia, Hirschsprung’s disease. The most common presentation of those patients is abdominal distension followed by, vomiting, palpable mass, irritability, and cellulitis of the abdominal wall [6].

Infants and toddlers, up to three years

The symptoms often occur in this age group are vaguer and more misleading, which unfortunately lead to delay in the diagnosis and possible adverse sequelae. The prominent encountered symptoms in this age group are vomiting, pain, fever, diarrhea. Followed by other symptoms sometimes seen, irritability, coughing, right hip restriction, and limping while ambulating. Signs that can be detected during the physical examination are high body temperature, abdominal distension and rigidity, right lower quadrant tenderness, and abdominal mass [7, 8].

Preschooler, three to five years

The perk from this age onward is that the patient can, somehow, communicate their feelings. In this age group, abdominal pain is the prominent symptom, followed by vomiting, fever, anorexia. The physical examination findings here mimic the ones typically found in the adult population, localized right lower quadrant pain, tenderness, involuntary guarding, rebound tenderness, and high temperature are all common findings to be found [9].

*Diagnosis**Laboratory evaluation*

White blood cells count with the differential, absolute neutrophil count, and CRP is all relevant tests for appendicitis in pediatrics. A CRP level of ≥ 10 mg/L and leukocytosis $\geq 16,000$ /mL are very strongly predictive of acute appendicitis. Urine analysis is also recommended only to rule out any ongoing urinary tract infection that may mimic the presentation of appendicitis. Also, the presence of ketones in the urine may suggest the occurrence of a perforated appendix [10, 11].

Imaging evaluation

Point-of-care-Ultrasound (POCUS) is a reliable first-line imaging technique with satisfactory sensitivity and specificity if conducted by a skilled operator. The findings suggestive of appendicitis are: distension and obstruction of the lumen; swollen, appendicolith, five concentric layers representing a target sign, high echogenicity surrounding the appendix, free fluid in the pericecal and perivesical, and thickened bowel with absence or decreases peristalsis. Liberal use of CT for diagnosis of appendicitis should be limited, better second-line imaging modality, yet more expensive, is MRI and it should prioritize due to the lack of radiation hazard that might not be necessary [10, 12].

Scoring system

Scoring systems are known for diagnosing appendicitis in the adult population, for example, the Alvarado scoring system. Modification has been made by Samuel in 2002 to introduce what is known as Pediatric Appendicitis Score (PAS). PAS is composed of 8 different items, see **Table 1**, each item stands for 1 except for right iliac fossa tenderness and coughing as they stand for 2. A score that is ≥ 6 is correlated with a high probability of appendicitis. According to his study, the PAS showed a sensitivity of 100%, specificity of 87%, a positive predictive value of 90%, and a negative predictive value of 100% [13].

The newly developed scoring system named Pediatric Appendicitis Laboratory Score (PALabS), 2019, is composed of signs and symptoms and laboratory findings, see **Table 2**. These new scoring systems showed for those who scored ≤ 6 a sensitivity of 99.2%, a negative predictive value of 97.6%, and a negative likelihood ratio of 0.03, which gave a good tool for excluding patients [14].

Table 1. Pediatric Appendicitis Score (PAS)

Parameter	Score
Anorexia	1
Nausea/ emesis	1
Migration of pain	1
Tenderness in the right lower quadrant	2
Cough/ percussion/ hob tenderness	2
Leukocytosis	1
Neutrophilia	1
Total	10

Table 2. Pediatric Appendicitis Laboratory Score (PALabS)

Parameter	score
Nausea	3
History of focal right lower quadrant pain	4

ANC ≥ 7500 / μ L	7
WBC of $\geq 10,000$ / μ	4
CRP of ≥ 10 mg/L	2
CP of ≥ 0.50 ng/mL	3
Total	23

WBC: leukocyte, ANC: neutrophil, CRP: plasma C-reactive protein, CP: calprotectin

