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ACUTE APPENDICITIS IN CHILDREN;

CORRELATION OF CLINICAL DATA WITH HISTOPATHOLOGICAL FINDINGS

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ABSTRACT… Objective: The study was conducted to identify clinical features significantly associated with histopathologically proven appendicitis in children. **Design:** Cross-Sectional Observational. **Place and Duration of study:** This study was conducted in Department of Paediatric Surgery, Shaikh Zayed Hospital, Lahore between August 2010 to August 2012. **Patients and methods:** Children aged 2 to 14 years who underwent appendectomy for acute appendicitis during the study period were included. Patients who had appendectomy for any reason other than appendicitis were excluded. Presenting symptoms, signs, hospital course of patients and histopathological diagnosis were recoded. Data was analyzed by using SPSS. Sensitivity, specificity, positive predictive value and negative predictive value for each symptom and sign were calculated. **Results:** Out of 1420 patients who were evaluated during the study period for acute abdominal pain, 70(5%) were diagnosed with acute appendicitis. Four patients left against medical advice so 66 patients were studied. Patients were divided into acute appendicitis and non-inflamed appendix group on the basis of histopathology of resected appendix. Acute appendicitis was confirmed histologically in 43 (65%) cases and perforated appendicitis was found in 8 (12%). No evidence of acute inflammation was found in 15 (22%) cases. Among clinical features only involuntary guard (p-value 0.01) and rebound tenderness (p-value 0.004) were significantly different among acute appendicitis and non-inflamed appendix group. Total leukocyte count more than 11,000 was significantly higher in acute appendicitis group. **Conclusions:** The cornerstone of diagnosis of acute appendicitis in children is thorough history and meticulous physical examination. Involuntary guard, rebound tenderness and total leukocyte count more than 11,000 were significantly more prevalent in biopsy proven cases of appendicitis.

Key words: Acute appendicitis, Children, Histopathology, Symptoms & Signs

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INTRODUCTION

Acute abdominal pain is one of the common complaints which pediatric surgeons come across on daily basis. In many cases, the cause is a self-limiting disease process like gastroenteritis or constipation[1,2]. The most common surgical cause of non-traumatic acute abdominal pain in children is acute appendicitis[3,4]. In United States seventy seven thousand pediatric hospital discharges each year are for appendicitis and other appendiceal conditions[5].

The diagnosis of appendicitis in children is problematic because many present with symptoms and signs that resemble other common but self-limiting causes. They often lack classic clinical features seen in adults and this poses challenge for the treating physician in making a timely diagnosis[3]. Delayed diagnosis especially in young children is common and in one third of patients perforation occurs prior to the operative intervention[5] increasing morbidity and mortality.

On the other hand around 10-30% of children have their appendices removed unnecessarily[6] increasing the cost and morbidity. It is important to

make a timely diagnosis and avoid removal of normal appendices.

The present study was conducted to identify clinical features significantly associated with histopathologically proven appendicitis in children.

PATIENTS AND METHODS

This study was conducted during August 2010 to August 2012 in Department of Pediatric Surgery, Shaikh Zayed Medical Complex Lahore. Patients between 2 years to 14 years of age who underwent appendectomy for acute appendicitis were included. Patients who had their appendix removed for malrotation, or for any reason other than acute appendicitis were excluded.

A questionnaire was filled for every admitted patient, which included age, gender, presenting symptoms and signs, laboratory test results, hospital follow up and diagnosis at the time of discharge. The collected data included duration, location, migration to right lower quadrant and character (colicky, dullache, burning) of pain. Associated symptoms like sore throat, anorexia, vomiting, fever, burning micturition, constipation and diarrhea were also noted. Physical examination included pulse rate, temperature, area of maximum tenderness, involuntary guard, rebound tenderness, any palpable masses and abdominal distension. Once diagnosis of appendicitis was made patients were prepared for surgery. All the patients received first dose of metronidazole and ceftazidime before surgery. All resected specimens were sent for histopathology and results were recorded. For non-complicated appendicitis patients received antibiotics for 2 days. In cases of perforated appendicitis intravenous antibiotics were continued for 5 days. The patients in whom pathology results were not available were not included. Patients were divided into acute appendicitis and non-inflamed appendix group on the basis of histopathology.

Data was analyzed by using SPSS 20. Data for symptoms and signs was presented for the two groups by using frequency and percentages. Comparison for each symptom and sign between groups was made by using chi square test. Sensitivity, specificity, positive predictive values and negative predictive values were calculated for each symptom and sign. p-value less than 0.05 was considered significant.

RESULTS

During the study period 1420 patients were evaluated for acute abdominal pain and acute appendicitis was diagnosed in 70 (5%) cases. Four patients left against medical advice so 66 patients were studied. There were 45 (68%) male and 21(32%) female patients. Acute appendicitis was confirmed histologically in 43 (65%) cases and perforated appendicitis was found in 8 (12%). Although no evidence of acute inflammation was found in 15 (22%) cases but they were reported to have reactive lymphoid follicular hyperplasia.

