International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 6, Issue 1, pp: (102-109), Month: April - September 2018, Available at: www.researchpublish.com

Reviewing Updated Evidence on Diagnostic Approaches for Appendicitis

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Abstract: **We discuss existing knowledge in classification, causes and modern diagnosis strategies, such as technologies and risk scoring foe early detection of appendicitis. We conducted a literature search of Medline (PubMed), the Cochrane Library, and CINAHL up to January, 2018. We used MeSH terms and key words to generate sets for the following themes: appendicitis diagnosis approach. Acute appendicitis is among the most common abdominal emergency situations worldwide. The cause remains badly recognized, with few advancements in the previous few years. To get a confident preoperative diagnosis is still a challenge, since the opportunity of appendicitis have to be entertained in any kind of patient providing with an acute abdomen pain. Although biomarkers and imaging are important adjuncts to history and examination, their limitations mean that clinical assessment is still the mainstay of diagnosis In diagnosis variable combination of clinical symptoms and signs has been used with each other with laboratory findings in several scoring systems proposed for recommending the possibility of AA.**

Keywords: **diagnosis strategies, clinical symptoms, technologies, laboratory.**

1. INTRODUCTION

Acute appendicitis is a common gastrointestinal disease impacting 5.7-57/per 100.000 individuals every year with the highest incidence in kids and teenagers [1] - [4].The variant of occurrence results from variations in ethnicity, sex, age, obesity and season of the year [5], [6]. According to the entrenched idea that appendicitis is an irreparable progressive illness at some point leading to perforation, removal of the appendix is the gold standard of treatment. The medical profession has obtained much experience in managing patients with acute appendicitis since Fitz's very first record in 1886 [7].

Acute appendicitis (AA) is an usual reason of acute abdominal pain, which can progress to perforation and peritonitis, connected with morbidity and death. The life time risk of appendicitis is 8.6 % for males and 6.7 % for females; nevertheless, the threat of going through appendectomy is much lower for men compared to for women (12 vs. 23 %) and it happens frequently in between the ages of 10 and 30, with a man: female proportion of around 1.4:1 [8].In spite of various studies on AA, lots of unsettled concerns stay, consisting of aetiology and treatment. The diagnosis of AA is a constellation of background, physical examination combined with laboratory examinations, supplemented by selective focused imaging. These can be utilized in combination in scoring systems. Various clinical scoring systems have been suggested in order to predict AA with assurance, yet none has been commonly approved. The role of diagnostic imaging (ultrasound (US), computed tomography (CT) or magnetic resonance imaging (MRI)) is an additional significant controversy.

The surgical therapy of AA has undergone a standard change from open appendectomy to laparoscopic appendectomy, both in grownups and now also in paediatric instances. Over the last years non-operative treatment with antibiotics has been recommended as an option to surgery in uncomplicated cases [9], while the non-surgical treatment played an essential function in the management of complex appendicitis with phlegmon or abscess [10].One more major problem in

management still open to discussion is the timing of appendectomy and the security of in-hospital delay. Furthermore, there are discussed suggestions on the sort of surgical therapy and the post-operative management consisting of antibiotic therapy.

We discuss existing knowledge in classification, causes and modern diagnosis strategies, such as technologies and risk scoring foe early detection of appendicitis.

2. METHODOLOGY

We conducted a literature search of Medline (PubMed), the Cochrane Library, and CINAHL up to January, 2018. We used MeSH terms and key words to generate sets for the following themes: appendicitis diagnosis approach. limits were used, as only English language studies were included. This basic approach was modified as necessary to search each electronic database. Additionally, we reviewed the reference lists of all included studies for complete search strategy and results. Studies that were clearly not related to our research question were immediately excluded.

3. DISCUSSION

- **Epidemiology:**

Acute appendicitis occurs at a rate of about 90-100 patients each 100 000 citizens each year in developed countries. The peak occurrence usually happens in the second or third decade of life, and the illness is less common at both extremes old. The majority of studies show a small male predominance. Geographical distinctions are reported, with life time risks for appendicitis of 16% in South Korea, 9 - 0% in the USA, and 1-8% in Africa [11], [12].

- **Causes:**

Direct luminal obstruction could create appendicitis (often by a faecolith, lymphoid hyperplasia, or affected feces; rarely by an appendiceal or caecal tumor) yet these have a tendency to be exceptions as opposed to routine events. Although a number of infectious agents are recognized to cause or be connected with appendicitis, [13], [14] the full range of specific causes stays unknown [15].Recent theories concentrate on genetic factors, environmental impacts, and infections. Although no specified gene has been recognized, the risk of appendicitis is about three-times higher in members of families with a positive history for appendicitis compared to in those with no family members history, [16] and a research of twins recommends that hereditary effects represent about 30% of the variant in threat for establishing appendicitis [17].

