Original Article

The sensitivity and specificity of the conventional symptoms and signs in making a diagnosis of acute appendicitis.

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ABSTRACT

Introduction: Simple appendicitis can progress to perforation, which is associated with a much higher morbidity and mortality. So, surgeons have therefore been inclined to operate when the diagnosis is probable rather than wait until it is certain.
Objective: This study is designed to evaluate the sensitivity and specificity of clinical examination in the diagnosis of acute appendicitis.
Methods: The study included 866 patients of acute appendicitis who had undergone appendicectomy with preoperative diagnosis of acute appendicitis. They were analyzed retrospectively. The parameters evaluated were age/gender, clinical presentation (signs and symptoms) and total white blood cell counts. The operative findings were recorded and the inflammation of the appendix was graded into normal, acutely inflamed and gangrenous.
Results: Clinical diagnosis was made correctly in 807 (93.2%) of the patients. White blood cells count ranged from 3.70 to 45.30 /mm^3 (mean 17.5353 /mm^3). It was <10,000/mm^3 in 133 (15.4%) patients.
Conclusions: Clinical assessment is the best criterion to reach a confident diagnosis. Investigations may supplement the diagnosis but are never a substitute for it.

Key Words: Appendicitis; Symptoms; Signs; Sensitivity; Specificity.

Acute appendicitis is a common surgical condition, despite technologic advances; the diagnosis of appendicitis is still based primarily on the patient's history and the physical examination[1]. Although most patients with acute appendicitis can easily be diagnosed, for many of them the signs and symptoms are variable and a firm diagnosis can be difficult. The percentage of appendectomies performed where the appendix is subsequently found to be normal varies between 15% and 30%[2-4]. Clinical judgment still remains the most important diagnostic tool for acute appendicitis[5]. Reductions in the number of "unnecessary" or non-therapeutic operations should not be achieved at the expense of an increase in number of perforations[6].

In up to 30 percent of the patients, the appendix may be "hidden" from the anterior peritoneum by being in a pelvic, retroileal or retrocolic (retroperitoneal retrocecal) position. The "hidden" position of the appendix notably changes the clinical manifestations of appendicitis[7]. There is a general trend to rely on laboratory tests in patients with equivocal signs or sometimes even with convincing signs, in the final decision making regarding operation. Most commonly available laboratory tests are total white blood cell counts (TWBCs). Some cases of acute appendicitis with normal white cell counts may be missed by the junior surgeons. Such patients present later on with various

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complications like appendicular mass, abscess or peritonitis due to perforation[5].

The purpose of this study was to evaluate the reliability of clinical examination and common laboratory tests e.g. total white cell counts in the diagnosis of acute appendicitis in our setting at eleven surgical departments of major hospitals of Khartoum State (Sudan).

PATIENTS AND METHODS

This study was conducted at multicentre of surgery, from January 2006 to August 2007. It included all adult patients [866] above 16 years of age of either gender with clinical diagnosis of acute appendicitis who had undergone appendicectomy at eleven surgical departments of major hospitals of Khartoum State, Sudan (Khartoum teaching hospital, Elribat National University hospital, Khartoum North teaching hospital and Omdurman teaching hospital). The patients were admitted through emergency department. A detailed history was taken. Thorough physical examination and relevant laboratory tests (e.g. total white cell count) were done in all cases. The cases were assessed by the senior registrars or consultants and operated on within 12 hours of admission. The duration of the condition is defined as the time from the onset of symptoms to presentation.

The decision to operate was made on the basis of history and clinical examination. Appendicectomy was done by using Grid-iron muscle splitting or small transverse (Lanz's) incision. The operative findings were recorded for each case of the removed appendices. The inflammation of appendix was graded as normal, acutely inflamed and gangrenous. In patients with normal appendix other possible conditions responsible for the symptoms and abnormal laboratory findings were also noted. The data were analyzed using SPSS.

RESULTS

The study included 866 patients (452 males and 414 females) of acute appendicitis who had undergone appendicectomy with preoperative diagnosis of acute appendicitis. The male to female ratio was 1.1:1. The age distribution ranged from 16-59 years, and mean ± Std. Deviation being 28.84±9.689 years. The incidence of acute appendicitis was maximum in the second and third decades of life (59.2% patients, 16-29 years), as shown in graph 1.