For purpose of comparison patients with histologically proven appendicitis and perforated appendix were included in acute appendicitis (AA) group. Those patients who did not have histologic evidence of acute inflammation in appendectomy specimen were included in non-inflamed appendix (NA) group.

Age of the patients ranged from 3 -14 years with mean of 9.98 years and median of 10.00. Most of the patients 52 (78%) were between 7-12 years of age. Only 4 (6%) patients were below 7 years and half of them had perforated appendix at the time of surgery. Majority of the patients (50%) presented within 24 hours of onset of symptoms. In 89% cases duration of pain was less than 3 days. Duration of pain in different pathologies is shown in table-I. Although patients with perforated appendix had delayed presentation as compared to other two groups but the difference was not significant statistically. In 42.9% (9) of female patients appendix was acutely inflamed and in 23.8% (5) it was perforated. On the other hand 75.6% (34) of male patients had acute appendicitis and only 6.7% (3) had perforated appendix and this difference was statistically significant (p-value .025). In majority of the patients (91%), pain was located in right lower quadrant. All of the patients

with perforated appendix had anorexia, fever and involuntary guard at the time of admission. Distribution of symptoms and signs among different groups and their significance is shown in table-II. Among clinical features only involuntary guard (p-value 0.01) and rebound tenderness (p-value 0.004) were significantly different among acute appendicitis and non-inflamed appendix group. Rest of the symptoms and signs were not significantly different between the two groups. Total leukocyte count more than 11,000 was significantly higher in AA group. The most sensitive sign was rebound tenderness (98%) followed by tenderness in right iliac fossa (96.1%). Involuntary guard and pain in right iliac fossa had sensitivity of 92.2% and 90.2% respectively. Total leukocyte count higher than 11,000 had highest positive predictive value of 89.1%. The sensitivity, specificity, positive predictive value and negative predictive value of different symptoms, signs and total leukocyte count (TLC) are shown in table-III. Out of 15 cases in NA group, 9 (60%) had equivocal symptoms and signs at the time of admission and were operated after 24hours of observation in the hospital.

	Mean (days)	N	Std. Deviation
Acute appendicitis	1.79	43	1.264
Perforated Appendicitis	2.88	8	1.959
Non inflamed Appendix	2.13	15	1.302
Total	2.00	66	1.392

Table-I. Duration of pain (days) in different groups.

DISCUSSION

Appendicitis is the most common surgical emergency in children. Clearly the most difficult challenge has been to make a timely diagnosis of appendicitis, early enough to prevent rupture of appendix. Definitive diagnosis of appendicitis in children is made only in 50-70% of children at the time of initial presentation[6]. Delays in diagnosis can lead to significant morbidity from appendicular rupture, possibly leading to abscess formation and, more rarely, peritonitis and septic shock[2,3]. This may also lead to prolonged hospital stay, increased risk of wound infection and risk of late adhesive bowel obstruction[7].

To distinguish appendicitis from other abdominal conditions is difficult, particularly in young preverbal children, who typically present with complicated appendicitis due to their inability to give an accurate history and physician's low index of suspicion[8]. Diagnostic imaging is being used extensively, but has its own limitations and risks, like exposure to ionizing radiations and unavailability of skilled radiologists at all hours[9]. Therefore, current study was undertaken to identify the factors which were significantly associated with biopsy proven acute appendicitis in children.

Incidence of appendicitis, in the current study was 5% among children presenting with complaint of acute abdominal pain. In a cohort of 9424 children presenting with acute abdominal pain, incidence of appendicitis was reported to be 4.3% by Caperell et al10. In other studies who evaluated children with pain in right lower quadrant only, incidence of appendicitis ranged from 35-62%[11-13].

Appendicitis was more common in males and this was also reported by others[10-13,14]. Although appendicitis was more common in males but female patients had increased perforation rate and the difference was statistically significant (p-value 0.025).

The incidence of perforated appendicitis in current study was 12%. In a large population based study that included more than 19,000 cases of appendicitis, rate of perforated appendicitis was 28%[14]. In other studies perforation rate varied from 18-37%[2,4,6,9,11,13]. Incidence of perforation in our patients younger than 7 years, was 50% and similar result was reported by Aarabi et al[14]. Although, young children have lowest incidence of appendicitis but have greatest risk of perforation[2,14]. This may be caused by several factors, including low degree of suspicion of

