A PROSPECTIVE STUDY - WHITE BLOOD CELL COUNT AS A DIAGNOSTIC PARAMETER IN ACUTE APPENDICITIS

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ABSTRACT

BACKGROUND

Although, appendicectomy is the most commonly done emergency surgery, still its diagnosis remains an enigmatic challenge with persisting high rate of negative explorations. The objective of the study was to evaluate the role of accuracy of WBC measurement in the diagnosis of acute appendicitis and to reduce the morbidity by avoiding negative explorations.

MATERIALS AND METHODS

This study was conducted in 68 patients at Govt. Chengalpattu Medical College Hospital in patients who have been clinically diagnosed by surgeons as having acute appendicitis and posted for emergency appendicectomy. Preoperatively, blood was sent for WBC estimation and after operation all specimens were sent for HPE examination. The WBC results were correlated with HPE reports to evaluate their role in diagnosis of acute appendicitis.

RESULTS

In present study, WBC has highest sensitivity and specificity of 97.7% and 85.7% with positive predictive value of 97.7%. Hence, we imply that WBC level can be used to rule out negative appendicectomy so that surgery can be deferred in them.

CONCLUSION

Though, history and clinical examination by an experienced surgeon still remains indispensable in diagnosing a case of acute appendicitis, but WBC counts help to reduce the rate of negative appendicectomy substantially and hence should always be included in the workup of acute appendicitis.

KEYWORDS

WBC - White Blood Cell, HPE - Histopathological Examination.

HOW TO CITE THIS ARTICLE: Thangamani, Raghupathy, Ravi S, et al. A prospective study - white blood cell count as a diagnostic parameter in acute appendicitis. J. Evolution Med. Dent. Sci. 2017;6(1):52-55, DOI: 10.14260/Jemds/2017/14

BACKGROUND

Acute appendicitis is one of the most common cause of Right Iliac Fossa [RIF] pain and one of the most common cause of surgical emergencies. Its diagnosis is established by surgeon's clinical impression depending on presenting history, clinical evaluation and laboratory test. Atypical presentations are not uncommon, as many inflammatory and non-inflammatory conditions may mimic the presentation of acute appendicitis. The classic triad of history compatible with acute appendicitis pain at McBurney's point has diagnostic accuracy rate of less than 80%. This resulted in a relatively high rate of about 15.30% of negative exploration for acute appendicitis and postoperative morbidity associated with these negative explorations is 5% - 15%. Traditionally, surgeons have accepted a higher incidence of unnecessary appendicectomies in order to decrease the

incidence of perforation. This approach is being increasingly questioned in today's era of evidence-based medicine. The high rate of negative explorations for appendicitis is a burden faced not only by the general surgeon but also the patient and the society as a whole, since appendicectomy like any other operation results in socioeconomic impact in the form of hospital expenses, lost working days and declining productivity. So the goal of surgical treatment is removal of inflamed appendix before perforation with a minimal number of negative appendicectomies. Many reports have investigated the value of raised serum WBC measurement in improving the diagnosis of acute appendicitis.^[1] In this study, we correlated the serum levels of WBC with the histopathology of removed appendix. This study emphasised the impact of normal (rather than raised) serum WBC in reducing the rate of negative explorations.

MATERIALS AND METHODS

In this study the patients who were diagnosed to have acute appendicitis, who came to Government Chengalpattu Medical College, duration from September 2015 to September 2016 were taken as the source for study following obtaining consent in both informed and written form. The parameters considered were patient's demographic details, duration of symptoms, temperature on admission, differential WBC count and the histological diagnosis of the appendicular specimen. The baseline data were subsequently examined to analyse the

Financial or Other, Competing Interest: None.

Submission 01-11-2016, Peer Review 21-12-2016,

Acceptance 27-12-2016, Published 02-01-2017.

