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Complicated appendicitis: Analysis of risk factors in children

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ABSTRACT

Background: Acute appendicitis (AA) is the most common surgical emergency in childhood. The risk of rupture is negligible within the first 24 h, climbing to 6% after 36 h from the onset of symptoms. Because of difficulty in accurate diagnosis of AA a significant number of children still are being managed when it is already perforated. There is always a need to make an early diagnosis of AA and to find out the risk factors associated with development of complication in this condition. **Patients and Methods:** A total of 102 patients with a clinical diagnosis of AA were admitted during the study period. On admission, a good clinical history and proper physical examination was performed. All the eligible patients who finally diagnosed clinically as having AA were planned for emergency open appendectomy. The removed appendix was sent for histopathological examination in all the study subjects. **Results:** Out of 102 cases, 93 cases were histopathologically appendicitis, rest nine cases showed no evidence of inflammation so the rate of negative appendectomy was around 9%. On histopathology normal appendix was found in nine patients (8.9%), AA in 71 patients (69.6%), complicated appendicitis (CA) which includes perforated and gangrenous appendicitis was present in 22 patients (21.5%). Perforations were more common in patients who were younger than 5 years. >60% patients presented with CA when the duration of pain was >72 h. Presence of appendicolith increased the probability of CA.

Key words: Acute appendicitis, children, complication

INTRODUCTION

Acute appendicitis (AA) is the most common surgical emergency in childhood.[1] It occurs in almost all age-groups and is particularly difficult to diagnose in its early stage in infants and toddlers. The lifetime risk of developing appendicitis is approximately 9% in males and 7% in females. Approximately 30-75% of children present with perforation, especially in younger children (<5 years).[2]

The risk of rupture is negligible within the first 24 h, climbing to 6% after 36 h from the onset of symptoms and remains steady at approximately 5% for each ensuring 12 h period, establishing a 36 h period from the onset of symptoms to surgery as a low risk period for appendiceal perforation.[3,4]

The diagnosis of AA is challenging specially in the paediatric population, due to potential atypical clinical presentation in this age group, non-specific clinical symptoms and also a wide range of differential diagnoses.[3] The initial misdiagnosis rate for appendicitis range from 28% to 57% for older children and may reach up to 100% for those 2 years or younger, despite clinical history, physical examination and diagnostic armamentarium including total leucocytes count (TLC), C-reactive protein (CRP), ultrasound, computed axial tomography scan and magnetic resonance imaging.[4] The early diagnosis is vital for the successful outcome because the delay in diagnosis can lead to gangrene or perforation with increased morbidity including wound infection, abscess formation, prolonged hospitalization, and mortality with an increased risk of malpractice litigation.Because of difficulty in accurate diagnosis of AA a significant number of children still are being managed when it is already perforated. There is always a need to make an early diagnosis of AA and to find out the risk factors associated with development of complication in this condition. The present study was done to determine the risk factors for complications in AA in paediatric patients.

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PATIENTS AND METHODS

The present study, a prospective type of study was carried out in the Department of Paediatric-surgery at Pt. B. D. Sharma, Postgraduate Institute of Medical Sciences, Rohtak. All the paediatric patients (up to 14 years of age) presented to the Emergency Department, PGIMS, Rohtak in 1 calendar year (February 2012-January 2013), for acute right lower abdominal pain and admitted to Paediatric Surgery Department with provisional clinical diagnosis of AA were included in this study. A total of 102 patients with a clinical diagnosis of AA 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 a clinical diagnosis of AA. After recording basic information like name, age, sex and address of the patients, 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 from periumbilical region to the right iliac fossa, nausea/vomiting, anorexia, diarrhoea 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 was recorded. Whether, a patient was having normal pulse rate or tachycardia, decided after considering expected normal pulse rate for the same age. After general physical examination, child was first asked to point out the site of maximum pain. A per-abdominal palpation was started from the site opposite to the site of maximum pain with warm hands. 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. Informed consent was taken from guardian of the patient before starting the interview. All patients were investigated by doing TLC, differential count, left shift and complete urine examination. A preoperative ultrasonography was also done.

All the eligible patients who finally diagnosed clinically as having AA were planned for emergency open appendectomy and the patient counselling was carried out before surgery. Guardians of all the subjects were explained clearly beforehand for the least possibility of misdiagnosis resulting to negative exploration and other differentials as a universal rule in AA. Afterwards, emergency appendectomy was done by conventional method. Intra-operative findings like location of appendix, gross appearance of appendix i.e., whether it was inflamed or not, perforation status of the appendix, etc., was recorded. In case of perforation, site of perforation in the appendix was also recorded.

