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Original Research Article

Leucocyte count in children with complicated and uncomplicated acute appendicitis: a comparative study

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ABSTRACT

Background: Identification of complicated and uncomplicated acute appendicitis is important in children. In acute appendicitis, along with clinical evaluation and staging, many laboratory tests have been used. The aim of the study was to compare total leucocyte count in children with uncomplicated and complicated acute appendicitis in different age groups.
Methods: Retrospective cohort study was performed in children who underwent appendicectomy, in a Government tertiary care institution between January 2017 and December 2018. 206 patients were divided into complicated and uncomplicated appendicitis. Total leucocyte count at time of admission was compared according to age. Unpaired t test and Chi-square test were used for statistical analysis.
Results: There were 136 males and 70 females. 107 patients (51.94%) had complicated and 99 (48.06%) had uncomplicated appendicitis. Mean leucocyte count per µl in uncomplicated appendicitis was 18993±3540 in <5 years, 17155±3386 in 5-10 years and 15833±3613 in 10-15 years. The mean leucocyte count for complicated appendicitis was 19974±3658 in <5 years, 17727±4487 in 5-10 years and 17220±3411 in 10-15 years age group. In 10-15 years group, patients with complicated acute appendicitis had statistically significant higher values of mean total leucocyte count.
Conclusions: Total leucocyte count can be used as marker of severity of acute appendicitis in children older than 10 years. In children with clinical suspicion of acute appendicitis, total leucocyte count >20000 per µl signifies complicated appendicitis in all age groups.

Keywords: Leucocytosis, Histopathology, Perforation

INTRODUCTION

Acute appendicitis is a common surgical emergency in children. Diagnosis of acute appendicitis is made based on its clinical features and presentation. However, in children, appendicitis often lack the typical clinical features as in adults.[1] This poses a challenge for the treating physician in making a timely diagnosis. The rate of over diagnosis leading to negative appendicectomy ranges from 10-30%.[2,3] Also, compared with adults, incidence of appendiceal perforation is more frequently observed in children.[4] Early surgical intervention for complicated acute appendicitis yielded lesser hospital stay as well as decreased morbidity and mortality for patients.[5] Recent research has revealed that antibiotic treatment might be an appropriate alternative for surgery in selected cases of uncomplicated acute appendicitis.[6-8] Therefore early diagnosis and staging of appendicitis is very important.

The introduction of imaging modalities like ultrasonography and computed tomography (CT) scan

has improved the accuracy of diagnosis of acute appendicitis. But heavy dependence on these imaging modalities has some disadvantages in children. CT scan carries risk of radiation which limits its use for routine imaging in all cases of suspected acute appendicitis.

Leucocytosis and shift to left have been associated with acute appendicitis and are important part of scoring systems like Alvarado score, modified Alvarado score and paediatric appendicitis score.[9] Total leucocyte count (TLC) before surgery may predict severity of acute appendicitis in children as shown in various studies.[10,11] But literature gives contradictory results regarding contribution of individual lab tests or their combination in children.[12,13]

The aim of the study was to compare TLC in children with complicated and uncomplicated acute appendicitis in different age groups, and to find out if leucocytosis could be used to predict severity of acute appendicitis in children.

METHODS

The medical records of 206 paediatric cases of acute appendicitis, at Government tertiary care and teaching institution between January 2017 and December 2018 were analysed. All the patients underwent appendicectomy for acute appendicitis and diagnosis was confirmed by histopathology. This study was approved by institutional research and ethics committee review board (No. B3/1573(A)/2010/TDMCA; EC49/2019).

Medical records were reviewed and preoperative leucocyte count at the time of admission were tabulated. Intraoperative findings of the surgery and final histopathology report were collected. Only those patients confirmed to have appendicitis during surgery and on histopathological examination were included in the study. Patients who underwent elective or incidental or interval appendicectomy were excluded from this study. Patient with other obvious infective foci, previous abdominal surgeries, known concurrent medical diseases that would have affected outcomes were excluded from this study. Patients who received antibiotics prior to admission were also excluded. All patients included in the study underwent appendicectomy within 24 hours of admission.