Management

The majority of pediatric appendicitis cases are uncomplicated, thence the recommended treatment option is non-operative management (NOM). It is a safe and effective method and should be the first-line management, note that in the case of an appendicolith, the failure rate is higher and a surgical method is recommended. NOM management main pillars are analgesia to manage the pain, prophylactic antibiotics, fluid resuscitation, and no oral intake (NPO) In case of failure of treatment or the presence of any factor that prevent the NOM, laparoscopic appendectomy is associated with better results in term of surgical site infection and post-operation pain and better quality of life, subsequently, it should be preferred over open laparotomy. Nevertheless, interval appendectomy, an appendectomy procedure scheduled after the subsiding of the flare of inflammation to successful non-operative management, should not be done routinely in young adult (<40) and pediatric groups, it should be reserved for those who suffer from recurrent episodes. see **Figure 2**, flow chart excerpted from the World Society of Emergency Surgery (WSES) newest guidelines [10].

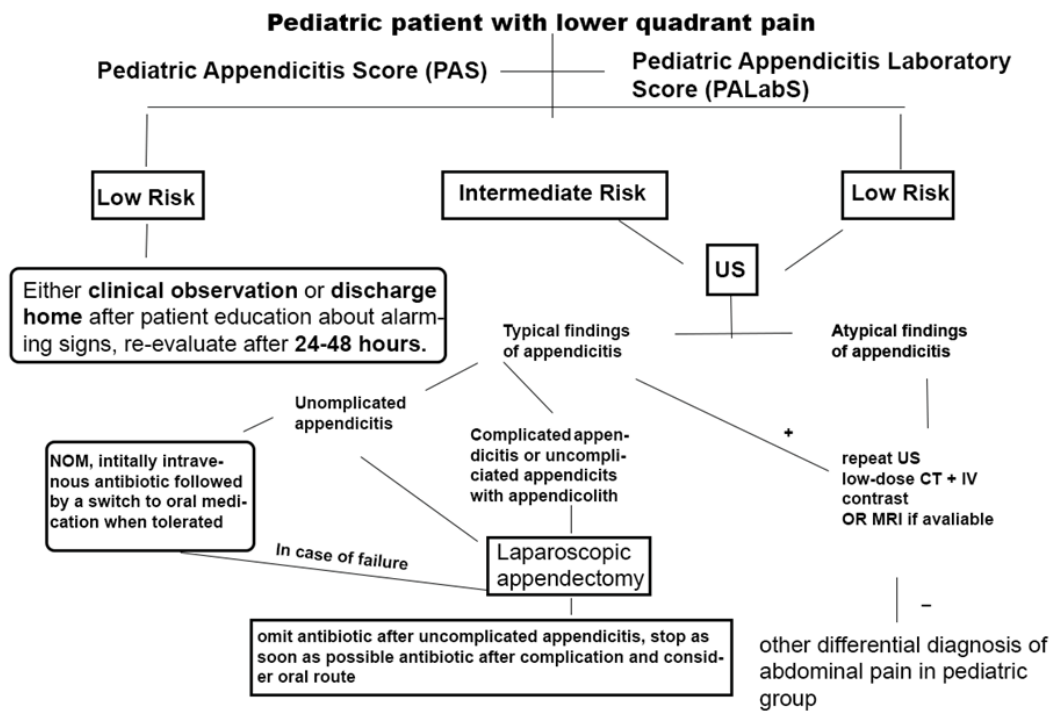


Figure 2. Excerpted flow chart WSES algorithm for diagnosis and treatment of pediatric patients with suspected acute appendicitis

CONCLUSION

Despite the uncommon occurrence of the appendicitis in pediatric age group, especially pre-schooler, it is usually causing trouble when it happens. Difficulty to diagnose this disease due to the lack of the main pillar of diagnosis tools, history, and verbal expression, stands in the face of abrupt management and further leads to more deterioration and complications. A skilled and alert surgeon should always put all their efforts to reach the correct diagnosis with no overuse of imaging modalities that may cause an unneeded radiological hazard for children. Relying on the newest guidelines with the help of an available scoring system. Eventually, the main target is to early diagnose the case and provide needed medical or surgical care to enhance the patient's quality of life.

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