	Acute Appendicitis		Non inflamed Appendix		Total		
	n	%	n	%	n	%	p-value
Pain Right iliac fossa	46	90.2	14	93.3	60	90.9	0.701
Anorexia	38	74.5	10	66.7	48	72.7	0.549
Vomiting	34	66.7	10	66.7	44	66.7	1.000
Color of vomits White	20	39.2	4	26.6	24	36.3	0.293
Tenderness Right iliac fossa	49	96.1	14	93.3	63	95.5	0.654
Fever	24	47.1	4	26.7	28	42.4	0.152
Involuntary Guard	47	92.2	10	66.7	57	86.4	0.011
Rebound tenderness	50	98	11	73.3	61	92.4	0.004
TLC> 11000	41	80.4	5	33.3	46	69.7	0.001

Table-II. Clinical features and their significance

	Sensitivity	Specificity	PPV	NPV
Pain Right iliac fossa	90.2	6.7	76.7	16.7
Anorexia	74.5	33.3	79.2	27.8
Vomiting	66.7	33.3	77.3	22.7
Fever	47.1	73.3	85.7	28.9
White colour vomiting	58.8	60.0	83.3	30.0
Tenderness Right iliac fossa	96.1	6.7	77.8	33.3
Involuntary Guard	92.2	33.3	82.5	55.6
Rebound tenderness	98.0	26.7	82.0	80.0
TLC> 11000	80.4	66.7	89.1	47.6

Table-III. Sensitivity, specificity, positive predictive value, negative predictive value of clinical features and TLC

appendicitis by treating physician and limited ability of these children to communicate their symptoms. Finally it is usually quite challenging for the surgeon to elicit specific signs of appendicitis in this group of children[14].

The negative appendectomy rate in our study was 22% which was more than reported in western literature which varied from 1-16%[6,7,11,12,15]. A study from India reported 53.2% negative appendectomy rate. Chandrasegaram from Australia reported results of 4670 appendectomy specimens and found that 24% of appendices were normal[16].

The studies that had low negative appendectomy

rate, had higher perforation rates than ours. Secondly CT scan was used in these studies routinely to diagnose appendicitis in children. A low threshold was probably practiced in our unit for removal of appendix and CT scan was not used to diagnose appendicitis because of its cost and risk of ionizing radiation.

The mean duration of pain was more in patients with perforated appendicitis as expected but the difference with other two groups was not statistically significant. Pain in right lower quadrant was noted in 90.2% of patients with AA and in 93.5% of patients with NA. The difference did not reach statistical significance and similar finding was reported by Bundy et al[5]. In a study by Lin et al that included patients with pain in right lower quadrant, only 53% had appendicitis[11]. So this is not a reliable symptom to differentiate patients with appendicitis from other pathologies.

Anorexia, nausea and vomiting were not significantly different in AA and NA groups in the current study. This was in contrast to other studies who gave high weightage to these symptoms[6,17]. Although fever was more prevalent in patients with AA (47.1% vs. 26.7%) but difference did not reach statistical significance. Similar was the case with tenderness in right lower quadrant. Among clinical features only involuntary guard and rebound tenderness were significantly different among patients with appendicitis and patients with non-inflamed appendix. Our findings were similar to the results reported in a meta-analysis by Bundy et al[5]. In agreement with other studies total leukocyte count was significantly higher in patients with appendicitis. Although pain and tenderness in right lower quadrant, anorexia, vomiting and fever were common in appendicitis but if studied alone, did not affect the diagnosis significantly. However, combination of these clinical features increases the likelihood of appendicitis. In our study rebound tenderness was most sensitive sign (98%) followed by tenderness in right lower quadrant (96%). Involuntary guard and pain in right lower quadrant had sensitivity of 92% and 90% respectively. Almost similar results were reported by Samuel et al[6]. Total leukocyte count more than 11000, had highest positive predictive value of 89.1%. The limitation of our study was that true negative cases could not be included so specificity and negative predictive values were not reflected truly.

In NA group 60% of patients, diagnosis was not clear at the time of admission. They were operated after 24 hours of in hospital observation, because they did not show signs of improvement. This approach was recommended by Cavusoglu et al[18]. This group of patients would have benefited most from radiological investigations.

Ultrasound had gained wide popularity for the diagnosis of appendicitis in children with equivocal presentation[19]. In a cohort of 454 patients, reported by Emil et al the sonography group had a higher incidence of pre-operative inpatient observation, a higher rate of negative appendectomy and higher rate of post-operative intra-abdominal infection[19]. It was recommended to use ultrasound in those patients who could not receive a definite diagnosis on clinical grounds alone[20]. Most importantly 24 hour availability of experienced sonographer would greatly enhance the utility of this modality.

CONCLUSIONS

In conclusion the cornerstone of diagnosis of acute appendicitis in children is thorough history and meticulous physical examination. Involuntary guard, rebound tenderness and total leukocyte count more than 11,000 were significantly more prevalent in biopsy proven cases of appendicitis. Selective use of ultrasonography done by an experienced paediatric radiologist can help in ruling out appendicitis in difficult cases.

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