Original Research Article

DOI: http://dx.doi.org/10.18203/2349-2902.isj20175914

Role of total leukocyte count in diagnosis of pediatric acute appendicitis: effect of antibiotic administration and duration of onset of symptoms

Arun M. Ainippully, Sarath Kumar Narayanan*, Vysakh C. N., Arun Preeth V., Prathap Somnath

Department of Pediatric Surgery, Government Medical College, Kozhikode, Kerala, India

Received: 27 October 2017 Accepted: 28 November 2017

*Correspondence:

Dr. Sarath Kumar Narayanan, E-mail: drsharat77@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Appendicitis is one of the most common pediatric surgical emergencies. The aim of the study is to determine the significance of total leukocyte count (TLC) in diagnosing appendicitis in the present era of rampant and injudicious antibiotic usage, and its relation to the duration of onset of symptoms.

Methods: Study population consists of 148 pediatric patients who had confirmed appendicitis and underwent appendicectomy between January 2015 and December 2015. TLC was performed in all these patients as part of the routine work up. The population was categorized as: group I <24hrs, group II 24 to 4hrs and group III >48 hrs, based on symptom duration and group A and B based on antibiotics received or not respectively.

Results: 64.9% (n = 96) were males and 35.1% (n = 52) were females. The ages ranged from 2.1 to 12.9 years (mean/SD being 8.3 ± 1.2). The number of patients with elevated TLC was significantly lesser in Group B (62.2%, n = 92) when compared to the group A (37.8%, n = 56) which did not receive antibiotics (P <0.017). Significantly higher number of patients showed rise in TLC if it was done within 24 hours of onset of symptoms (66.6%, n = 40).

Conclusions: Our study shows that TLC proved more useful if it is performed within 24 hours of the onset of symptoms and is relevant only if antibiotics have not been administered.

Keywords: Antibiotics, Appendicitis, Inflammation, Total leucocyte count

INTRODUCTION

Acute abdominal pain is one of the common complaints which pediatric surgeons encounter on a daily basis. In many cases, the cause is a self-limiting disease process, such as gastroenteritis or constipation.^{1,2} The most common surgical cause of non-traumatic acute abdominal pain in children is acute appendicitis (AA).^{3,4} In United States, 77,000 pediatric hospital discharges were accounted each year for appendicitis and other appendiceal conditions.⁵ The diagnosis of AA in children is challenging because many present with symptoms and signs that resemble other common but self-limiting causes. They often lack typical clinical features seen in

adults, and this poses a 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 leading to increased morbidity and mortality.⁵ On the other hand about 10-30% of children have their appendices removed unnecessarily increasing the cost and morbidity.⁶ Therefore, it is vital to make a timely diagnosis and avoid removal of normal appendices.

Despite advances in imaging modalities, routine history and physical examination remain the most effective means to diagnose AA in pediatric age group. To increase diagnostic accuracy, inflammatory variables such as total leukocyte count (TLC), C-reactive protein (CRP), and body temperature have been studied.⁷⁻⁹ None of these is specific for AA and their ability to improve upon the preoperative clinical diagnosis is doubtful. The prevailing perception is that the patients with appendicitis will have a high TLC and most of the primary care physicians, while evaluating AA obtain a complete blood cell count (CBC), with the expectation that a high TLC would support the diagnosis. Considering the overlap with other inflammatory processes mimicking acute appendicitis, the diagnostic value of the TLC remains controversial. Several literatures recommend the TLC as part of the evaluation with suspected AA. The primary aim of this study is to find the relation between onset of symptoms and rise in TLC in AA. This study also aims to find relevance of TLC in patients with appendicitis for whom antibiotics were administered prior to evaluation.

METHODS

This is a retrospective study using the database at a tertiary children's hospital, of all patients who underwent appendicectomy (laparoscopic or open) during the study period (January 2015 to December 2015). Only those confirmed to have appendicitis during surgery and on histopathology where included in the study. Patients aged above 13 years, those with other obvious infective foci, previous abdominal surgeries and elective/incidental/interval appendicectomies were excluded. Patients with known concurrent medical diseases that would have affected outcomes were also excluded. Parameters that were recorded included patients demographics, duration of symptoms, patient history, treatment given at the referring centre, findings from physical examination and results from routine laboratory tests.

While many of patients were already on antibiotics from peripheral hospitals at the time of referral, none of the patients who presented primarily to our centre were started on antibiotics until the decision to operate was taken by the surgeon involved. TLC measurements were performed using a sysmex XE-5000 analyser and was considered elevated if above >10000/mm³.

Based on time interval between onset of symptoms and evaluation of TLC, patients were grouped into 3 groups:

- Group I- less than 24hours
- Group II- 24 to 48 hours
- Group III- more than 48 hours

Based on whether patients were on antibiotics at the time of laboratory tests the study population was further divided into group A- on antibiotics and group B- not on antibiotics.

