Journal of Carcinogenesis
Covering Genesis to Therapeutics

Journal of Carcinogenesis, ISSN: 1477-3163
2025; Vol 24: Issue 9s, https://carcinogenesis.com/

Clinical Scores For Acute Appendicitis – Alvarado Score Vs Appendicitis Inflammatory Response Score

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ABSTRACT

Background: Acute appendicitis is the most frequent cause of acute abdomen in young adults. Alvarado score is the most commonly used clinical scoring system but has variable specificity and sensitivity. Appendicitis Inflammatory Response (AIR) score has been found better than the older Alvarado score. The rationale of this study was to determine the diagnostic accuracy of two scoring systems which are commonly used in acute appendicitis.

Materials and Methods: 289 patients fulfilling criteria with suspected acute appendicitis were included. Demographic data was recorded. A score of 8 was cut off threshold for AIR and 7 for Alvarado Score. Sensitivity, specificity, positive predictive value (PPV) and negative predictive (NPV) for AIR and Alvarado score were calculated. Specimen were sent for histopathology for final diagnosis. Statistical analysis was done using SPSS version 21.

Results: Results showed that Alvarado scoring at value > 7 had sensitivity of 53.03%, specificity of 90.45%, PPV of 82.35%, NPV of 69.61% and diagnostic accuracy of 73.36%. Furthermore, AIR scoring > 8 had sensitivity of 51.52%, specificity of 96.82%, PPV of 93.15%, NPV of 70.37% and diagnostic accuracy of 76.12%.

Conclusion: The diagnostic accuracy of AIR score was 76.12% and diagnostic accuracy of Alvarado score was 73.36%. AIR score has been found to have a higher discriminating power as compared to Alvarado score.

Keywords: *Alvarado score, Appendicitis Inflammatory Response (AIR) score, Acute Appendicitis, Diagnostic accuracy*

How to Cite: Saad Bin Abdul Qudus, Zeeshan Ishaque, Mustansar Iqbal, Muhammad Hassan, Muhammad Ahmad Yusuf, Mohibba Azam, (2025) Clinical Scores For Acute Appendicitis – Alvarado Score Vs Appendicitis Inflammatory Response Score, *Journal of Carcinogenesis*, *Vol.24, No.9s,* 646-649

1. INTRODUCTION

Acute appendicitis is the most frequent cause of acute abdomen in young adults. It is so common that appendectomy is the most widely performed abdominal operation, being the first major procedure performed by a surgical resident. Individual lifetime risk of appendicitis leading to appendectomy is 8.6% in male and 6.7% in female.[1,2] Male: Female ratio being highest (3:21) at the age of 25 years.

Advancement in radiographic imaging have improved the diagnostic accuracy of appendicitis; however, its diagnosis still remains essentially clinical, requiring a combination of clinical features and surgical expertise. Thus it holds a significant challenge for the surgeons. In order to categorize the patients who require urgent appendectomy and who do not, various scoring systems have been introduced. These scoring systems not only avoid the risk of delayed diagnosis but also decrease the load of negative appendectomies.

'Alvarado score' is the most commonly used clinical scoring system but has variable specificity and sensitivity[3,4]. It was devised on the basis of a review which was conducted on those patients who had undergone appendectomy due to suspected appendicitis, whereas this scoring system is supposed to be applied on all who have been suspected of having appendicitis. Despite of the fact that many studies have highlighted the role of C – reactive protein (CRP) in assessing the patients having appendicitis, CRP has not been incorporated in Alvarado score.[5,6] In order to overcome these drawbacks, 'Appendicitis inflammatory response score' (AIR) was designed.

The AIR score is a more organized diagnostic scoring system that has recently been developed. It includes seven variables to classify the patients into low, intermediate and high risk categories. This scoring system is based on the clinical criteria along with two laboratory investigations i.e., the C-reactive protein (CRP) and the complete blood count (CBC), leading to a better and easier diagnosis of acute appendicitis[7,8]

One study conducted in India by Patil S et al showed that AIR (cut off > 4) had greater sensitivity and specificity as compared to Alvarado score (89.9% vs 78.6%) and (63.6% vs 54.5%) respectively, whereas; at cut off score of > 8 'Alvarado score' demonstrated slightly higher sensitivity (21.3% vs 12.3%)[9]. In another study conducted in Kashmir showed that AIR score have a higher sensitivity (97% vs 83%) and specificity (77% vs 73%) compared to Alvarado score when cut of > 4 is used. But when > 8 is considered the cut off score, AIR score becomes less sensitive in diagnosing acute appendicitis than 'Alvarado score' (12% vs 32%)[10].

Another study conducted in Netherlands showed similar results. According to this study, considering > 4 as the cut off score, AIR demonstrated greater specificity than Alvarado score (85% vs 55%) whereas their sensitivity was quite similar (93% vs 90%)[11]. A similar study conducted in India by Gopalam PR et al showed quite comparable results[12]. Taking into consideration the results of previous studies, AIR score has been more validated and it has outperformed the older 'Alvarado score'[13].

The rationale of this study is to determine the diagnostic accuracy of two scoring systems commonly used in patients having scores between 9 to 12 for AIR and 7 to 10 for Alvarado, taking histopathology as the gold standard. The objective was also to identify superiority of either scoring systems to accurately diagnose patients who may benefit from surgery versus patients which could be managed conservatively.