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DOI: 10.14260/jemds/2017/14

correlation between a high WBC count and the severity of appendicitis namely acute appendicitis, gangrenous appendicitis and appendicular perforation with a localised or diffuse peritonitis.⁸ Those patients who underwent appendectomies as part of other surgical procedures were excluded from the study. Acute appendicitis was diagnosed only on histological grounds according to the following criteria: Macroscopic signs include intravascular injection of serosa, fibrinous and purulent film; oedematous, necrotic changes of the wall; and blood or pus on opening the appendix. Microscopic signs include focal or expanded erosion, ulceration, abscess, fistula and necrosis or perforation.⁹ A WBC count of $3.9 - 10.9 \times 10^9/L$ was accepted as normal and greater than $11 \times 10^9/L$ as elevated. Neutrophil count $> 73\%$ (Normal range, $48\% - 73\%$) and lymphocyte count $< 18\%$ (Normal range, $18\% - 48\%$) were considered abnormal.^[2]

Method of Collection of Data

Patient with history of acute abdominal pain were examined by a surgeon for establishing the diagnosis; complete patient history was obtained followed by examination by surgeon and decided for emergency appendectomy. Blood samples were drawn and sent for WBC examination before operation. Appendix specimens were sent for HPE for improving the quality assurance of the study, specificity and sensitivity of WBC as a diagnostic parameter were calculated.

RESULTS

In our study, 68 cases were included who were diagnosed as having acute appendicitis clinically by surgeons. In present study, age of patient varies from 6 - 60 years. All the patients in our study presented with right-sided pain abdomen with most common site of pain being RIF (80%). In 90% of patients, McBurney's point tenderness was present. Peroperatively, most common position of appendix was found to be retrocaecal. Out of 68 patients 7 patients had normal HPE, so our negative appendectomy rate was 10.2%. Histopathologically, 58% of patients had acute suppurative appendicitis, remaining showed acute gangrenous or catarrhal type. In present series 61 patients had elevated WBC count, which is 89.76% of total study group; 7 patients had normal WBC level, i.e. 10.24% of patients. In these patients, 6 that is 85.7% had normal appendix on HPE. Therefore, total WBC count has sensitivity of 97.7% with specificity of 85.7% and positive predictive value of 97.7%.

DISCUSSION

The classic presentation of acute appendicitis has been well described for many years, and the diagnosis can often be made on clinical grounds alone. Appendicitis remains an acute surgical problem, but advances in surgical care and the availability of antibiotics have made it less of an emergency. Some patients such as children under 3 years, the elderly and those with significant comorbidities are at a higher risk of complications. Furthermore, the morbidity and increased costs of perforated appendicitis are not insignificant. However, the mortality of appendicitis is virtually zero today. In addition, much progress has been made in medical imaging.^[3] Ultrasonography, CT and MRI, although not infallible have greatly enhanced our diagnostic accuracy in

appendicitis. In recent years, there has therefore been an increased awareness that unnecessary appendectomies and their inherent pain, discomfort and cost should be avoided as much as possible. The current literature reveals NA (Negative Appendectomy) rates at other Institutions ranging from 3% to 11%, in keeping with our own NA rate of 2.6% (Before implementation of the current recommendations).

The suspicion of appendicitis relies on constellation of signs, symptoms and ancillary findings that have been combined into a variety of scoring systems. The most commonly used one is the Alvarado score, also known as Mantrel's,^[4] which weighs heavily toward the typical signs of localised peritonitis and an abnormal leukocytosis and differential. The higher the score the higher the likelihood of appendicitis, which helps in decision-making regarding patient discharge, further investigations, observation or surgical intervention. A recent systematic review of the Alvarado score confirmed that it is more appropriate as a triage tool than as a definitive diagnostic tool. A score < 5 points was 94% to 99% sensitive in "ruling out" appendicitis. However, the data analysis did not support it as a "rule in" for surgery. The paediatric appendicitis score, which is similar to the Alvarado score revealed similar flaws: if applied to the decision to operate, it would have led to an NA rate of 12.9% in one study. Scoring systems that do not include laboratory variables and that are solely based on history and physical findings prove even worse with NA rates as high as 17%.^[5]

