

Original Research Article

Diagnosing Acute Appendicitis in Children: Importance of Clinical Assessment

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ABSTRACT

Background: The diagnosis of acute appendicitis is challenging specially in the pediatric population, due to potential atypical clinical presentations. Despite the available multiple modern diagnostic tools the diagnosis of acute appendicitis is still primarily done by taking into account history and physical findings and raised differential count. In this study we have compared the diagnostic value of various elements of the disease history and clinical findings and differential counts in patients with suspected appendicitis.

Methodology: In this prospective type of study, a total of 102 patients with clinical diagnosis of acute appendicitis were admitted during the study period of one calendar year. On admission, a good clinical history and proper physical examination was performed. All patients were investigated by doing total leucocytes count, differential count, left shift and complete urine examination. All the eligible patients who finally diagnosed clinically as having acute appendicitis were planned for emergency open appendectomy. The removed appendix was sent for histopathological examination (HPE) in all the study subjects. HPE report was made available and was taken as final diagnosis.

Results: A total of 102 patients with clinical diagnosis of acute appendicitis were admitted during the study period and on histopathology there was no evidence of appendicular inflammation in 9 patients. The symptoms of nausea/ vomiting and periumbilical pain migrating to right iliac fossa were found to be good predictors of appendicitis. Among the signs the presence of tenderness at McBurney's point, guarding in RIF and rebound tenderness were significant predictors of appendicular inflammation. A normal value of total leucocytes count was a good evidence of ruling out the appendicitis. Neutrophils were found to be shifted on left side in majority of the cases of appendicitis.

Keywords: acute appendicitis, children, clinical signs.

INTRODUCTION

Acute appendicitis (AA) is the most common surgical emergency in childhood. [1] The diagnosis of acute appendicitis is challenging specially in the pediatric population, due to potential atypical clinical presentation in this age group, non-specific clinical symptoms and also a wide range of differential diagnoses. [2]

The sensitivity of clinical examination alone in pediatric age group ranges between 54% and 70% compared to 70% to 87% in adults. [3] However when the imaging investigations like USG, CT and MRI are also taken into account for diagnosis of acute appendicitis the sensitivity may reach up to 95-100%. [4,5] But each investigation has its own limitations. As a result the diagnosis of

acute appendicitis still depends on the good clinical history, physical findings and differential counts. Although these criteria have taken a back seat in the making of a surgical decision in acute abdomen but in appendicitis it is justified for early operative intervention to prevent the complications of delayed interventions. In this study we have compared the diagnostic value of various elements of the disease history and clinical findings and differential counts in patients with suspected appendicitis.

METHODOLOGY

The present study, a prospective type of study was carried out in the Department of Pediatric-surgery at Pt. B. D. Sharma, Postgraduate Institute of Medical Sciences, Rohtak. All the pediatric patients (up to 14 years of age) presented to the emergency department, PGIMS, Rohtak in one calendar year (Feb 2012 - Jan 2013), for acute right lower abdominal pain and admitted to pediatric surgery department with provisional clinical diagnosis of acute appendicitis were included in this study. A total of 102 patients with clinical diagnosis of acute appendicitis were admitted during the study period. Patients with nonspecific symptoms, not suspected to have appendicitis and patient with appendicular lump on per abdominal examination were excluded from the study. Such patients were managed conservatively and were kept under observation.

On admission, a good clinical history and proper physical examination was performed on all the subjects admitted with clinical diagnosis of acute appendicitis. Informed consent was taken from guardian of the patient before starting the interview. After recording basic information, a good clinical history focusing on describing the abdominal pain, duration of pain, site of start of pain and any history of migration of pain, nausea/vomiting, anorexia, diarrhea and fever was recorded. Past history of similar pain was also extracted.

A good general physical examination was performed starting from

general looks, vital signs like pulse rate and temperature and the same were recorded. After general physical examination, child was first asked to point out the site of maximum pain. A detailed examination was carried out giving special attention to right lower quadrant, point of maximum tenderness, rebound tenderness, muscle guarding and any palpable lump. All patients were investigated by doing total leucocytes count, differential count, left shift and complete urine examination and ultrasound of the abdomen for appendicitis.

All the eligible patients who finally diagnosed clinically as having acute appendicitis were planned for emergency open appendectomy. Afterwards emergency appendectomy was done by conventional method. The removed appendix was sent for HPE in all the study subjects. HPE report was made available and was taken as final diagnosis. According to the histopathological results, patients were classified into the following groups: normal appendix (no evidence of any inflammation in any layer of appendix), acute appendicitis, gangrenous appendicitis (diffuse infiltration of granulocytes or areas of necrosis extending through the wall) and perforated appendicitis. Acute appendicitis was grouped under simple appendicitis (SA) and gangrenous and perforated under complicated appendicitis (CA) subgroups. Histopathological results (Gold standard) were compared with clinical diagnosis.

