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Diagnostic Accuracy of Alvarado Score In Comparison With Raised C-Reactive Protein Levels For Acute Appendicitis

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ABSTRACT

Objective *To find out the diagnostic accuracy of Alvarado score in comparison with raised C-reactive protein (CRP) levels for acute appendicitis considering histopathological findings as gold standard.*

Study design *Cross sectional study.*

Place & Duration of study *Department of Surgery Unit II, Jinnah Postgraduate Medical Centre (JPMC) Karachi, from August 2022 to August 2024.*

Methods *Patients of either gender above 12-years of age were included. A detailed history was taken and physical examination performed. C-reactive protein level estimation was done along-with CBC and urine D/R. All patients underwent surgery and appendectomy done. Specimen was sent for histopathology. Descriptive statistics were used to report quantitative data as mean with standard deviation and qualitative variables as frequency and percentages. Sensitivity, specificity, positive and negative predictive values with diagnostic accuracy were computed for Alvarado score and CRP level.*

Results *A total of 369 patients were included. Mean age of the patients was 41.90 ±8.82 years. There were 216 males and 153 females. Alvarado score had a sensitivity of 85.7%, specificity 83%, positive predictive value 62.4%, negative predictive value 94.6%, and diagnostic accuracy 83.7%. CRP levels had sensitivity of 59.3%, specificity 88.8%, positive predictive value 63.5%, negative predictive value 86.6%, diagnostic accuracy of 81.5%.*

Conclusion *Alvarado score had a better diagnostic accuracy in comparison with CRP levels.*

Key words *Acute appendicitis, Alvarado score, CRP level, Diagnostic accuracy.*

INTRODUCTION:

Acute appendicitis is among the most frequent surgical emergencies with approximately 8% global incidence.[1] Immediate appendectomy is needed in most of the cases to avoid complications such as perforation leading to the peritonitis. The diagnosis of acute appendicitis is based upon the clinical history, examination and supported by different laboratory investigations and imaging techniques. Ultrasound and CT scan are also used to avoid negative appendectomy in doubtful cases. A high diagnostic accuracy rate of above 90% is reported with the use of such techniques. However, the clinical judgment is still essential.[2]

A delay in diagnosis as well as incorrect decision to perform appendectomy may add to morbidity and mortality. In order to reduce the incidence of negative appendectomy, it is essential to accurately diagnose patients who presents with clinical features

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suggestive of acute appendicitis. Laboratory investigations also help in strengthening the clinical diagnosis. The elevated level of C-reactive protein and neutrophil counts are helpful in diagnosing acute appendicitis.[3,4]

CRP is produced by liver in response to the inflammation. It is used as a marker for diagnosing acute appendicitis. In acute condition the CRP level is increased within 4 to 6-hours and its level peaks at 36 to 48-hours.[5] However, its diagnostics accuracy is variable.[6] The Alvarado scoring system is commonly used as an important tool in diagnosing acute appendicitis for over two decades. It is affordable and cost-effective approach.[7,8] The rationale of this study was to compare the diagnostic accuracy of Alvarado score for diagnosis of acute appendicitis with raised CRP level by taking histopathology as gold standard.

METHODS:

Study design, place & duration: This was a cross-sectional study conducted in the Department of Surgery, Unit II, Jinnah Postgraduate Medical Center Karachi, from August 2022 to August 2024.

Ethical considerations: Ethical approval was taken from Institutional Review Board letter No.F.2-77/2022-GENL/242/JPMC dated 18th July 2022.

Inclusion criteria and exclusion criteria: Patients of both sexes, age 13 – 60-years, presenting with right lower abdominal pain of less than 24-hours in whom clinically acute appendicitis suspected, were included. Patients with past history of abdominal surgery, positive pregnancy test, and any atypical abdominal pain were excluded.

Sample size estimation: The sample size calculator was used by taking sensitivity as 47% and specificity as 93% for Alvarado score, prevalence equal to 53.2%, margin of error for sensitivity as 7% and specify as 3.8%, the calculated sample size came at 369 after adjusting for drop outs and more representative data.[7] A non-probability consecutive sampling method was used to enroll patients.

Study protocol: Detailed history was taken. Any comorbid were recorded. Alvarado score was calculated at admission and CRP levels along-with other biochemical tests such as CBC, urine D/R were sent to the laboratory. Chest x-ray was also obtained. Data collection were done on a predesigned form. All patients were subjected to appendectomy. Specimen of appendix was sent for histopathology.

Statistical analysis: Data were entered into IBM SPSS Statistics version-23. Descriptive statistics were used to report quantitative variables as mean ±SD for age, Alvarado score and CRP level. Frequency and percentage were calculated for qualitative variables like gender. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were computed using a 2 x 2 table (true positive - TP, true negative - TN, false positive - FP and false negative - FN). Effect modifiers like age and gender were controlled though stratification.