The removed appendix was sent for Histopathological Examination (HPE) in all the study subjects. Post-operative stay and any wound infection were also recorded. 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), AA, gangrenous appendicitis (diffuse infiltration of granulocytes or areas of necrosis extending through the wall) and perforated appendicitis. AA was grouped under simple appendicitis (SA) and gangrenous and perforated under complicated appendicitis (CA) subgroups.

Statistical analysis

All the collected data were entered in Microsoft Excel spread sheet. All the categorical variables were analysed by applying Chi-square test and continuous variables were analysed by applying independent *t*-test. All the analyses were done in the Statistical Package for Social Sciences version 17, a software package used for statistical analysis, officially named "IBM SPSS Statistics".

RESULTS

A total of 102 consecutive cases were operated based on clinical diagnosis of AA. Out of these 93 cases were histopathologically appendicitis, rest nine cases showed no evidence of inflammation so the rate of negative appendectomy was around 9%. On histopathology the appendix was normal appendix in nine patients (8.9%), AA in 71 patients (69.6%), CA which included perforated and gangrenous appendicitis in 22 patients (21.5%). Thus, one-fourth patients presented with CA.

Perforation was more common in females (30.4% vs. 13.9) whereas distribution of other types of appendicitis was almost similar in both groups. Although perforation was more common in females, ($P = 0.288$) [Table 1].

With respect to age, four (44.4%) out of nine patients who were <5 years had perforation, whereas five (12.5%) out of 40 patients who were aged between 5 and

10 years had perforation. Thus, perforations were more common in patients who were younger than 5 years, ($P = 0.060$) [Table 2].

More than half (64%) of the patients were operated with pain duration of <24 h while about one-fourth were operated with pain duration between 24 and 72 h. Mean duration of pain of all patients was 38.6 h. Over 60% patients presented with CA when the duration of pain was >72 h, ($P < 0.001$) [Table 3].

Perforations were more common in patient from rural than urban areas (18.8 vs. 15.2) ($P = 0.80$) [Table 4].

Intra-operatively, appendicolith was found in 13 cases (12.7%) out of which seven cases were non-perforated and six cases were of CA (4 perforated, 2 gangrenous). Thus, out of 18 perforated appendices appendicolith was present in four cases (22.3%) and out of four cases of gangrenous appendices it was present in two cases (50%), suggesting the presence of appendicolith increases the probability of CA ($P < 0.027$) [Table 5].

The most common site of perforation was body of appendix. About half perforation was on the body, one-third on the tip and the rest at the base of appendix [Table 6].

Table 1: Sex wise distribution of histopathologic features of appendix

Histopathology	Male	Female	Total
Normal appendix	08 (10.1)	01 (04.3)	09 (8.9)
Acute appendicitis	57 (72.2)	14 (60.9)	71 (69.6)
Perforated appendicitis	11 (13.9)	07 (30.4)	18 (17.6)
Gangrenous appendicitis	03 (03.8)	01 (04.4)	04 (03.9)
Total	79 (77.5)	23 (22.5)	102 (100)

$P = 0.288$ non-significant; figures in parenthesis are in percentages

Table 2: Age wise distribution of perforation

Age group	Intra-operative appendix			Total
	Perforated	Non-perforated	Gangrenous	
<5 years	04 (44.4)	05 (55.6)	0	09 (100)
5-10 years	05 (12.5)	35 (87.5)	0	40 (100)
10-14 years	09 (17.0)	40 (75.5)	4 (7.5)	53 (100)
Total	18	80	4	

$P = 0.060$ non-significant; figures in parenthesis are in percentages

Table 3: Duration of symptoms and perforation

Duration of symptoms	SA	CA	Total	*P* value
<24 h	62 (96.9)	02 (3.1)	64 (100)	<0.001*
24-72 h	13 (52.2)	10 (47.8)	23 (100)	
>72 h	05 (40.0)	10 (60.0)	15 (100)	
Total	80 (78.4)	22 (21.6)	102 (100)	
Mean duration	26 h	76 h	38.66 h	<0.001*

Figures in parenthesis are in percentages; *Significant; SA: Simple appendicitis; CA: Complicated appendicitis

Table 4: Distribution of perforation with locality

Locality	Intra-operative appendix			Total
	Perforated	Non-perforated	Gangrenous	
Rural	13 (18.8)	53 (76.8)	3 (4.3)	69 (100)
Urban	5 (15.2)	27 (81.8)	1 (3.0)	33 (100)

$P = 0.80$ non-significant; figures in parenthesis are in percentages

Table 5: Appendicolith and perforation

Appendicolith	Intraoperative appendix			Total
	Perforated	Non-perforated	Gangrenous	
Present	04 (22.3)	07 (08.8)	02 (50)	13 (12.7)
Absent	14 (77.7)	73 (91.2)	02 (50)	89 (87.3)
Total	18 (17.2)	80 (100)	04 (100)	102 (100)