Statistical analysis

All the collected data were entered in Microsoft excel spreadsheet. All the categorical variables were analyzed by applying Chi-Square test and continuous variables were analyzed by applying independent t-test. Sensitivity, specificity, positive predictive value and negative predictive value were also calculated. All the analyses were done in SPSS (Statistical Package for Social Sciences) version 17.

RESULTS

In this present study a total of 102 consecutive cases were operated based on

clinical diagnosis of acute appendicitis. Out of these 93 cases were histopathologically appendicitis, rest 9 cases showed no evidence of inflammation so rate of negative appendectomy was 8.9%.

Demographics

Out of all cases, 79 cases were boys, rest were girls thus male: female ratio was 3.5:1. The most common age group was 10-14 yrs. Mean age at presentation was 9.95 ± 2.45 years in boys whereas in girls it was 10.26 ± 2.94 years. Difference in mean age at presentation was not statistically significant ($p=0.141$)

History, sign and symptoms analysis

Most common symptoms were pain in right iliac fossa (100%), nausea and vomiting (93.5%), periumbilical start of pain (60.2%) and migration of pain from periumbilical region to right iliac fossa (60.2%). Anorexia and diarrhea were uncommon symptoms present only in few cases. Most common signs were tenderness at McBurney's point (98.9%), rebound tenderness (96.7%), and tachycardia (60.2%). Fever was present only in 44% cases and guarding in only 30% cases.

Among all patients, start of pain was periumbilical in 58 cases (56.9%) while in rest it was started in right iliac fossa. It was started in periumbilical region in 56 cases (60.2%) among AA and only two cases (22.2%) among NA. This difference in site of start of pain was found to be statistically significant ($p \text{ value} < 0.02$). ([Table 1](#))

History of anorexia was present in 40 cases (39.2%) out of which 37 cases had appendicitis and 3 cases with no appendicitis. This difference was not statistically significant ($p \text{ value} = 0.070$). Out of total 102 cases diarrhea was present in only 5 cases (4.9%) and all had appendicitis. Out of these 5 cases there was perforation in two cases, rest 3 were not perforated.

Nausea and vomiting was present in 91 cases (93.5%), out of which 87 cases had appendicitis and 4 cases with no appendicitis. This difference was statistically significant ($p \text{ value} < 0.001$).

Analysis of signs

On analysis of sign variables, general condition was fair in 72 cases (70.6%) and rests were sick.

Tachycardia was more common in patient with appendicitis than without it and it was statistically significant ($p \text{ value} < 0.001$). Fever was more common in patient with appendicitis.

On per abdominal examination tenderness at Mc Burney's point was present in 100 cases and it was more common in patient with appendicitis (98.9%) than without appendicitis (88.8%) making it statistically significant ($p \text{ value} < 0.03$). Majority of the appendicitis cases (96.7%) had rebound tenderness except three (3.3%). Rebound tenderness was also present in about one fifth (22.3%) cases without appendicitis, rest were not having any rebound tenderness; and this difference was found to be statistically significant ($p \text{ value} < 0.001$).

When guarding in RIF was analyzed, it was found to be present in about one third (30.4%) cases, rest (60.8%) were not having guarding in RIF. None of the cases without appendicitis had guarding, this difference in guarding was found to be statistically significant ($p \text{ value} 0.03$) ([Table 2](#)).

Laboratory investigations analysis

TLC was raised in majority of cases (91.5%) with simple appendicitis and in only 59.1% cases of complicated appendicitis. TLC was also raised in 66.7% cases with no appendicitis. This was found to be statistically significant ($p \text{ value} < 0.001$) Mean TLC among acute appendicitis cases was 13946.48 and 11318.18 in complicated appendicitis while it was 10622.22 in cases without appendicitis, this difference in mean TLC was analyzed by ANOVA test and it was found statistically significant ($p \text{ value} 0.01$) ([Table 3](#)).

