PREDICTIVE VALUE OF LEUKOCYTOSIS FOR DIAGNOSING ACUTE APPENDICITIS

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ABSTRACT

Objective: To determine the predictive value of leukocytosis in the diagnosis of acute appendicitis using histopathology as gold standard.

Study Design: Cross-sectional validation study.

Place and Duration of Study: Department of general surgery Combined Military Hospital Bahawalpur, from Jan 2015 to Dec 2015.

Material and Methods: A total of 180 patients were included in this study. Leukocyte count was done in each patient on presentation in emergency department. Following open appendectomy, resected specimens were sent for histopathological examination. Sensitivity analysis was done using two by two tables.

Results: Out of 180 patients, 132 (73.3%) were male while remaining 48 (26.7%) were female with mean age of 27.2 ± 8.5 years. Sensitivity of leukocyte count in diagnosing acute appendicitis was 93.5%, specificity 64.3%, positive predictive value 89.6%, negative predictive value 75.1% and diagnostic accuracy was 86.7%.

Conclusion: Raised leukocyte count was found to have high sensitivity but low specificity for diagnosing acute appendicitis. It is a poor sole inflammatory diagnostic marker for acute appendicitis necessitating additional investigations in certain cases.

Keywords: Acute appendicitis, Histopathology, Leukocyte count.

INTRODUCTION

Acute appendicitis is the most common cause of acute abdomen worldwide[1]. Lifetime prevalence of acute appendicitis is approximately 7% with peak incidence between the age of 10 and 30 years[2]. Appendectomy is the most commonly performed operation worldwide with life time risk of 12% for males and 25% for females[3]. Acute appendicitis has morbidity of approximately 10% and mortality of approximately 1-5% even after advancements in diagnosis and treatment[4]. Attempts have always been made to enhance the diagnostic accuracy of acute appendicitis to prevent negative appendectomies which cause significant post-operative morbidity[5].

Acute appendicitis being an inflammatory disorder is associated with raised leukocyte count[6]. Leukocyte count estimation is one of the most helpful and first line investigations for patients presenting with acute abdomen. It is an easily available, simple and economical laboratory investigation that can be performed in all patients presenting with right lower quadrant abdominal pain mimicking acute appendicitis[7]. Sensitivity and specificity of raised leukocyte count range from 70% to 80% and 60% to 68% respectively for diagnosing acute appendicitis[8]. Leukocyte count is also integral component of various scoring systems used for diagnosis of acute appendicitis.

A normal pre-operative leukocyte count in patients presenting with suspected acute appendicitis is most likely associated with a normal appendix. Deferring surgery in this group of patients and/or further investigation into other possible causes might reduce the rate of negative appendectomies[9]. This could reduce the morbidity associated with negative exploration and might be cost effective by reducing both the negative appendectomy rate and length of hospital stay. Appendectomy is one of the most

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commonly performed emergency surgical procedure accounting upto 10% of all abdominal surgeries[10]. About 20-33% of the patients having acute appendicitis present with atypical clinical findings in the emergency department[11]. Atypical clinical presentations impose diagnostic dilemmas which have led to devise different scoring systems, imaging modalities, laparoscopy and laboratory teststo help in making the diagnosis. Leukocyte count estimation is one of the initial investigations performed in emergency department for evaluation of acute abdomen. Elevated leukocyte count not only helps in complementing the diagnosis of acute appendicitis but its levels also help in predicting the severity and natural history of disease. Keeping all this in view, we conducted this study to detect the efficacy of raised leukocyte count in complementing the diagnosis of acute appendicitis in our set up.

Table-I: Comparisons of leukocytosis and histopathology.

		Histopathology of Appendix		
		Inflamed appendix	**Normal appendix**	**Total**
Leukocyte Count	>10,000/mm^3	True Positive (a) (129)	False Positive (b) (15)	144
	≤10,000/mm^3	False Negative (c) (09)	True Negative (d) (27)	36
	Total	138	42	180

Table-II: Statistical pattern of leukocytosis for diagnosing acute appendicitis.