With the addition of imaging studies in diagnosing acute appendicitis, the NA rates in the literature have improved greatly over the past 2 decades. The modalities that are currently used most are CT and ultrasonography. In addition, MRI is also available but is as yet mostly limited to a second- or third-line study. The current literature suggests that CT has better diagnostic accuracy with sensitivities of ~94%. The disadvantage of CT, especially in the paediatric population is primarily related to ionising radiation. Ultrasound has been shown to be slightly less accurate than CT overall with sensitivities of 88%. It is operator-dependent and may be more difficult to interpret by someone who did not personally perform the test. Ultrasonography has gained popularity in the paediatric population, primarily because it involves no radiation exposure. In experienced centres and in patients with a lean body habitus, accuracy mirrors or exceeds that of CT. At our hospital, ultrasonography is the primary imaging modality used to confirm the diagnosis of acute appendicitis and $> 50\%$ of patients undergo this examination. Anecdotal reports of a false-positive ultrasound still arise; however, a review of our NA cases over the past 4 years failed to identify a specific finding (or a particular operator) that would increase the suspicion of a false-positive result.

After reviewing all NA cases at our Institution in the past 4 years, we found clinical variables equally unhelpful in identifying false-positives. Details of the history and physical examination were comparable to those in patients with true appendicitis. The findings of a normal WBC count and a normal differential in most patients who underwent NA was the only significant variable.

Leukocytosis is a supportive laboratory finding in the diagnosis of acute appendicitis, both in adults and children. A review of the literature reveals that the sensitivity and specificity of WBC counts range from 70% to 80% and 60%

to 68%, respectively. However, one study reported that as many as 20% of paediatric patients with pathologically proven appendicitis had a normal WBC count. Our series revealed similar findings with a small subset of patients with appendicitis without leukocytosis.^[6] Some of these patients had symptoms for < 1 day and it might be assumed that a number of those would have shown an increased WBC count upon repeat testing. Of patients without appendicitis in our series, the vast majority had a normal WBC count. An abnormal differential ("left shift") is believed by some to be more sensitive than the absolute WBC count. In our experience; however, an elevated neutrophil count was present in 21% of NAs compared with a leukocytosis finding of only 11%. Because the specificity of a WBC count was superior to that of the neutrophil count, we further evaluated the value of leukocytosis only.

Rather than using leukocytosis as a dichotomous value (present or absent with a cut-off at 11,500 per μL), we chose to treat WBC count as a continuous variable to determine its performance as its discrimination threshold was changed. Our results indicate that WBC count performs well as a continuous variable with an AUC of 0.86 and a clear change in the slope of the tangent (likelihood ratio) between 9000 and 10,000 per μL . Of course, the relative paucity of NA patients (22 of > 800 appendectomies) resulted in a somewhat jagged ROC curve. Nevertheless, the validation portion of this study suggests that a cut-off of ~8000 to 9000 per μL significantly improves diagnostic accuracy. By using 9000 per μL as a cut-off in our series, the false-positive rate of appendicitis could have been further reduced from an already low 2.6% to 0.6%, but it would have decreased the sensitivity to 92% of its current value (i.e. we would have failed to operate on 8% of patients with appendicitis). Using 8000 per μL as a cut-off value would have yielded a slightly higher false-positive rate 1.2%, but with a 95% sensitivity.