When analysis of raised TLC was done with duration of symptoms in appendicitis then statistically significant ($p \text{ value} 0.03$) raised TLC were found in early period as compared to late presentation ([Table 4](#))

Table 1: Analysis of history and symptoms variables

Variables in history and symptoms		Histopathology		Total	p value
		Appendicitis (AA)	No appendicitis (NA)		
Past H/o similar pain	Yes	22(23.6)	01(11.2)	23(22.5)	0.39
	No	71(76.4)	08 (88.8)	79(77.5)	
Start of pain	Periumbilical	56(60.2)	02(22.2)	58(56.9)	0.02*
	RIF	37(39.8)	07(67.8)	44(43.1)	
Migration of pain	Yes	56(60.2)	02(22.2)	58(56.9)	0.02*
	No	37(39.8)	07(67.8)	44(43.1)	
Anorexia	Yes	37(39.8)	03(2.9)	40(39.2)	0.070
	No	56(60.2)	06(5.9)	62(60.8)	
Diarrhea	Yes	05(5.4)	0	05(4.9)	0.47
	No	88(94.6)	09(100)	97(95.1)	
Nausea/ vomiting	Yes	87(93.5)	04(44.4)	91(89.2)	< 0.001*
	No	06(6.5)	05(55.6)	11(10.8)	
Analgesics intake	Yes	21(20.6)	03(2.9)	24(23.5)	0.46
	No	72(70.6)	06(5.9)	78(76.5)	

Figures in parenthesis are in percentages, *=significant

Table 2: Analysis of signs variables

Variables of signs		Histopathology		Total	p value
		Appendicitis	No appendicitis		
General Condition	Fair	64(68.8)	08(88.8)	72(70.6)	0.20
	Sick	29(31.2)	01(11.2)	30(29.4)	
Pulse Rate	Normal	37(39.8)	05(55.5)	42(41.2)	< 0.001*
	Tachycardia	56(60.2)	04(44.5)	60(58.8)	
Temperature	Normal	52(55.9)	07(77.7)	59(57.8)	0.20
	Fever	41(44.1)	02(22.3)	43(42.2)	
Tenderness at McBurney's point	Yes	92(98.9)	08(88.8)	100(98)	0.03*
	No	01(1.1)	01(11.2)	02(2.0)	
Rebound Tenderness	Yes	90(96.7)	02(22.3)	92(90.1)	< 0.001*
	No	03(3.3)	07(77.7)	10(9.9)	
Guarding RIF	Yes	31(30.4)	00	31(30.4)	0.03*
	No	62(60.8)	09(8.8)	71(69.6)	

Figures in parenthesis are in percentages, *=significant

Table 3: Analysis of Total leucocytes count (TLC)

TLC	Histopathology			Total	p value
	No appendicitis	Simple appendicitis	Complicated appendicitis		
Normal	03(33.3)	06(8.5)	09(40.9)	18(17.6)	0.001*
Raised	06(66.7)	65(91.5)	13(59.1)	84(82.4)	
Total	09(100)	71(100)	22(100)	102(100)	
Mean±SD	10622.22±1956	13946.48± 2755	11318.18±3716	13086.27±3190	< 0.001*

Figures in parenthesis are in percentages, *=significant

Table 4: Analysis of TLC with duration of symptoms in appendicitis

Duration of symptoms	No of patients	Mean TLC	Std. deviation	p value
<48 hours	58(62.3)	13875.86	2893.205	0.03*
>48 hours	35(37.7)	12411.43	3489.039	

Figures in parenthesis are in percentages, *=significant

Table 5: Analysis of left shift of Neutrophils

		Histopathology		Total	p value
		Appendicitis	No appendicitis		
Left shift	Yes	75(73.5)	04(3.9)	79(77.5)	0.01*
	No	18(17.6)	05(4.9)	23(22.5)	

Figures in parenthesis are in percentages, *=significant

Left shift of neutrophils was found in 75 cases (73.5%) of acute appendicitis as compared to 4 cases (3.9%) without appendicitis, this difference in left shift of neutrophils was found statistically significant. ([Table 5](#))

DISCUSSION

Acute appendicitis traditionally has

been a clinical diagnosis and remains so to this day. The diagnosis can be difficult to make in many children who may present with atypical sign and symptoms or an equivocal physical examination. [5] Delay in diagnosis, especially in children can lead to morbidity and even mortality. [6] To prevent delay in diagnosis various investigations have been tried but diagnosis of acute

appendicitis is still clinical. Till date we have no laboratory parameters that could indicate or reliably point on presence or absence of acute appendicitis. [7-9] The clinical diagnosis still remains the corner stone in acute appendicitis; nevertheless, laboratory investigations provide significant complimentary aid in diagnosis. In this study we compare the diagnostic value of various elements of the disease history and clinical findings and differential counts in patients with suspected appendicitis.