Environmental factors could figure in, because researches report a mainly seasonal discussion during the summer, which has been statistically related to an increased amount of ambient ground-level ozone, used as a marker of air contamination [18].Time-space collections of illness presentation could additionally indicate a transmittable cause. Pregnant women seem to have a decreased danger for appendicitis, with the lowest threat in the 3rd trimester, although appendicitis is a diagnostic challenge when it takes place in this subgroup [19].Population-level ethnic background data from the UK and USA reveal that appendicitis is less usual in non-white groups compared to in white people, although we have little understanding of the reasons [20].Alternatively, ethnic minority groups are at an enhanced threat of perforation when they have appendicitis, although this searching for may be as a result of unequal access to care rather compared to predisposition; definitive evidence is scarce [21].Neurogenic appendicitis has likewise been suggested as an original mechanism of discomfort. Characterised by excess proliferation of nerve fibres into the appendix with overactivation of neuropeptides, this inadequately comprehended disorder could be rather typical, especially in youngsters. From an instance series of 29 patients, neurogenicity existed in both inflamed and normal appendix samplings [22].This finding might in theory give an explanation for renovation after regular appendectomy, although evidence for this and for its general importance is scarce.

- **Clinical symptoms and signs:**

Inning accordance with [23], AA could be called simple AA in the absence of gangrene, perforation or abscess around the inflamed appendix, or complicated AA when perforation, gangrene or periappendicular abscess are existing. Stomach discomfort is the primary providing complaint, adhered to by vomiting with migration of the pain to the right iliac fossa, defined initially by J Murphy in 1904 [24].Nonetheless, this classical presentation is quite frequently absent, either due to variation in the structural setting of the appendix or the age of the patient, with irregular presentations seen frequently in infants and senior patients [23].

- **Classification:**

Irrespective of the reason, clinical stratification of intensity at discussion, which relies on preoperative analysis as opposed to postoperative histopathology, is beneficial for surgeons and patients due to the fact that it allows stratified perioperative preparation. However, lots of patients can just be identified with an equivocal diagnosis, which stays one of the most challenging problems in the management of acute abdominal discomfort. Table 1 and figure 1 show the pathological basis of each stratum of appendicitis. A questioned concept splits acute appendicitis into separate types of acute inflammation procedures with different fates. One is the simple inflamed appendicitis without gangrene or necrosis that does not proceed to perforation. This supposed reversible form could offer as phlegmonous (pus-producing) or advanced swelling (but without gangrene or perforation) that might require surgery, or additionally as a moderate inflammation that could resolve, either spontaneously or with antibiotic therapy. By comparison, the more extreme inflammatory type proceeds quickly to gangrene, perforation, or both. Data to support separate types of inflammation arise from clinical registries [24] and laboratory studies [25].In population-based studies, the rate of non-perforated appendicitis has in general decreased in male patients between 1970 and 2004, with even better decreases in female patients [26].However, a comparable decrease in rate of perforated appendicitis was not reported. Although this finding recommends that a disconnect exists between perforated and non-perforated condition, it could also be indicative of improved diagnosis with boosted use of imaging during the period, reclassifying some formerly classified very early appendicitis into other medical diagnoses.

Table 1: Stratified disease approach to acute appendicitis [15].

	Macroscopic appearances	**Microscopic appearances**	**Clinical relevance**
Normal appendix (figure 1A)			
Normal underlying pathology	No visible changes	Absence of any abnormality	Consider other causes
Acute intraluminal inflammation	No visible changes	Luminal neutrophils only with no mucosal abnormality	Might be the cause of symptoms, but consider other causes
Acute mucosal/submucosl inflammation	No visible changes	Mucosal or submucosal neutrophils and/or ulceration	Might be the cause of symptoms, but consider other causes
Simple, non-perforated appendicitis (figure 1B)			
Suppurative/phlegonous	Congestion, colour changes, increased diameter, exudate, pus	Transmural inflammation, ulceration, or thrombosis, with or without extramural pus	Likely cause of symptoms
Complex appendicitis (figure 1C)			
Gangrenous	Friable appendix with purple, green, or black colour changes	Transmural inflammation with necrosis	Impending perforation
Perforated	Visible perforation	Perforation; not always visible in microscope	Increased risk of postoperative complications
Abscess (pelvic/abdominal)	Mass found during examination or abscess seen on preoperative imaging; or abscess found at surgery	Transmural inflammation with pus with or without perforation	Increased risk of postoperative complications

