

Risk Factors for Complications in Acute Appendicitis among Paediatric Population

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ABSTRACT

Introduction: Appendicitis is one of the most common causes of acute abdomen in children. Patients who are diagnosed early and undergo an appendectomy before perforation have a good outcome. However, it is difficult to diagnose in young children because its clinical manifestations may be atypical. The aim of this study was to determine the risk factors for complications in acute appendicitis in paediatric population.

Methods: We performed a cross sectional study on children (age ≤ 18 years) who underwent appendectomy for suspected appendicitis from January 2014 to December 2015. Medical records of patients who met inclusion criteria were reviewed. Preoperative, operative and post-operative data were analyzed. The main outcome measure was intraoperative confirmation of gangrenous or perforated appendicitis. Multivariate logistic regression analysis was performed, and the main predictors of interest were patient's age, duration of pain and total leucocyte count.

Results: Total 73 paediatric patients (46 males) with mean age 13 ± 3.8 were studied. In multivariate logistic regression analysis, patients having pain duration more than 72 hours and patients with leucocyte count $>15000/\text{mm}^3$ were more likely to have complicated appendicitis [(OR:14.6), (95% CI= 2.40 - 89.77), (P= 0.004)] and [(OR=16.38), (95% CI = 1.836-146), (P = 0.012)] respectively. However, the age of the patient is not independently associated with complicated appendicitis.

Conclusions: Increase in total leucocyte count and duration of the presentation can be a good marker of complicated appendicitis.

Keywords: *appendicitis; complicated; gangrenous; pediatric; perforated; risk factors.*

INTRODUCTION

Appendicitis is one of the most common causes of acute abdomen in children.¹⁻³ Patients who are diagnosed early and undergo an appendectomy before perforation have a good outcome.^{4,5} However, it is difficult to diagnose in young children because its clinical manifestations may be atypical.⁶⁻⁸ Children tend to have higher rates of appendiceal perforation than do adults.⁹⁻¹¹

Several factors may contribute to this observation.

First, children may present with a variety of atypical symptoms, in contrast with the classic periumbilical pain that later migrates to the right lower quadrant. In addition, very young children may have little omentum and intraabdominal fat, allowing peritoneal spread to occur more readily.^{7,12} Finally, children tend to present

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later than adults, thereby causing a delay in diagnosis that contributes to a higher perforation rate.¹²

The aim of this study was to determine the risk factors for complications in acute appendicitis in the paediatric population.

METHODS

We performed a cross sectional study. The ethical approval was taken from Institutional Review Board at Universal College of Medical Sciences (UCMS), Bhairahawa. Medical records of all children (age ≤ 18 years) who underwent appendectomy for suspected appendicitis from January 2014 to December 2015 at UCMS, Bhairahawa were reviewed. Those patients with appendicular lump, interval appendectomy, and negative appendectomy were excluded.

Variables analyzed were patient age, sex, duration of pain, admission vitals and total leucocyte count. Primary outcome measure was intraoperative findings of complicated appendicitis. Complicated appendicitis was defined as the intraoperative identification of perforated or gangrenous appendicitis. Perforated appendicitis was defined as the presence of an appendiceal luminal disruption, visible hole in the appendix, or evidence of a fecalith outside the appendix, whereas gangrenous appendicitis was defined as the presence of gray or black discoloration of the appendiceal wall in the absence of perforation.¹³ According to intraoperative findings patients were divided into two groups, complicated appendicitis and non-complicated appendicitis. Secondary outcome measures were duration of surgery, length of hospital stay and wound infection between two groups.

Statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 23. Descriptive statistics were calculated for all variables. A Multivariate logistic regression analysis was performed to identify independent predictors of complicated appendicitis. Bivariate analysis was performed to determine the association between complicated appendicitis and duration of surgery, length of hospital stay and wound infection. A categorical variable was compared with Chi Square or Fisher exact test and continuous variables were compared with independent samples T-test and Mann-Whitney U test, where appropriate. P value less than 0.05 was considered significant.

RESULTS

During this two year study period, a total of 73 patients met inclusion criteria. A total of 46 (63.01%) were male and 27 (36.98%) were female with mean age of 13 ± 3.8

were studied. The median duration of presentation after the onset of pain was 48 ± 39 hours ranging from 2 to 192 hours. Complicated appendicitis was found in 27 patients (37%). There were no significant differences between patients with complicated appendicitis and non-complicated appendicitis with regard to age, sex or admission vitals except for the duration of pain in hours and white blood cell count (Table 1).

Table 1. Baseline characteristics of patients in two groups.

Variable	Complicated appendicitis	Non complicated appendicitis	P Value
Age	12 ± 4.8	13.46 ± 18	0.86
Male Sex	17	29	0.99
Duration of pain in hours	75 ± 43	39 ± 29	0.01
Temperature, °F	98 ± 1.05	98 ± 1.2	0.08
Heart Rate, bpm	97.93 ± 22	89 ± 14	0.18
Systolic BP	103 ± 13	107 ± 10	0.16
Respiratory rate	22 ± 6	21 ± 7	0.57
WBC count (/mm ³)	13800 ± 5000	11900 ± 4200	0.04

bpm = beats per minute; BP = blood pressure; WBC = white blood cell, mm = millimeter.