The age-specific incidence progresses from extremely low in the neonatal period to a peak incidence between ages 12 and 18 years. The peak incidence of appendicitis in children occurs in early adolescence and it is exceedingly rare in children under 2 years of age. Several investigators have documented a higher incidence of acute appendicitis in preadolescents/adolescents and young adults. [2] In this age group, a proliferation of submucosal lymph tissue was observed in the appendix. An increase in the amount of lymphoid tissue in the appendiceal wall is thought to be the key determinant of local immunological and inflammatory responses to infectious or environmental agents, resulting in acute appendicitis. [2]

In this study most common symptoms in patients with appendicitis were pain in right iliac fossa (100%), nausea and vomiting (93.5%), periumbilical start of pain (60.2%), migration of pain (60.2%). Anorexia was present only in 40% cases. Several authors have examined the frequencies of these variables. In the largest of these studies, Williams et al reported on children younger than 15 years with appendicitis, 81% had nausea, 77% vomiting, and 66% anorexia. [4] Nelson et al examined children younger than 12 years with appendicitis and found that 84% of children presented with anorexia. [10] Several other authors, including O'Shea et al have commented on the strong association between vomiting and appendicitis while some showed vomiting as unreliable symptom. [11]

Most common signs were tenderness at McBurney's point (98.9%) and rebound tenderness (96.7%). Tachycardia (60%) and fever (44%) was found less commonly. Same has been found by some other studies. Bundy et al found that in children with abdominal pain, fever was the single most useful sign associated with appendicitis. [12] Andersson et al found that the signs found on clinical examination which are associated with a high positive likelihood ratio are signs of peritoneal irritation (rebound and percussion tenderness, guarding and rigidity). [13] Muller AM et al found that out of 856 children by consideration of the factors "leucocyte count", "vomiting" and "percussion tenderness" 75% of the children would have been allocated to the accurate postoperative pathomorphological diagnosis of appendicitis. [14]

Total leucocytes count (TLC) is the most common and most studied laboratory investigation with regards to appendicitis. Regarding the cut-off values of TLC the review of literature did not show any reliable cut-off values to signify simple acute appendicitis in children. Studies have been carried out to determine the cut-off values from the onset of symptoms to diagnosis; but they all vary in results. [15,16] In the present study, TLC was raised in majority of cases (91.5%) with simple appendicitis and in only 59.1% cases of complicated appendicitis. TLC was also raised in 66.7% cases with no appendicitis. This was found to be statistically significant (p value <0.001). Mean TLC among acute appendicitis cases was 13946.48, while it was 10622.22 in cases without appendicitis. Leukocytosis is a non-specific reaction induced by many conditions. This is reflected in numerous reports by an acceptable sensitivity (79-93%) but a rather low specificity for appendicitis. [17,18]

In this study there were 9 histopathologically negative appendices so negative appendectomy rate was 8.9%. Surgical community traditionally accepts a 10% to 20% negative appendectomy rates in

order to minimize the incidence of perforated appendicitis with its increased morbidity. Thus the negative appendectomy rate in the present study was within permissible limits. The negative appendectomy rates which have been described in literature vary from 5-35%. Oyetunji TA et al in a study found younger age, female gender; Black ethnicity and rural hospitals are independent predictors of negative appendectomy. These factors can be incorporated into diagnostic algorithms to improve the accuracy of diagnosis of appendicitis in children. [19] Bachur RG et al found that negative appendectomy rates were highest for children younger than 5 years (boys 16.8%, girls 14.6%) and girls older than 10 years (4.8%). [24] To decrease the negative appendectomy various new imaging modalities (especially CT scan) have been used but with conflicting reports. [20]

In this study, perforated appendices were found in 18 cases (17.6%). Perforation rates which have been described in literature vary between 5-62%. [3-6] Various risk factors associated with increased incidence of perforation have been studied which includes; extremes of ages, [21] male sex, [21] race, rural locality, delays in presentation or diagnosis, lack of insurance or financial coverage status, hospital volume, presence of appendicolith. [22-24]

CONCLUSIONS

Authors are of the opinion the natural history of appendicular inflammation follows the traditional symptomatology as well as raised leucocytes and it is fairly justified to remove the appendix by applying the conventional diagnostic criteria in this era of radiological evolution. Despite studies advocating routine use of medical imaging for patients with suspected acute appendicitis, this study showed that the clinical evaluation is still paramount to the management of patients with suspected acute appendicitis before considering medical imaging. If acute appendicitis is ruled out (by testing and/or

medical imaging), the patient can be sent home from the emergency department. In a tertiary care setting, this strategy may be successful, especially where patients do not live far from the hospital. However, in smaller level setups, discharging a patient with a clinical suspicion of appendicitis and normal medical imaging might not be a safe option

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