$P = 0.027$ significant; figures in parenthesis are in percentages

Table 6: Site of perforation in perforated appendix

Site of perforation	Frequencies	Percentage
Base	02	11.1
Body	10	55.5
Tip	06	33.4
Total	18	100

DISCUSSION

AA 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. Delay in diagnosis, especially in children can lead to morbidity and even mortality. To prevent delay in diagnosis various investigations have been tried but diagnosis of AA is still clinical. Until date, we have no laboratory parameters that could indicate or reliably point on the presence or absence of AA. The clinical diagnosis will remain the cornerstone in AA; nevertheless, laboratory investigations provide significant complimentary aid in diagnosis. In this study, perforated appendices were found in 18 cases (17.6%). Perforation rates which have been described in the literature vary between 5% and 62%, respectively.[3,4] Various risk factors associated with increased incidence of perforation have been studied which includes; extremes of ages, male sex, race, rural locality, delays in presentation or diagnosis, lack of insurance or financial coverage status, hospital volume, presence of appendicolith, elevation in the blood parameters, namely neutrophils count and CRP.[5-9]

Young children have less ability to understand or articulate their developing symptomatology compared with adolescents, the accuracy of diagnosis in this age group is also less, the immaturity of omentum and

the reduction of defence mechanism results higher perforation rate. Perforation rates have been reported to be as high as 82% in children younger than 5 years and nearly 100% of 1-year-old.[1,2] In this study, out of nine patients who were <5 years 4 (44.4%) had perforation, out of 40 patients who were between 5 and 10 years, 5 (12.5%) had perforation. Thus, perforation was more common in patients who were younger than 5 years which is similar to findings in some other studies.[2] Delays in presentation or diagnosis causing elevated perforation rates have been documented to occur for reasons other than age. Children with perforation are much more likely to have been initially referred to a paediatrician rather than a surgeon. In this study, we found that as the duration of symptoms increases, the proportion of simple to CA decreases thereby number of patients with perforation or gangrene increases. >60% patients presented with CA when the duration of pain was >72 h, a finding confirmed by other studies. A study evaluated 126 children with AA in which 26% of patients underwent surgery at the first 6 h and 74% at the first 6-24 h after the onset of symptoms, but there weren't any significant differences of perforation between these two groups.[7] Another research in America, was conducted on 219 patients and was found that rupture risk was ≤2% in patients with <36 h of untreated symptoms. For patients with untreated symptoms beyond 36 h, the risk of rupture rose to and remained steady at 5% for each ensuing 12-h period. Rupture was greater in patients with 36 h or more of untreated symptoms.[8] Papaziogas *et al*. in a study of 169 patients found that the risk of perforation was negligible within the first 12 h of untreated symptoms, but then increased to 8% within the first 24 h. It then decreased to approximately 1.3-2% during 36-48 h, and subsequently rose again to approximately 6% (7.6-5.8%) for each ensuing 24-h period.[10] Augustin *et al*. found that there is an early risk of perforated appendicitis even within the first 36 h of symptoms. This risk appears to be higher in males and patients older than 55 years, a quarter of who are perforated within the first 36 h of symptom duration. In addition, perforation in AA may be more of continuous phenomena worsening exponentially with duration of symptoms rather than a threshold phenomenon.[11]

It would logically follow that patients who do not have good access to medical care would be more likely to present with perforation. Patients from rural areas have higher rates of perforation with AA than urban patients. This difference persists when accounting for other factors associated with perforation.[9] In this study, perforations were more common in patient from rural locality than urban (18.8 vs. 15.2) but this difference was found statistically insignificant ($P = 0.80$).

APPENDICOLITH

The appendicolith, also known as "fecalith" or "corpolith" is composed of firm faeces and some mineral deposits. Presence of appendicolith is a well-established risk factor for perforation now. Perforation is more common in male because males have been found to have a higher incidence of appendicular faecoliths and calculi. Appendicolith may obstruct the appendix lumen, causing appendicitis and is found in approximately 10% of patients with appendix inflammation. Case reports of the presence of an appendicolith and its strong correlation to AA can be found in the literature. Appendicitis which is caused by appendicolith is more commonly associated with perforation and abscess formation.[12,13] In the present study appendicolith was found in 13 cases (12.7%) out of which seven cases were non-perforated and six cases were of CA (4 perforated, 2 gangrenous). Thus, out of 18 perforated appendices appendicolith was present in four cases (22.3%) and out of four cases of gangrenous appendices it was present in two cases (50%), suggesting the presence of appendicolith increases the probability of CA.

CONCLUSIONS

The perforations were more common in females and patients who were younger than 5 years, but statistically it was not significant. As the duration of pain increases, the proportion of complicated to SA increases significantly. Presence of appendicolith significantly increased the probability of CA.

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