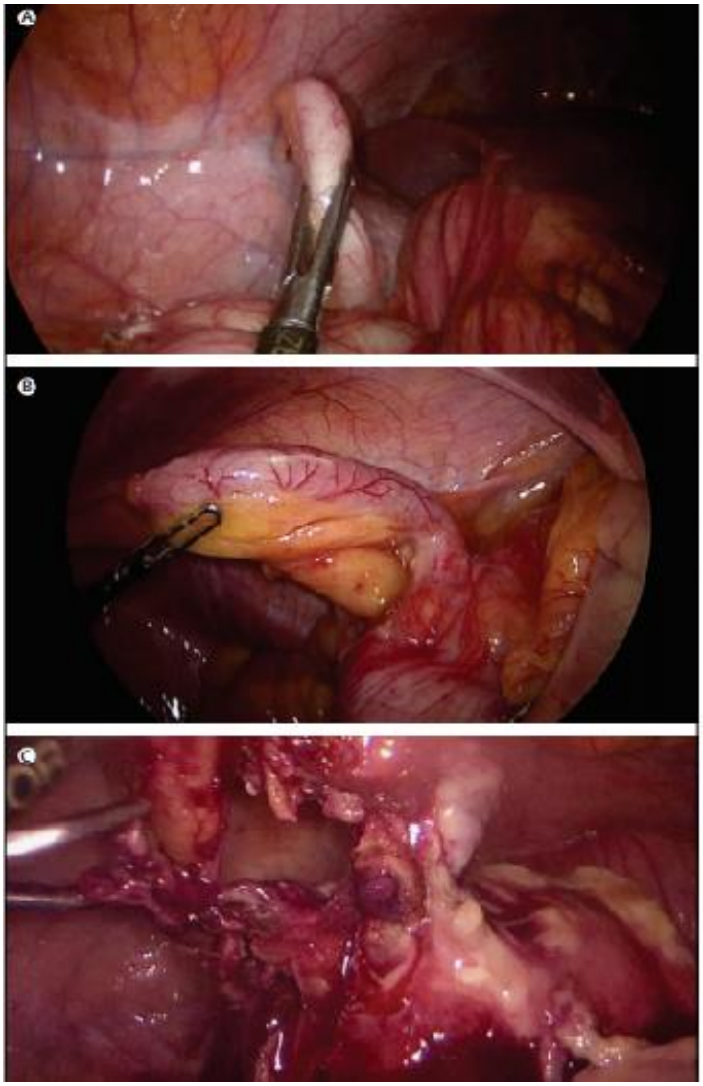

Figure 1: Macroscopic pathological features of appendicitis (A) Macroscopically normal appendix. (B) Simple inflamed appendicitis. (C) Complex appendicitis showing perforation with pus formation [15].

- **Modern diagnostic strategies:**

Modern diagnosis aims to first validate or remove a medical diagnosis of appendicitis, and 2nd to stratify basic and complex disease when appendicitis is believed. The maximum technique that restricts harm (eg, radiation from imaging) while keeping a high degree of accuracy has still not achieved agreement, standing for the difficulty dealt with by patients and surgeons.

Biomarkers:

Biomarkers are used to supplement patient background and scientific assessment, especially in youngsters, women of productive age, and elderly patients when diagnosis is difficult. No inflammatory marker alone, such as leukocyte count, C-reactive healthy protein, or various other unique examinations, including procalcitonin, could recognize appendicitis with high specificity and level of sensitivity [27].However, leukocyte matter is obtained in practically all patients who are evaluated for appendicitis, when available. A range of novel biomarkers has been suggested during the past decade, consisting of bilirubin, but these do not have external validity and suffer continuously from low sensitivity, which suggests they are unlikely to come right into professional technique [28].

Clinical decision rules or risk scores:

Each and every clinical sign for appendicitis alone has an inadequate predictive value. However, in mix, their predictive capability is much stronger, although not perfectly precise. Subsequently, a number of clinical risk scores have been established, the purpose which is to identify low, intermediate, and high-risk patients for appendicitis (table 2), enabling

further investigations to be stratified according to risk (figure 2) [29].The most commonly used score so far is the Alvarado score. A systematic testimonial and pooled diagnostic accuracy research revealed that the score has great sensitivity (particularly in men) but low specificity, restricting its clinical impact and definition that few surgeons rely on it to guide management over and past their own clinical opinion [30]. Recently, the appendicitis inflammatory action score has been developed, and seems to outperform the Alvarado score in regards to accuracy [31].