A total of 495 patients (57.6%) presented within 24 hours of onset of complaints with sensitivity and specificity of 89.4% and 72.3% respectively, whereas 86 patients (9.9%) had history of more than 72 hours with sensitivity and specificity of 67.3% and 68.5% respectively. In 201 (23.2%) patients, there was past history of similar attacks, with mild to moderate pain in right lower quadrant. The sensitivity and specificity of past history of similar attacks were found to be 82.3% and 51.3% respectively. On admission, 625 (72.2%) patients had fever of variable degrees [37-38.2 $^{\circ}$C] with sensitivity and specificity of 63.8% and 39.2% respectively.

Many patients presented with nausea, vomiting and diarrhea which had been seen in 713 (82.3%), 153 (17.7%) and 328 (37.9%) of the patients respectively.

The site of tenderness was variable, but in the majority it was in the right iliac fossa. Muscle rigidity and rebound tenderness were present in 760 (87.8%) of patients. Rovsing's sign, psoas test, and Obturator's test were positive in 807 (93.2%), 651 (75.2%), and more than 576 (66.5%) of patients respectively. Table 1 shows the various sensitivities and specificities recorded.

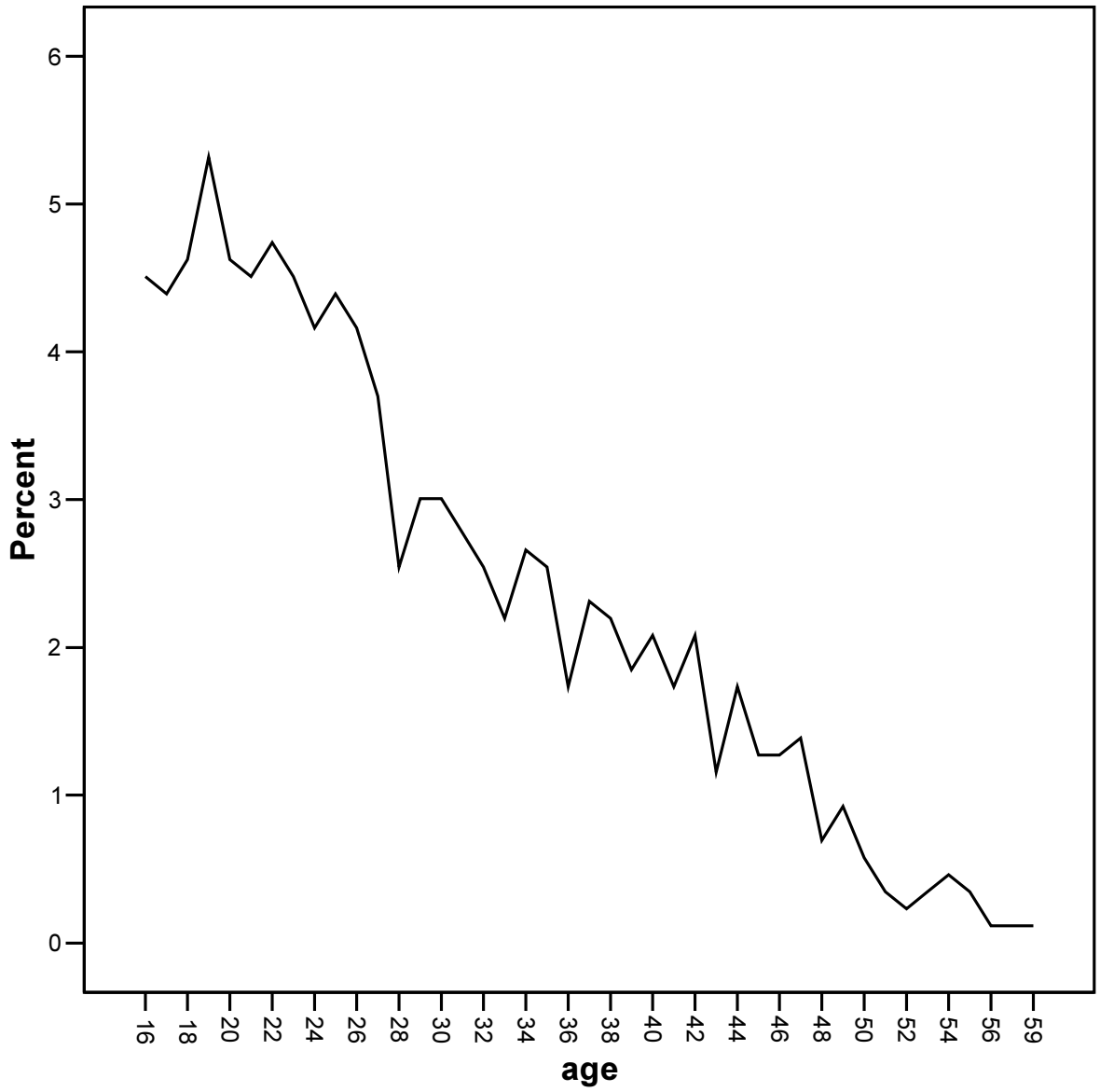
Table 1: The sensitivities and specificities of the common symptoms and signs.