Statistical Parameter		**Results**
Sensitivity	a / a +c x 100	93.5%
Specificity	d / b + d x 100	64.3%
Positive Predictive Value	a / a + b x 100	89.6%
Negative Predictive Value	d / c + d x 100	75.1%
Diagnostic Accuracy	a + d/ a + b + c + d x 100	86.7%

PATIENTS AND METHODS

This cross-sectional validation study was carried out at Combined Military Hospital, Bahawalpur from 1st Jan 2015 to 31st Dec 2015. Life time incidence of acute appendicitis is 50%[12], so anticipated population proportion (p) was 0.5, confidence level was 95% and absolute precision required (d) was 0.08, so calculated sample size was 180 by using WHO sample size calculator. Both male and female patients between 10 to 50 years of age who presented with right iliac fossa (RIF) pain of less than 2 days duration suspected to have acute appendicitis were included in the study by non-probability consecutive sampling. Patients presenting with non-right iliac fossa pain, pregnant, patients having appendicular mass or appendicular abscess and patients who underwent incidental appendicectomy were excluded from the study.

All the patients were initially assessed by adequate history, thorough examination and investigations (total leukocyte count and urine examination) were done. Other investigations such as those required for evaluation of fitness for general anesthesia were also carried out. Leukocyte count of over 10,000/mm^3 was considered elevated. After confirming the diagnosis, informed written consent was obtained for surgery. Pre-operatively, the patients were kept nil by mouth for 6 hours, received intravenous fluids/antibiotics and analgesics. Open appendectomy was performed in all patients. Resected specimens were sent for histopathological examination.

All the data collected through the proforma were entered into the Statistical Package for Social Sciences (SPSS) version 18.0 and analyzed through its statistical package. Mean and standard deviation was used for quantitative data

like age while frequency and percentage was calculated for qualitative data like gender. 2 x 2 table was used to determine sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of raised leukocyte count in acute appendicitis.

RESULTS

A total of 180 patients were included in this study during the period of 1 year from January 2015 to December 2015. Regarding age distribution,121patients (67.2%) were between 11-30 years of age, while 48 patients (32.8%) were between 31-50 years of age. Age distribution ranged from 12–50 years, mean ± SD was calculated as 27.2 ± 8.5. In our study, range of leukocyte count was 4500/mm^3 to 26400/mm^3 with a mean of 12363.89 ± 3285.54/mm^3. There were 144 patients with elevated leukocyte counts (range 10200/mm^3 to 26400/mm^3 with a mean of 13589.58/mm^3 ± 2355.82/mm^3 while there were 36 patients with <10,000/mm^3 leukocyte counts, ranging from 4500/mm^3 to 9400/mm^3 with a mean of 7461.11/mm^3 ± 1275.76/mm^3. Out of 180 patients, 132 (73.3%) were male while remaining 48 (26.7%) were female. True positive were 129, false positive 15, false negative 09 and true negative were 27 (table-I). Sensitivity of raised leukocyte count in diagnosing acute appendicitis was 93.5%, specificity 64.3%, positive predictive value 89.6%, negative predictive value 75.1% and diagnostic accuracy was 86.7% (table-II). Receiver operating characteristic (ROC) curve was drawn (figure).