Statistical analyses were performed using SPSS Statistics, version 19. Paired T-test was performed when comparing dichotomous variables of two groups. Sensitivity,

specificity and likelihood ratios were calculated using standard formulae. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 148 patients with confirmed appendicitis on surgery and histopathology, who matched the inclusion criteria were included in this study, among whom, 64.9% (n=96) were males and 35.1% (n=52) were females. The most common presenting symptom was abdominal pain (90.1%). The ages ranged from 2.1 to 12.9 (Mean±SD being 8.3±1.2). The mean duration from the onset of symptoms was 34hours. The degree of appendicitis was just inflamed and non-perforated in 66.21% (n=98), gangrenous in 16.21% (n=24), perforated in 10.1% (n=15), and 7.4% (n=11) with appendiceal abscess. The mean TLC was 13715.23.

Table 1: Impact of antibiotic administration on TLC.

Antibiotics	TLC >10000/mm ³	TLC <10000/mm ³	Total
Group A (on antibiotics)	42 (45.6%)	50 (54.4%)	92
Group B (not on antibiotics)	42 (75%)	14 (25%)	56

Table 2: Measurement of TLC at various time intervals.

Duration of onset of symptoms	TLC >10000/mm ³	TLC <10000/mm ³	Total
Group I (<24hrs)	40 (66.6%)	20 (33.3%)	60
Group II (24-48hrs)	32 (53.3%)	28 (46.7%)	60
Group III (>48hrs)	14 (50%)	14 (50%)	28

Table 3: Mean TLC value in various types of appendicitis.

Operative findings (n)	Mean TLC
Inflamed appendix (98)	12854
Gangrenous appendix (24)	14267.86
Appendicular abscess/perforated (26)	14025.83

At the time when laboratory tests were carried out, 62.2% (n=92) were already on antibiotics (Group A) while 37.8% (n=56) were not (Group B). The subsets of patients with and without elevated TLC in either of these groups are shown in Table 1. In group B (not on antibiotics), the number of patients with elevated TLC was significantly lesser when compared to the group A which did not receive antibiotics upon evaluation (P <0.017). Likewise, the measurements of TLC (elevated or normal) against the duration of onset of symptoms are shown in Table 2. Significantly higher number of patients showed rise in TLC if it was done within 24 hours of onset of symptoms (P <0.023). The mean TLC values in the degrees of appendicitis are enumerated in Table 3. As

expected the mean levels are higher with the higher grades of severity or complication.

DISCUSSION

Inflammatory markers have long been used to improve the diagnostic accuracy in AA. Measurement of TLC is usually considered a routine part of work-up for AA in all age groups. Several studies suggest that an elevated TLC is usually the earliest laboratory finding of appendiceal inflammation. However, neither TLC nor neutrophil percentage is specific for AA. Leucocytosis is a non-specific reaction caused by acute or chronic inflammation, acute physical or emotional stress, and several other conditions.

TLC is widely available test, not very expensive and can be done in almost all laboratories round the clock. Various studies have been published on the evaluation of role of leucocytosis in the diagnosis of AA. But with the excessive and rampant usage of antibiotic by the community physicians the role of TLC in diagnosing appendicitis is in contention.

A review of the literature reveals that the sensitivity and specificity of WBC counts range from 70% to 80% and 60% to 68%, respectively. 10 In the present study, majority of the patients were already on antibiotics (62%). While 45.6% patients demonstrated an elevated TLC while on antibiotics, it was greater when the patient was referred to us without administration of antibiotics (75%). This association is statistically significant indicating that prior antibiotic use decreases the chances of an elevated TLC and that this marker must be used with caution in such a setting. 66.6% patients showed elevated TLC when performed within 24 hours of onset of symptoms, in comparison to 53% and 50% when performed between 24-48 hours and over 48 hours respectively. This finding affirms the evolving process of appendicitis and mirrors other studies which have shown that for TLC and absolute neutrophil count, the greatest discriminative accuracy for appendicitis is within 24 hours of onset of pain whereas for CRP, it is more accurate between the 24 and 48 hours period. 11-13 In the total study population of 148, among the degrees of appendicitis identified during surgery, mean TLC values were 12852 in simple inflamed appendicitis (n=92), 14268 in gangrenous (n=24).14026 appendicular appendicitis in abscess/perforation (n=26) respectively. This indicates that with higher elevations of TLC, more complicated forms of appendicitis are likely to be encountered.