Symptom / Sign	Sensi	Speci
RLQ tenderness	96.9	14.2
Dunphy's sign	95.1	80
Rovsing's sign	94.3	14.2
Rigidity and guarding	91	33.6
Psoas's sign	75.8	29.2
Obturator's sign	67.7	41.6
RLQ pain	85.7	58.1
Fever	63.8	39.2
Anorexia	95.6	70.9
Nausea	91.2	87.6
Vomiting	77.2	41.5
Diarrhea	52.3	27.9

In this study, clinical diagnosis was the main stay but in every case total white blood cells count was done. The total white blood cells count ranged from 3.70 to 45.30 /mm^3 (mean 17.5353 /mm^3). It was <10,000/mm^3 in 133 (15.4%) patients.

Appendix was gangrenous in 160 (18.48%) and acutely inflamed in 593 (68.47%) cases. Macroscopically 113 appendices were found normal on the basis of naked eye appearance and after histopathology, 102 (11.8 %) proved to be normal, the so-called negative appendicectomy. The operative findings in patients having normal appendix included pelvic inflammatory disease, mesenteric lymphadenitis, ruptured ovarian cyst, inflamed Meckel's diverticulum and Crohn's disease. The diagnosis in 61 patients remained uncertain.

Postoperative nonspecific fever for one or two days was present in 39 cases (4.5%). Post operative complications were present in 35 patients (4.0%) and local wound infection was the most common among them. It ranged from stitch abscesses to deep infection. There was no mortality in this study.



Graph1: The incidence of acute appendicitis.

DISCUSSION

Acute appendicitis is commonly encountered in the emergency department, and it continues to be a challenge because of its variable presentation. This study was carried out to test the reliability of various conventional symptoms and signs in establishing a diagnosis of acute appendicitis in the emergency department setting. Controversy still exists over determining which patient is to be operated on.

In this study, the age distribution ranged from 16-59 years, and mean ± Std. Deviation being 28.84 ± 9.689 years. In comparative international study, the commonest age group was 10-30 years in 90% of patients[8]. Amir M and Shami IH found in their study that 44.8% of cases were in their 2nd decade and 30% cases were in 3rd decade with a gradual decrease in incidence with increasing age[4]. Male to female ratio in the present study is 1.1:1 which is more or less similar to that found by Walker et al. (1.3:1)[3] but, differs from what had been reported by Wazir et al. (2.2:1.2)[9].

Duration of symptoms exceeding 24 to 36 hours is uncommon in nonperforated appendicitis[10].

This study showed that, the sensitivity and specificity were 89.4% and 72.3% respectively within 24 hours of presentation, and 67.3% and 68.5% after 72 hours. Thus, as the time lapse from the onset of symptoms to the presentation, the increases in specificity remain high while the sensitivity falls greatly after the first 24 hours. These results agree with Wani et al. in their study[11].

Wagner et al. revealed the sensitivity and specificity of low-grade fever of 67% and 69% respectively[12]. The sensitivity is comparable to the result of this study (63.8%), however the specificity is different from our finding (39.2%).

The sensitivity and specificity of anorexia in diagnosis of acute appendicitis of 95.6% and 70.9% were similar to reports[12].

In our study, we calculated general sensitivity and specificity values of nausea as 91.2% and 47.6% respectively. This is higher than others' findings[12,13]. Higher sensitivity value which is found in this study implies that a negative symptom of nausea may exclude acute appendicitis more reliably (low number of false negative symptom).

On the other hand, vomiting has a comparable lower sensitivity and specificity[12,13].

Abdominal pain is the most common symptom of appendicitis[12]. The most consistent and frequent sign was right lower quadrant tenderness in 827 (95.5%) patients and then increased pain upon coughing (Dunphy's sign) in 820 (94.7%) patients. Lower rates of abdominal pain in cases of appendicitis were reported in literature[8]. In multiple studies, specific characteristics of the abdominal pain and other associated symptoms have proved to be reliable indicators of acute appendicitis[1, 14, 15]. This study revealed that the sensitivity and specificity of the right lower quadrant pain was 85.7% and 58.1% respectively. This goes with reports from elsewhere[12].