If we accept that early appendicitis poses only minimal risk of perforation, it is reasonable to observe some patients overnight. Doing so while using the same admission WBC cut-offs of 9000 and 8000 per μL , we would have obtained false-positive rates of 0.6% and 1.2% respectively with respective sensitivities of 95% and 96%. It is important to note that this degree of accuracy was calculated after all other clinical and imaging variables had already suggested appendicitis. WBC count cannot reasonably be used as the sole determinant of acute appendicitis at the exclusion of all others and it certainly does not replace clinical judgment. However, a WBC count < 8000 to 9000 per μL in a child who has had symptoms for < 24 hours merits a period of observation, provided there are no signs of advanced disease.

In the validation portion of our study, we applied the above principles and were able to further reduce our NA rate. By using a threshold of 9000 per μL , we lowered our false-positive rate to 0.98% (2 NAs out of 204 appendectomies in 2012). By using WBC count alone, we would have decreased the sensitivity to 91% (18 of 204 patients had a WBC count < 9000 per μL). However, other factors (Clinical and imaging findings) helped make the correct diagnosis of appendicitis in all but 4 of these 18 patients for a true sensitivity of 98%. We were therefore able to lower our NA rate below 1% with minimal impact on the incidence of false-negative appendicitis: only 4 of 204 patients could be considered

missed appendicitis, and all presented with considerable delay making accurate diagnosis more difficult.

Once a common practice, hospital admission for serial examination and repeat testing may have become rarer as diagnostic accuracy has improved. The addition of near-routine imaging and a more cost-conscious approach are 2 factors that have shortened the decision-making time. Nevertheless, observing patients with an equivocal diagnosis or contradictory findings has its place. It is important to note that whereas judicious use of analgesics may be considered during the observation period antibiotics should not, so as not to mask the evolution of possible appendicitis. In one retrospective study, active observation was practiced for patients presenting with doubtful clinical diagnosis based on clinical history, physical examination and WBC and C-reactive protein results. Although, the mean observation was long at 2.5 days, the NA rate was only 2.6%. A similar study incorporating active in-house observation for patients with questionable diagnosis of acute appendicitis showed a decrease in NA rate, decreased costs and shortened hospitalisation without an increase in morbidity. We do not routinely obtain C-reactive protein levels and despite promising results, this test is not yet used ubiquitously. Its addition to the diagnostic panel could in the future prove helpful in further refining diagnostic accuracy.

Of course, clinical judgment should prevail and certain patients are more at risk. Young children (< 3 - 5 years) for example are more likely to present with advanced appendicitis or frank peritonitis and the disease may progress more rapidly in that age group. Therefore, any suspicion of advanced appendicitis should be treated as the true emergency it represents. Furthermore, it is unrealistic to expect zero NA rates, given the variability of the disease in onset, evolution and body response. Nevertheless, several recent studies have confirmed that a false-positive rate < 5% is safe and feasible, and a sophisticated use of adjunctive tests such as leukocytosis can help to achieve this goal.

So in our study of "WBC count as a diagnostic parameter in acute appendicitis." The diagnostic value of WBC was studied and after the study negative appendectomy rate was 10.2%, which was comparable to study done by Khan MN et al¹ in 2004 with negative rate of 14.3% and with Vinoth Kumar et al⁴ in 2011 with negative rate of 10%.

In our study sensitivity of 97.7%, specificity of 85.7% was compared with study by Dueholm et al⁵ in which he demonstrate that WBC had best sensitivity of 83% and negative predictive value of 88%; MN Khan et al³ showed sensitivity of 83% and positive predictive value of 92%. Hence, serum WBC complements the clinical diagnosis of acute appendicitis.

As all these efforts were taken to reduce the rate of negative appendectomy.

CONCLUSION

Though history and clinical examination by an experienced surgeon still remain indispensable in diagnosing a case of acute appendicitis. But WBC counts help to reduce the rate of negative appendectomy substantially and hence should always be included in the workup of acute appendicitis.

SUMMARY

In above study, it was concluded that serum WBC has highest sensitivity and specificity; hence, it proves that there is definite association between raised serum WBC and acute appendicitis and hence WBC is a good laboratory test which can be used to reduce negative appendicectomy rates.

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