TLC at the time of admission was recorded as per microlitre of blood. TLC measurements were performed using Sysmex XE-5000 analyser. TLC was considered elevated if it was above the reference value for that particular age (Table 1).[14]

Patients included in this study were divided into two groups as uncomplicated appendicitis and complicated appendicitis, according to intra operative findings and histopathology. Uncomplicated appendicitis, also referred to as simple appendicitis, is acute appendicitis without presence of inflammatory mass, phlegmon, abscess, or perforation peritonitis. Complicated appendicitis is acute appendicitis with presence of complications-inflammatory mass, phlegmon, abscess, or perforation peritonitis.[15,16]

Table 1: Normal reference values for TLC according to patient age.

Age	Reference total leucocyte count (µl)
0-3 days	9000-30000
4-7 days	5000-20000
8-30 days	5000-19500
2-12 months	6000-17500
2-4 years	5000-15500
5-6 years	5000-13500
7-10 years	4500-12000
11-18 years	4500-11000

Statistical analysis

Qualitative variables were summarised in percentages. Quantitative variables are in mean with standard deviation. Leucocytosis in complicated and uncomplicated cases of acute appendicitis was compared using unpaired t test. Number of patients with leucocytosis in each group were analysed and compared using Chi- square test. The data was analysed using SPSS statistics 21.0 (SPSS Inc., Chicago, IL, USA). P value <0.05 was considered to be statistically significant.

RESULTS

206 children had histopathologically confirmed acute appendicitis during the study period. There were 136 males and 70 females. The youngest child was of age 2.5 years. The mean age was 8.34±3.54 years. 107 patients (51.94%) had complicated appendicitis and 99 patients (48.06%) had uncomplicated appendicitis.

Considering variation in TLC in different age groups of paediatric population, patients were divided into 3 groups- <5 years, 5-10 years and 10-15 years. It was found that 57.2% of patients belonged to 5-10 years age group. Complicated appendicitis was more common in the age groups <5 years and 5-10 years (Table 2).

Mean values of TLC in children underwent appendicectomy for acute appendicitis is shown in Table 3. Patients with complicated appendicitis had higher values of mean TLC compared to those with uncomplicated acute appendicitis. This was statistically significant in the age group 10-15 years (p=0.0401).

Number of patients with leucocytosis was compared between the groups of complicated and uncomplicated appendicitis (Table 4). In the age group less than 5 years, there were 70% patients with leucocytosis. In age group 5-10 years, there were 84.8% patients with leucocytosis. In age group 10-15 years, there were 82.4% patients with

leucocytosis. On comparing number of patients with leucocytosis in uncomplicated and complicated group, p value was found significant in age group 10-15 years. Thus, leucocytosis cannot be considered a predictor in differentiating complicated and uncomplicated appendicitis in the age <10 years. However, leucocytosis may be considered as a predictor in differentiating complicated and uncomplicated appendicitis in the age group 10-15 years.

In <5 years age group 10 children, 5-10 year age group 19 children and >15 years 13 children had TLC >20000/µl. On comparing children with TLC less than 20000/µl to more than 20000/µl, it was found that TLC >20000 was significantly predictive of complicated acute appendicitis in all age groups (Table 5).

Table 2: Results of patients with acute appendicitis.

Demographic characteristics	Total patients	Uncomplicated appendicitis	Complicated appendicitis
	N (%)	N (%)	N (%)
Total	n=206 (100)	n=99 (48.06)	n=107 (51.94)
Males	136 (66.02)	71 (34.47)	65 (31.55)
Females	70 (33.98)	28 (13.59)	42 (20.39)
Age (in years)			
<5	20 (9.7)	6 (2.91)	14 (6.8)
5-10	118 (57.2)	56 (27.18)	62 (30.1)
10-15	68 (33.1)	36 (17.48)	32 (15.54)

Table 3: Age wise distribution and mean leucocyte count per µl.

Age group (in years)	Uncomplicated appendicitis	Complicated appendicitis	P value
<5	18993±3540	19974±3658	0.1031
5-10	17155±3386	17727±4487	0.2210
10-15	15833±3613	17220±3411	0.0401

Table 4: Comparison of number of patients with leucocytosis.

Age group (in years)	Uncomplicated appendicitis		Complicated appendicitis		χ2 value	P value
	Leucocytosis present	Leucocytosis absent	Leucocytosis present	Leucocytosis absent		
<5	4	2	10	4	0.0454	0.8313
5-10	47	9	53	9	0.0551	0.8144
10-15	25	11	31	1	8.7712	0.0030

Table 5: Comparison with TLC >20000/ µl.