Table 2: Clinical risk scoring for suspected acute appendicitis AIR=appendicitis inflammatory response

			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 Light Medium Strong			1	 1 2 3
Body temperature>37. 5°C			1	
Body temperature>38. 5°C				1
Laboratory test				
Leucocytosis shift			1	
Polymorphonuclear leucocytes 70-87% ≥ 85%				 1 2
White blood test cell count >10.0*10^9/L 10.0-14.9*10^9/L ≥ 15.0*10^9/L			2	 1 2
C-reactive protein concentration 10-49g/l ≥ 50g/l				 1 2
Total score			**10**	**12**
Risk of appendicitis				
Low risk: Alvarado score 1–4 AIR score 0–4	**Intermediate risk:** Alvarado score 5–6 AIR score 5–8	**High risk:** Alvarado score 7–10 AIR score 9–10		

Transabdominal ultrasonography

Initial reliance on ultrasound has come to be more protected recently due to the fact that of moderate sensitivity (86%, 95% CI 83-88) and specificity (81%, 78-84) as revealed through pooled diagnostic precision of 14 studies, [32] restricting its diagnostic capacity. Owing to the need for an expert operator, it is commonly unavailable out of hrs and at weekends, additionally limiting its effectiveness. Its first-line investigatory duty is greatest in youngsters, that generally have thinner musculature, much less stomach fat, and a higher need for radiation avoidance than grown-up patients.

Computed tomography:

In adolescent and adult patients, computed tomography (CT) has come to be one of the most widely accepted imaging approach. In the USA, it is utilized in 86% of patients, with a level of sensitivity of 92-3% [33].This technique has resulted in a normal appendectomy rate of 6%. Uptake outside North America is lower as a result of issues regarding the danger of radiation exposure in kids and young adults, variation in hospitals' remuneration systems, absence outside typical hours, and lack of scanners in low-resource health centers. In one randomised regulated test comparing low-dose versus standard-dose CT in 891 patients, the regular appendectomy rate was 3 - 5% for low-dose CT versus 3-1% for standard-dose CT, although these advanced technology scanners are not in widespread use [34].For older patients at increased risk of hatred, preoperative CT is suggested to identify malignancy impersonating as (or causing) appendicitis. Selective CT based upon clinical danger scores is most likely to target its use and validate radiation exposure (figure 2).

MRI:

MRI for patients with an acute abdomen might remove the risks related to radiation use in young patients Nonetheless, little is found out about the precise use and precision of MRI in the acute abdominal area. First, few units worldwide are able to give immediate-access MRI today. Second, MRI has no better accuracy than ultrasound in differentiating perforated appendicitis [35].

Diagnostic strategies in young female patients:

In female patients of reproductive age, the initial diagnostic strategy includes urinary pregnancy test to determine possible ectopic pregnancy and transvaginal ultrasound to determine ovarian pathology. In equivocal instances, a thorough clinical assessment (including pelvic assessment) by on-call gynaecologists could differentiate alternative pathology and guide further investigations. Early laparoscopy has been suggested as a method to enhance medical diagnosis in women patients with an equivocal diagnosis, and has been assessed in single-centre randomised trials thus far [36] When compared to clinical observation and selective escalation, regular very early laparoscopy boosts the rate of diagnosis and can allow earlier discharge from hospital than observation alone [37], [38].

Differentiation of simple from complex disease:

Neither CT neither emergency MRI are able to discriminate between non-perforated and perforated appendicitis, [35] which limits clinicians' ability to objectively stratify patients for brief in-hospital hold-ups prior to surgery or for selection to tests of nonoperative treatment with prescription antibiotics. Presence of an appendicolith in radiological imaging is connected with both an increased danger of antibiotic failure and recurrence, [39] whereas the triad of C-reactive protein level below 60 g/L, white blood cell count lower than compared to 12×10^{9}, and age below 60 years has been reported to predict antibiotic success [40].