Multivariate logistic regression analysis was performed to identify independent predictors for complicated appendicitis. The increase in duration of pain was associated with higher odds of complicated appendicitis. Compared to pain duration less than 24 hours, patients having pain duration more than 72 hours were more likely to have complicated appendicitis (Odds ratio = 14.6, 95% Confidence interval 2.40 – 89.77, P = .004). Compared to Total Leucocyte count less than 11000, Patient with Leucocyte count >15000 had higher odds of having complicated appendicitis (Odds ratio = 16.38, 95% CI 1.836 – 146, P = .012). However, the age of the patient is not independently associated with complicated appendicitis (Table 2).

Table 2. Multivariate logistic regression analysis for complicated appendicitis.

Variable	Odd ratio	95% confidence interval	P value
Pain duration			
24 hrs or less	Ref		
25-48 hrs	1.52	.171-13.49	.70
49- 72 hrs	4.41	.668-29.11	.12

More than 72 hrs	14.6	2.40-89.77	.004
Total Leucocyte			
< 11000	Ref		
11000-15000	4.287	.743-24.76	.104
> 15000	16.38	1.836-146	.012
Age (Years)			
2-6	Ref		
7-12	.195	.018-2.18	.185
13-18	1.61	.142-18.31	.699
hrs = Hours; Ref = Reference			

Bivariate analysis was done to compare the outcome of patients in two groups. There was a significant difference in the length of hospital stay among patients who had complicated appendicitis vs. non complicated appendicitis (6 vs 4 days, $p < 0.001$). Similarly, there were significant differences in duration of surgery and surgical site infection in two groups ($p = 0.03$ and $p = 0.007$ respectively) (Table 3).

Table 3. Bivariate analysis for outcome in two groups.

Variable	Complicated appendicitis	Non complicated appendicitis	P Value
Duration of surgery (minutes)	99 ± 34.33	73 ± 25.6	0.03
Length of hospital stay (days)	6 ± 2.66	4 ± 1.58	<0.001
Wound infection	7(25.9%)	2 (4.3%)	0.007

DISCUSSION

In this cross sectional study we found that duration of presentation after onset of pain and total leucocyte count were independently associated with complicated appendicitis. And patient with complicated appendicitis were likely to have more surgical site infection and increased length of hospital stay.

The approach to the diagnosis of acute appendicitis is mainly clinical. Diagnosis of acute appendicitis in children may be difficult especially in those having atypical symptoms and signs. Delay in diagnosis may lead to complicated appendicitis with an increase in morbidity and mortality. Duration of symptoms may be a factor in the high perforation rate seen in very young children, as signs and symptoms may be less

specific.^{7,14} However, other factors, such as the lack of a well-developed omentum, may also contribute to the rapid progression of complicated appendicitis in children. Although it is generally understood that appendicitis in very young children behaves differently, the exact age cutoff is less clear.

Several studies have been done to identify predictors for complications in acute appendicitis. In a study done by Mahavir Singh et al. in India, where they analyze 102 cases and found that complicated appendicitis was associated with a delay in presentation >72 hours and children less than age 5 were more likely to have complications.¹⁴

Another study done Chaitan K. Narsule et al. where they analyzed 202 patients and found that the perforation rate rose in a linear fashion from 10% by 18 hours to 44% by 36 hours. If symptoms were present for more than 2 days, the risk of perforation was greater than 40%. They found no difference in white cell counts in two groups; in contrast, our study shows that white cell counts were significantly higher in patient with complicated appendicitis group.¹⁵

Likewise, another study done by William Bonadio et al. in New York, where they conducted a retrospective case review of 248 consecutive children aged less than 18 years. They found that the risk for developing perforation increased by 1.10 for each hour of time delay from emergency department presentation to surgery; the estimated odds ratios for developing perforation per interval of in-hospital delay were 2.05 at 8 hours, 4.22 at 16 hours, 8.67 at 24 hours. They also further concluded that antibiotic therapy does not reliably prevent the progression of the disease. This could perhaps be due to the predominant effect of ischemia (rather than bacterial infection) causing progression of tissue compromise, especially in those with the solid concretion of an appendicolith.¹⁶

We also analyzed the postoperative outcomes in patients with complicated appendicitis in means of length of hospital stay and surgical site infection. There was a significant difference in hospital stay as well as surgical site infection. Most studies done for analyzing the risk factors for perforations have agreed with its association with duration of pain. In addition to duration of presentation, our studies showed that increase in total leucocyte count is also associated with complicated appendicitis.

There are several limitations to this study. Because of its retrospective design, there are potential for bias in data gathering. Since the study population was from a single medical center, the results may be less generalizable than those from multicenter studies. There

were no clear data regarding the use of preoperative antibiotics. Whether the use of preoperative antibiotics has any meaningful impact on preventing complications is unclear but may be an area for future research.

CONCLUSIONS

In conclusion, increase in leucocyte count and duration of presentation can be good predictors of complicated

appendicitis. Patients with complicated appendicitis have prolonged hospital stay and a higher incidence of wound infection. There should be a higher index of suspicion of complicated appendicitis in patient with late presentation and high leucocyte count.

Conflict of Interest: None.

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