The above findings show that TLC cannot reasonably be used as the sole determinant of acute appendicitis and it surely does not replace clinical judgment especially when the presentation is late and if antibiotics have been prescribed at the referring hospitals. 14-16 At the same time, with higher TLC values in a clinical setting for appendicitis, a complicated form or higher grade of severity is more likely. Misdiagnosis in these subsets of

patients are potentially higher putting them at risk if TLC alone is unrealistically depended upon. Antibiotics should not mask the evolution of possible appendicitis. Additionally, it may also encourage formation of an appendiceal mass/ localized adhesions leading to difficult diagnosis later. In this effect, it is important that proper antibiotic protocols/guidelines be disseminated to community physicians treating abdominal pain in children.

The main limitation is that this is a single centre experience with findings governed by practices in the region, and may need to be validated before generalized use can be recommended. We do not routinely obtain C-reactive protein levels, its addition to the diagnostic panel could help further refining diagnostic accuracy.

Our study shows that elevated TLC is more useful in the diagnosis of acute appendicitis when it is performed before the antibiotics have been administered. Further, TLC estimation is relevant when it is done within 24 hours of onset of symptoms. Higher TLC values are also more likely in complicated forms of appendicitis.

ACKNOWLEDGEMENTS

Authors would like to thanks Dr. Jagadeesh N.P., Dr. Anoop P.V. and Dr. Ninith N. for support of the study.

Funding: No funding sources
Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

REFERENCES

- Uba AF, Lohfa LB, Ayuba MD. Childhood acute appendicitis: Is routine appendicectomy advised?. J Indian Assoc Pediatr Surg. 2006;11:27-30.
- 2. Bratton SL, Haberkern CM, Waldhausen JHT. Acute Appendicitis risks of complications: Age and Medicaid Insurance. Pediatr. 2000;106:75-78.
- 3. Mason JD. The evaluation of acute abdominal pain in children. Emerg Med Clin North Am. 1996;14:629-43.
- 4. Tseng YC, Lee MS, Chang YJ, Wu HP. Acute abdomen in pediatric patients admitted to the pediatric emergency department. Pediatr Neonatol. 2008;49:126-34.
- 5. Bundy DG, Byerley JS, Liles EA, Perrin EM, Katznelson J, Rice HE. Does this child have appendicitis? JAMA. 2007;298:438-51.
- 6. Samuel M. Pediatric appendicitis score. J Pediatr Surg. 2002;37:877-81.
- 7. Peltola H, Ahlqvist J, Rapola J, Räsänen J, Louhimo I, Saarinen M, et al. C-reactive protein compared with white blood cell count and erythrocyte sedimentation rate in the diagnosis of acute

- appendicitis in children. Acta Chir Scand. 1986;152:55-8.
- 8. Elangovan S. Clinical and laboratory findings in acute appendicitisin the elderly. J Am Board Fam Pract. 1996;9:75-8.
- 9. Tind S, Lassen AT, Zimmerman-Nielsen E, Qvist N. C-reactive protein and white blood cell count do not improve clinical decision-making in acute appendicitis. Dan Med J. 2015;62(12):A5167.
- 10. Bates MF, Khander A, Steigman SA, Tracy TF Jr, Luks FI. Use of white blood cell count and negative appendectomy rate. Pediatr. 2014;133(1).
- 11. Kharbanda AB, Cosme Y, Liu K, Spitalnik SL, Dayan PS. Discriminative accuracy of novel and traditional biomarkers in children with suspected appendicitis adjusted for duration of abdominal pain. Acad Emerg Med. 2011;18(6):567-74.
- 12. Thomson C, Underwood M, Dookeran K, Lloyd D, Bell P. Role of sequential Leukocyte count and CRP in the diagnosis of acute appendicitis. Br J Surg. 1992;79:822-410.
- 13. Mathews EK, Griffin RL, Mortellaro V, Beierle EA, Harmon CM, Chen MK, et al. Utility of Immature Granulocyte Percentage in Pediatric Appendicitis. J Surg Res. 2014;190(1):230-34.

- Gendel I, Gutermacher M, Buklan G, Lazar L, Kidron D, Paran H, et al. Relative value of clinical, laboratory and imaging tools in diagnosing pediatric acute appendicitis. Eur J Pediatr Surg. 2011;21(4):229-33.
- 15. Mohammed AA, Daghman NA, Aboud SM, Oshibi HO. The diagnostic value of C-reactive protein, white blood cell count and neutrophil percentage in childhood appendicitis. Saudi Med J. 2004;25(9):1212-5.
- Prada-Arias M, Vazquez JL, Salgado-Barreira A, Gomez-Veiras J, Montero-Sanchez M, Fernandez-Lorenzo JR. Diagnostic accuracy of fibrinogen to differentiate appendicitis from nonspecific abdominal pain in children. Am J Emerg Med. 2017;35(1):66-70.

Cite this article as: Ainippully AM, Kumar SN, Vysakh CN, Preeth AV, Somnath P. Role of total leukocyte count in diagnosis of pediatric acute appendicitis: Effect of antibiotic administration and duration of onset of symptoms. Int Surg J 2018;5:296-9.