2. MATERIALS AND METHODS

This cross sectional study was conducted in Surgical Unit I, Services Institute Of Medical Sciences, Lahore Pakistan from July 2020 to June 2024. Total 289 patients who fulfilled the inclusion criteria were included through non – probability consecutive sampling. Risk benefit ratio was discussed and informed consent was signed. Demographic data including age, gender and occupation was recorded. Patients were then evaluated by investigator for 'Appendicitis Inflammatory Response (AIR) score as well as 'Alvarado Score'. Clinical examination for both the scores was done. Patients were subjected to investigations including CBC, CRP and Ultrasound.

A score of 8 was taken as the cut off threshold for AIR and 7 for 'Alvarado Score'. Scoring was done by the researcher himself. Specificity, sensitivity, positive and negative predictive values (PPV & NPV) for AIR and Alvarado score were calculated. Open Appendectomy was done for all the cases. Specimen were sent for histopathology for final diagnosis. Histopathology report was followed and entered on same Performa. All information were kept confidential.

Statistical analysis was done using SPSS version 21. Descriptive analysis was done for demographic data. Qualitative data like gender, presence of acute appendicitis was presented as frequencies and percentages. Quantitative data like age was presented as standard deviation. Data was stratified for age, gender and BMI. Post-stratification 2 x 2 contingency table

was used to check the diagnostic accuracy of AIR and Alvarado score.

3. RESULTS

Data analysis shows that a total of two hundred and eighty nine patients participated in our study. In this study, 65.06% patients were between the ages of 15-40 years while 34.94% patients were between the ages of 41-60 years. Mean age of patients was 31.40 $\pm$ 5.78 years.

Regarding gender distribution, 46.71% patients were male while remaining 53.29% patients were female. A total of 55.37% patients had BMI < 25 kg/m^2 whereas 44.63% patients had BMI > 25 kg/m^2. With regards to presence of appendicitis on histology, 45.67% patients had appendicitis on histology.

Further analysis showed that Alvarado scoring at value > 7 had sensitivity of 53.03%, specificity of 90.45%, PPV of 82.35%, NPV of 69.61% and diagnostic accuracy of 73.36%. Furthermore, AIR scoring > 8 had sensitivity of 51.52%, specificity of 96.82%, PPV of 93.15%, NPV of 70.37% and diagnostic accuracy of 76.12%.

When we stratified our data according to different age groups, gender and BMI according to Alvarado and AIR, there was no association between different age groups, gender, BMI and Alvarado score. Similarly, analysis showed that there was no significant association between different age groups, gender, BMI and AIR score.

4. DISCUSSION

One of the most common surgical emergency is acute abdomen and acute appendicitis being its most frequent cause. Multiple scoring systems have been devised for its diagnosis and most commonly used is Alvarado score despite having variable specificity and sensitivity. AIR score, a more advanced scoring system, has undoubtedly outperformed the older 'Alvarado score'. We conducted this study to determine the diagnostic accuracy of 'Alvarado Score' and 'Appendicitis Inflammatory Response' (AIR) score in diagnosing acute appendicitis.

Our study showed that Alvarado scoring at value > 7 had sensitivity of 53.03%, specificity of 90.45%, PPV of 82.35%, NPV of 69.61% and diagnostic accuracy of 73.36%. Whereas, AIR scoring > 8 had sensitivity of 51.52%, specificity of 96.82%, PPV of 93.15%, NPV of 70.37% and diagnostic accuracy of 76.12%. These results were comparable with results of other studies.

One study conducted by Sammalkorpi et al. showed sensitivity of 68.8%, specificity of 76.4% at a score > 7. Furthermore AIR socre at > 9 had sensitivity of 14.6% while specificity of 97.1%.[14] The reason for high specificity on AIR score was probably due of higher cut off value of 9 rather than 8.

Another study conducted at Egypt by Elshakhs and his colleague had results similar to our study. Results of this study revealed that at score 7, Alvarado score had 50% sensitivity, 87.5% specificity, 89.5% PPV and 45.2% NPV. With regards to AIR score at > 8, sensitivity was 70.6%, specificity was 93.8%, PPV was 96% and NPV was 60%.[15] In a study conducted by Kollar et al., showed that AIR score had sensitivity 15%, specificity 97%, PPV of 88% whereas Alvarado score showed sensitivity of 45%, specificity 76% and PPV of 65%.[16]

In our study diagnostic accuracy of Alvarado score was 73.3%. In his study, Ozkan et al. revealed that Alvarado score was sensitive in 54% and specific in 73.3% patients. Furthermore, PPV of Alvarado was 88.2%, and NPV was 29.7% with an accuracy rate of 57.7%.[17]

Yet another study done by McKay and Shepherd showed low sensitivity of Alvarado score (35.6%) and a higher specificity (94%)[18] at a cut off score of 6. Difference of low sensitivity and higher specificity can be explained by cut off level of Alvarado score in this study which was 6 and in our study, it was 7.

A study conducted by Karami et al. at Iran used a different cut off for AIR score. According to results of this study, at cut off of 4, AIR score was sensitive in 78.41% patients and specific in 91.67% patients. PPV was 98.57% and NPV was 36.67%.[19] The difference in sensitivity and specificity compared to our study was due to cut off of 4 for AIR score in this study. Further analysis showed that Alvarado score at > 7 was sensitive in 78.41% and specific in 100% patients. Alvarado score had PPV in 100% and NPV in 36.67% of patients who underwent acute appendectomy.[19]

The results of our study highlight that AIR score outpaces the most commonly used Alvarado score in diagnosing the patients who may benefit from surgery and reducing the burden of negative appendectomies.

5. CONCLUSION

Clinical assessment and experience still holds the major significance in the diagnosis of acute appendicitis. AIR score has been found to have a higher discriminating power as compared to Alvarado score.

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