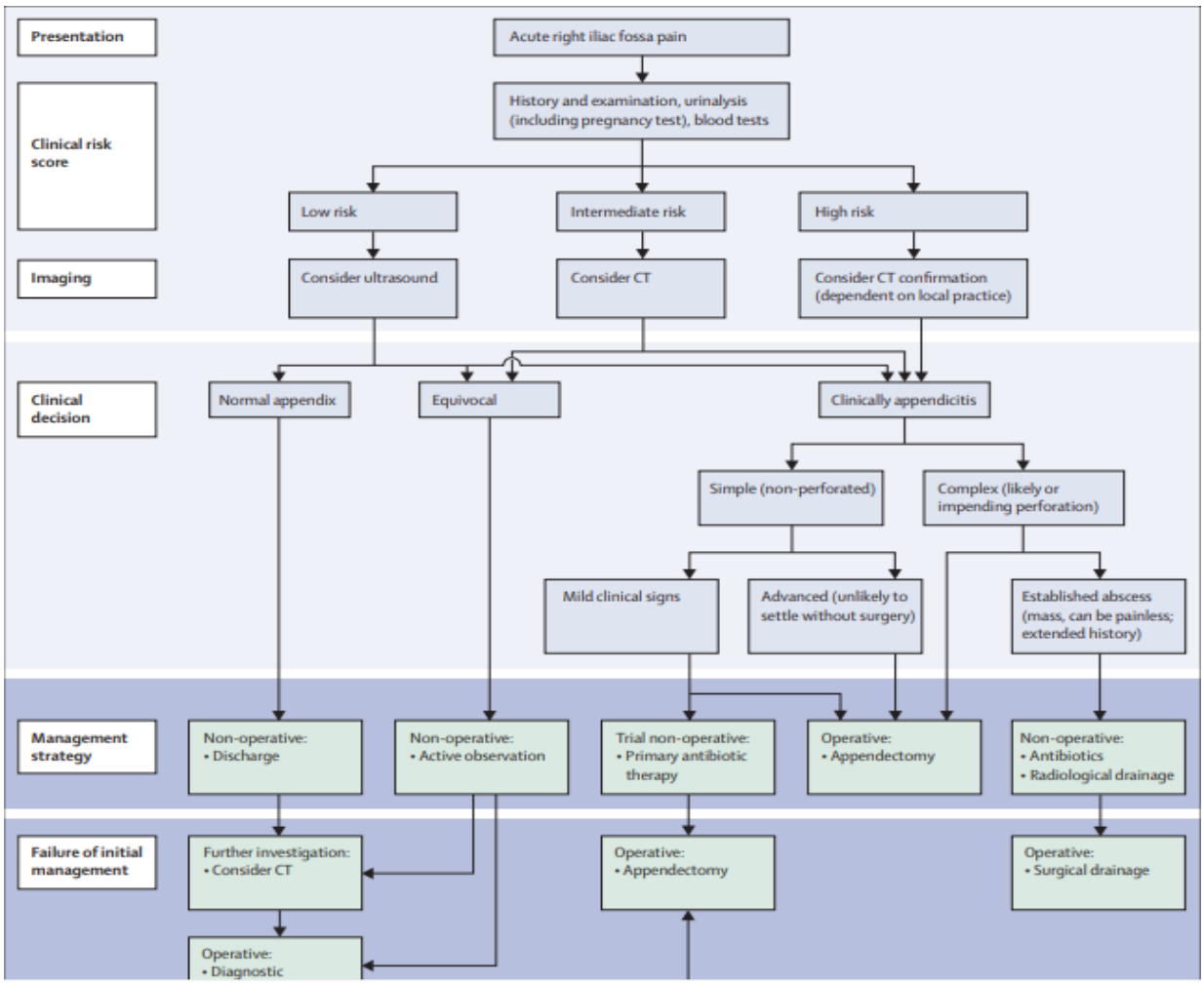

Figure 2: Flowchart of guidance for a stratified approach to preoperative management of suspected appendicitis

4. CONCLUSION

Acute appendicitis is among the most common abdominal emergency situations worldwide. The cause remains badly recognized, with few advancements in the previous few years. To get a confident preoperative diagnosis is still a challenge, since the opportunity of appendicitis have to be entertained in any kind of patient providing with an acute abdomen pain. Although biomarkers and imaging are important adjuncts to history and examination, their limitations mean that clinical assessment is still the mainstay of diagnosis In diagnosis variable combination of clinical symptoms and signs has been used with each other with laboratory findings in several scoring systems proposed for recommending the possibility of AA. The function of imaging in the diagnosis of AA is still debated, with variable use US, CT and MRI in different setups worldwide. A clinical classification is utilized to stratify management based on simple (non-perforated) and complicated (gangrenous or perforated) inflammation, although numerous patients stay with an equivocal medical diagnosis, which is among the most challenging problems. Although the mortality rate is low, postoperative difficulties are common in complicated disease.

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