In this study, the calculated sensitivity and specificity values of Dunphy's sign were different from that reported by Colledge et al[16].

Other signs of acute appendicitis showed variable values of sensitivity and specificity. Their comparison and correlation with other studies are shown in Table 2.

Table 2: Comparative correlation of signs of acute appendicitis

	Our study		Wagner at al		Jahn et al	
Sign	Sens.	Spec.	Sens.	Spec.	Sens.	Spec
Guarding	91%	33.6%	39%	57%	74%	84%
R. tenderness	96.9%	14.2%	63%	69%	-	-
Rovsing's sign	94.3%	14.2%	-	-	68%	58%
Psoas sign	75.8%	29.2%	16%	95%	-	-

Laboratory investigations usually contribute little and can be misleading. Coleman et al. found that the proportion of gangrenous and perforated appendices in patients with a normal white count is the same as in those with raised counts[17].

After exclusion of cases with other surgical conditions necessitating exploration, the sensitivity and specificity of raised white cell count (WBC) in acute appendicitis in our patients were 84.6% and 14.2% respectively. There is a correlation of sensitivity but not of specificity of (WBC) with the studies carried out by others[18,19]. In this study leukocytes count was >10,000/mm^3 in 733 (84.6%) patients. According to reports, WBC count was elevated (greater than 10,000 per mm^3 [100 3 10^9 per L]) in 49% and 80% of all cases of acute appendicitis respectively[19,20]. The WBC was elevated in up to 70 percent of patients with other causes of right lower quadrant pain[21]. Thus, an elevated WBC has a low predictive value. Serial WBC measurements (over 4 to 8 hours) in suspected cases may increase the specificity, as the TWBC count often increases in acute appendicitis (except in cases of perforation, in which it may initially falls)[15].

In spite of all diagnostic modalities, preoperative diagnosis of appendicitis is still confusing for clinicians. New diagnostic techniques such as estimation of C-reactive protein, peritoneal aspiration cytology, scoring and computer analysis, graded compression ultra sonography, computed tomography, non contrast helical computed tomography and laparoscopy have been introduced in recent years[22]. The drawback with these techniques is involvement of additional costs and lack of free availability. Due to these factors these modalities have not gained wide acceptance as routine diagnostic investigations of acute appendicitis. The diagnosis of acute appendicitis is still primarily based on history and physical examination.

The vagaries of presentation and the variability of signs are such that even the most experienced surgeons may remove normal appendices or "sit on" those that have perforated. The squeals of delayed diagnosis may result from late presentation by the patient but are sometimes due to the initial failure of the clinician to make the correct diagnosis[23].

The negative appendicectomy rate reported in the surgical literature varies from 8-33%[24]. Nevertheless, higher figures reaching 75% were also reported (table3). However, there is some international improvement in the diagnosis of acute appendicitis due to modern imaging techniques and the development of different scoring system, based on the clinical symptoms and signs, as well as laboratory investigations[25].

The study revealed that the negative appendicectomy rate was 11.8%, which is comparable with other global studies shown on table 3[26-35].

Table 3: Negative appendicectomy rates

Authour	Year	N. append.
Ross et al[26]	1962	42%
Hobson et al[27]	1964	19%
Lichtner et al[28]	1971	75%
Chang et al[29]	1973	33%
Lewis et al[30]	1975	20%
Mason et al[31]	1976	36%
Jess et al[32]	1981	30%
Van Way et al[33]	1982	24%
Arian et al[34]	2001	16.1%
Khan et al[35]	2005	18.6%

N. append.= negative appendicectomy

CONCLUSIONS

Clinical assessment is the best criterion to reach a confident diagnosis. The total WBC count and sometimes ultrasonography may be used in diagnosis of right iliac fossa pain as a diagnostic aid in doubtful cases in association with physical findings but, it doesn't replace the clinical skills of general surgeons. Symptoms such as anorexia, nausea and vomiting commonly occur in acute appendicitis. However, the presence of these symptoms does not necessarily increase the likelihood of

appendicitis nor does their absence decrease the likelihood of the diagnosis. Moreover, other symptoms have more notable positive and negative likelihood ratios.

We do not yet have an accurate means of diagnosis, and therefore the decision to operate will continue to be based on clinical backgrounds with minimal reliance on laboratory findings.

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