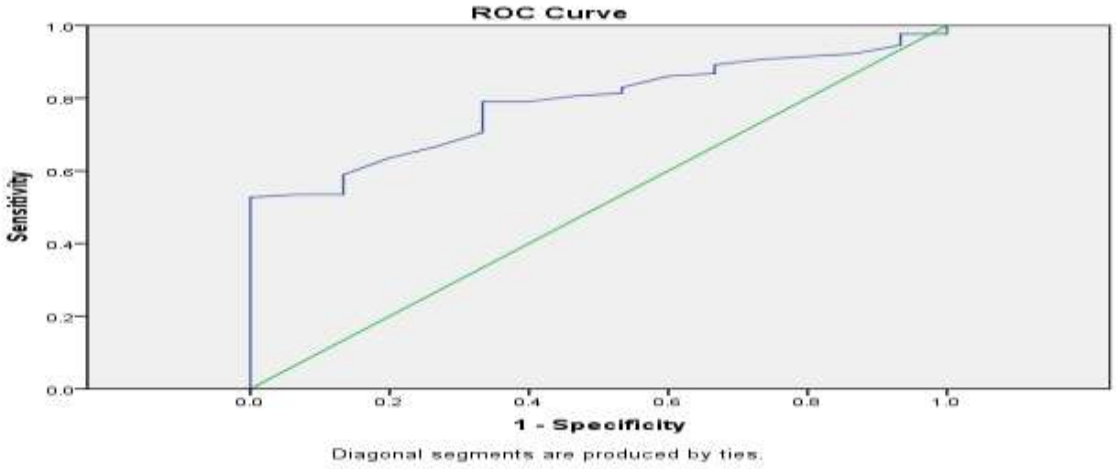

Figure: ROC Curve Area under the curve is 0.784 with a standard error of 0.045 and confidence interval of 0.695 to 0.873.

DISCUSSION

One hundred and twenty one patients (67.2%) out of a total of 180 patients in our study were in 2nd and 3rd decade of life, which is in accordance to other study conducted by Ramachandra et al[13]. In our study, acute appendicitis was more frequent among males than females which is in conformity with published literature[14]. Elevated leukocyte count was found in 71.6% (n=129) patients with macroscopically confirmed acute appendicitis in our study which is in accordance with studies conducted by Saaiq[15] and Ahmed et al[16].

Sensitivity of raised leukocyte count in diagnosing acute appendicitis was found to be 93.5%, specificity 64.3%, positive predictive value 89.6%, negative predictive value 75.1% and diagnostic accuracy was 86.7% in our study. Our result of 93.5% sensitivity of raised leukocyte count for acute appendicitis is comparable with findings of Shafi[17]. Similarly specificity of raised leukocyte count in our study was found to be 64.3% which is comparable to 67% and 73.3% reported by Gulzaret al[18] and Kamran et al[19] respectively. However, various studies have

reported different results about the specificity of raised leukocyte count for acute appendicitis, as lower as 38% specificity had been reported in literature making leukocyte count alone a poor inflammatory predictor of disease[17]. Because of the inherent problem of low specificity, leukocyte count may mislead the diagnosis at times because other acute abdominal conditions are also frequently associated with raised leukocyte count.

In our study, 76.7% of cases (n=138) were confirmed positive on histopathology, giving the overall negative appendectomy rate of 23.3% which is in concordance to 17.3% mentioned in literature[20]. The reason for this slightly higher negative appendectomy rate could be that all patients in our study were managed by surgical intervention and conservative non operative management was not done in any patient considering open appendectomy as gold standard treatment in our set up.

Leukocytosis is a basic supportive laboratory finding in the diagnosis of acute appendicitis. The usefulness of leukocyte count estimation for excluding acute appendicitis has been supported by previous studies showing that at a cutoff value of <10,000 cell/mm^3 is highly sensitive for ruling out acute appendicitis[21]. Schellekens et al[22] conducted a study comparing the role of various inflammatory markers in diagnosing acute appendicitis. Sensitivity and specificity of leukocyte count was 78% and 71% respectively with area under the curve in ROC being 0.79 (0.73–0.85). Sensitivity of leukocyte count was found to be better in our study but specificity and area under the curve in ROC in this study are highly comparable with our study. They also concluded that leukocyte count has excellent sensitivity for acute appendicitis, equivalent to or better than that of other biomarkers making it a preferred biomarker for patients suspected of having acute appendicitis. In another study conducted by Andersson[23] sensitivity and specificity of leukocyte count >10,000 cell/mm^3 was found to be 83% and 67% respectively with area under the curve in ROC being 0.72 showing modest discriminatory power for acute appendicitis, findings which are comparable to our study.

There are certain limitations in our study. Firstly, we use leukocyte count alone as inflammatory marker for acute appendicitis. However various studies have shown that diagnostic accuracy of leukocyte count can be markedly increased if it is combined with other inflammatory markers for acute appendicitis such as C-reactive protein[7] and Interleukin 6[24]. Secondly, single measurement of leukocyte count in patients of acute abdomen represents the snap shot of the condition at that particular time only. Serial measurement of leukocyte count is what is required to enhance not only its diagnostic accuracy but also its role in clinical decision making.

CONCLUSION

Raised leukocyte count was found to have high sensitivity but low specificity for diagnosing acute appendicitis. It is a poor sole inflammatory diagnostic marker for acute appendicitis necessitating additional investigations in certain cases.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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