Age group (in years)	Uncomplicated appendicitis		Complicated appendicitis		χ2 value	P value
	TLC >20000	TLC <20000	TLC >20000	TLC <20000		
<5	1	5	9	5	4.0229	0.0448
5-10	3	53	16	46	9.1082	0.0025
10-15	2	34	11	21	9.0997	0.0025

DISCUSSION

Acute appendicitis is characterised by development of inflammation at a local level followed by a more generalised inflammatory response. The rationale of a laboratory test in diagnosis and staging of acute appendicitis is based on tests that are widely available, easy to perform, minimally invasive, limited cost and repeatability.[17]

Although over the last few decades several markers of inflammation have been proposed for acute appendicitis, TLC and C-reactive protein are the most widely used.[18] TLC estimation is widely available, easy to perform and cost effective. TLC has low specificity in adults and children, as many other conditions mimicking acute appendicitis are also associated with inflammatory response.[19] The sensitivity of TLC in various studies ranged from 55-98%.[20,21] The role of total count in staging of acute appendicitis has been studied.

In this study, among the 206 patients, 107 (51.94%) had complicated appendicitis and 136 (66.02%) were males. Kim et al reported 52% had complicated appendicitis and 57.7% were males in their study.[10] 20 (9.7%) patients were in <5 year age group. This corresponds to study by Monsalve et al and Rothrock et al that appendicitis was less common in less than 5-year age group compared to more than 5 year age group.[12,15] None of the children in our study were of less than 2.5 years age. This corresponds to study by Rothrock et al that appendicitis was rare in children <2 years age.[12]

In children <5 years, 14 (70%) patients had complicated appendicitis. In study by Mallick et al, 60.3% of children <5 years had complicated appendicitis and 56% had perforation at time of diagnosis.[22] High incidence of complicated appendicitis in young children is multifactorial. Inability to communicate with parents, atypical presentations, delay in diagnosis due to associated illness, anatomical immaturity due to lack of omental barrier; all contribute to rapid perforation in this age group .

In this study, the mean leucocyte count in uncomplicated appendicitis was 18993±3540 in <5 years, 17155±3386 in 5-10 years and 15833±3613 in 10-15 years. The mean leucocyte count for complicated appendicitis was 19974±3658 in <5 years, 1772±74487 in 5-10 years and 17220±3411in 10-15 years age group. Kim et al conducted a retrospective study in 6-18 years age group and found mean TLC 15300±300 in uncomplicated appendicitis and 19400±440 in complicated appendicitis.[10]

In this study 36 patients (17.5%) with acute appendicitis had normal leucocyte count. This corresponds to study by Gronroos in which 20% of children with pathologically proven appendicitis had leucocyte count within normal range. Thus, normal leucocyte count cannot exclude appendicitis in children.[19]

On comparing patients with leucocytosis between complicated and uncomplicated appendicitis, it was found that p value was found significant in age group 10-15 years. Thus, leucocytosis may be considered a predictor in differentiating complicated and uncomplicated appendicitis in the age group 10-15 years. But it was not found to be significant in <10 year age group. This may be due to decline in leucocyte response in young children.[23] In study by Beltran et al, in 198 patients of, leucocytosis was found useful in discriminating simple appendicitis from perforated appendicitis.[21] In study by Guraya et al, TLC with differential count was found as a reliable marker of severity of appendicitis and signified a more advanced stage.[11]

In this study, 42 patients (20.4%) had TLC more than 20000/µl. On comparing children with TLC less than 20000/µl to more than 20000/µl it was found that TLC >20000/µl was significantly predictive of acute complicated appendicitis in all age groups. This result corresponds to study by Rentea et al who concluded that TLC >20000/µl and symptoms >48 hours had a positive predictive value of 100% in diagnosing appendicitis.[24]

Limitation

The main limitation of this study was that this was a retrospective single centre experience with a relatively small sample size. Other inflammatory markers like C-reactive protein were not assessed. Thus a prospective multicentre study is required for further evaluation.

CONCLUSION

In conclusion, the TLC can be used as marker of severity of appendicitis in children older than 10 years. In children with clinical suspicion of acute appendicitis, TLC >20000/ µl signifies complicated appendicitis in all age groups.

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