RESULTS:

A total of 369 patients were included in this study. The age was from 13 - 60-years. The mean age was 41.90±8.82 years. There were 216 (58.5%) male and 153 (41.5%) female patients. The mean Alvarado score was 8.11±1.25 and raised CRP level was 21.78±4.65 mg/dL. Considering the histopathological confirmation as gold standard, the Alvarado score for acute appendicitis is given in table I and for CRP level given in table II.

In age group of less than 40-years, considering the histopathological findings as a gold standard, for acute appendicitis, the Alvarado score specificity was 77.2%, sensitivity 85%, PPV 52.8%, NPV 94.7%, and diagnostic accuracy 79.1%. In age group of above 40-years, the Alvarado score had sensitivity 86.1%, specificity 79.2%, PPV 56.8%, NPV 94.6%, and diagnostic accuracy 92.2%.

In age group of less than 40-years with acute appendicitis, the raised CRP specificity was 87%, sensitivity 75.9%, PPV 63%, NPV 92.5%, and diagnostic accuracy 84.55%. In age group of more than 40-years, the raised CRP had sensitivity 35.1%, specificity 92.3%, PPV 65%, NPV 77.9% and diagnostic accuracy 75.9%.

In males with acute appendicitis the Alvarado score had specificity of 84.9%, sensitivity 89.4%, PPV 68%, NPV 95.7% and diagnostic accuracy 86.1%. In females the values were sensitivity 79.4%, specificity 80.6%, PPV 54%, NPV 93.2% diagnostic accuracy 80.3%.

In males with acute appendicitis the raised CRP specificity was 87%, sensitivity 63.9%, PPV 66.1%, NPV 85.9% and diagnostic accuracy 80.5%. In females the corresponding figures were sensitivity 50%, specificity 91%, PPV 57.6%, NPV 88.1% and diagnostic accuracy 83%.

Table I: Alvarado Score for Acute Appendicitis With Histopathological Confirmation

Sensitivity	TP/TP+FN	85.7%
Specificity	TN/TN+FP	83.0%
PPV	TP/TP+FP	62.4%
NPV	TN/FN+TN	94.6%
Diagnostic accuracy	TP + TN/Total patients	83.7%

Table II: Raised CRP for Acute Appendicitis With Histopathological Confirmation

Sensitivity	TP/TP+FN	59.3%
Specificity	TN/TN+FP	88.8%
PPV	TP/TP+FP	63.5%
NPV	TN/TN+FN	86.9%
Diagnostic accuracy	TP + TN/Total patients	81.5%

DISCUSSION:

This comparative study of acute appendicitis for raised CRP level and Alvarado score provided significant insights about the diagnostic accuracy of the two tools in context of clinical decision making. However, the findings indicate that the sensitivity, specificity, PPV, NPV and diagnostic accuracy of Alvarado scoring system was better than the raised CRP level. The Alvarado scoring system integrates clinical signs, symptoms and laboratory findings into a single score which make this system a comprehensive tool in the diagnosis of acute appendicitis.[9,10]

The findings of this study are also in line with another study in which the Alvarado score substantially lowered the probability of negative appendectomies by predicting acute appendicitis with high sensitivity and specificity.[11] A study reported that Alvarado scoring system has the ability to enhance the reliability of diagnostic findings, and reported that 80% of negative appendectomy cases had an Alvarado score of less than six.[12] Other studies have also showed that the Alvarado score successfully differentiated the patients into categories who may be at a risk of acute appendicitis. The score of seven or above indicates a significant likelihood of developing the illness. The stratification of people into several risk categories for acute appendicitis is crucial, in order to reduce the percentage of negative appendectomies.[13,14] Additionally, the Alvarado score is found consistently reliable across a range of demographic settings.[15]

On the other hand, although C-reactive protein is a valuable indicator of inflammation, it does not have the specificity and comprehensiveness as that of Alvarado scoring system. On its own, elevated CRP level cannot definitively diagnose appendicitis, although they might suggest inflammation. The CRP estimation is less accurate as a stand-alone diagnostic tool since it can be raised in a number of different illnesses.[16,17]

Limitations of the study: This was a single center study with a small sample size. The inclusion criteria were also too focused on right lower quadrant pain. This may add to a bias in a clinical assessment.

CONCLUSION:

The Alvarado scoring system provided a more reliable information for diagnosing acute appendicitis as compared to isolated CRP levels. However, integration of both CRP level estimation and Alvarado scores may add to a better clinical judgment and lower the incidence of negative appendectomies.

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Aazma Mirza: Data collection and analysis.

All authors are responsible of writing and revising as well as content of the article.

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