Open Access

Original Article

Comparison of the Appendicitis Inflammatory Response System and Alvarado Scores for the Prediction of the Acute Appendicitis

Paras Ibn E Ali, Muhammad Ayub Ashraf Malhi, Nosheen Abbas*, Ammara Iqbal Muhammad, Usman Bin Ali, Sohaib Ashraf**

Department of General Surgery, Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan,
*Department of General Medicine, Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan,
**Department of Gynecology, Pak Emirates Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To evaluate the accuracy of Appendicitis Inflammatory Response system in comparison to that of the Alvarado score for the diagnosis of the acute appendicitis.

Study Design: Validation study.

Place and Duration of Study: Accident and Emergency Department of Combined Military Hospital Rawalpindi, Pakistan, from Aug 2021 to Jan 2022.

Methodology: A total of 150 patients who presented to accident and emergency department with complaints of pain in right iliac fossa and were diagnosed clinically by surgeons as cases of acute appendicitis were included. Appendicitis Inflammatory Response and Alvarado scores were calculated for all patients and diagnostic accuracy was compared for both scores taking the histopathology report as the gold standard.

Results: The study had 87(56.1%) males and 63(40.6%) females. Ninety-six (61.9%) individuals were below 40 years of age. Ninety-nine (63.9%) of the patients presented within 48 hours of onset of symptoms. The sensitivity, specificity, PPV, NPV and accuracy were calculated as 89.4%, 77.8%, 50%, 96.7% and 88% for Appendicitis Inflammatory Response scoring system and 74.2%, 77.8%, 29.2%, 96.1% and 74.6% for Alvarado score respectively.

Conclusion: The diagnostic accuracy of Appendicitis Inflammatory Response score was better as compared to Alvarado in diagnosis of acute appendicitis.

Keywords: Acute Appendicitis, Appendicitis Inflammatory Response Score, Alvarado score.

How to Cite This Article: *Ali PIE, Malhi MAA, Abbas N, Muhammad AI, Ali UB, Ashraf S. Comparison of the Appendicitis Inflammatory Response System and Alvarado Scores for the Prediction of the Acute Appendicitis. Pak Armed Forces Med J 2024; 74(6): 1670-1673. DOI: https://doi.org/10.51253/pafmj.v74i6.8711*

INTRODUCTION

The incidence of appendicitis, which is the inflammation of appendix is reported to be 8.6% in males and almost 6.7% in females.[1] The potential and direct pathological cause of appendicitis is still unknown.[2] Its timely diagnosis is a major challenge for physicians, especially in young adults and children.[3]

Clinicians have greatly emphasized that early and accurate diagnosis of acute or chronic appendicitis is vital for reducing resulting morbidity and mortality.[4] Studies have demonstrated Computerized Tomography (CT) as an important diagnostic tool.[5] However, utilization of CT scans and other imaging techniques is not possible in every case, especially in primary healthcare settings in developing nations, which is why healthcare professionals prefer specific clinical scoring systems.[6] These scoring scales are considered as standardized methods of diagnosing and assessing the extent of the inflammation within the appendix.

These reliable scoring systems are based on the observation of laboratory results and clinical examination performed by healthcare professionals.[7-8] One of the most commonly used and appropriate scoring system for the diagnosis of appendicitis is the Alvarado scoring system.[9]

On the other hand, another similar and modified scoring system known as the Acute Inflammatory Response (AIR) is designed to provide a more authentic diagnosis. The AIR scoring scale takes uses C-reactive protein (CRP) values to diagnose appendicitis, with a sensitivity of 93.6% and specificity of 86.6%.[10] This is comparatively higher than the Alvarado scoring system. The inclusion of the CRP component sufficiently reduces the risk and complications associated with the exposure of the patients to unnecessary terms of imaging modalities as well as surgical interventions.

The main purpose of the study is to evaluate the accuracy of Appendicitis Inflammatory Response (AIR) system in comparison to that of the Alvarado

Correspondence: Dr Paras Ibn E Ali, Department of General Surgery, Combined Military Hospital, Rawalpindi Pakistan
Received: 16 May 2022; revision received: 12 Sep 2023; accepted: 14 Sep 2023

score for the screening and reliable diagnosis of the acute appendicitis.

METHODOLOGY

This Validation study was performed at Combined Military Hospital Rawalpinid, Pakistan from August 2021 to January 2022 after approval from Ethical Review Board (Serial # 232, dated 04-08-2021, CMH Rawalpindi).

Inclusion Criteria: Individuals of either gender, aged between 12 to 80 years, with para-umbilical pain that radiated to the right iliac fossa or the right lower abdomen were clinically evaluated for acute appendicitis were included.

Exclusion Criteria: Patients who had a mass in the right iliac fossa or were scheduled for an interval appendectomy were excluded.

For this study, 150 patients were recruited using non-probability convenience sampling technique. Sample size was calculated using WHO calculator, using prevalence of 57.3% which came out to be 147.[11]

Surgical residents performing duties in the Emergency Department helped in collecting the data by assessing patients after taking written informed consent. A predesigned proforma was used as medium of assessing patients and collecting relevant data. Senior registrars and consultants evaluated patients to make the diagnosis of acute appendicitis clinically. The severity of acute appendicitis among these patients was analyzed using the Alvarado and AIR scores.[12]

Using the Alvarado and AIR scoring the patients were observed for the degree of high and low frequency of appendicitis. Patients scoring 6 or below on the Alvarado or 8 or below on the AIR scoring system were considered to have low probability rate. On the other hand, all the patients scoring above 8 and 6 on AIR and Alvarado score respectively were considered to have a high probability of needing immediate surgical removal of the organ. The confirmation obtained through the Alvarado and AIR scores for each patient was evaluated against the histopathology report of patients, taken as gold standard to diagnose the condition. This process helped in providing confirmatory analysis.

Data was analysed using Statistical Package for Social Sciences (SPSS) version 23. Quantitative variables were presented using mean and standard deviation, while qualitative variables were presented using frequencies and percentages. Sensitivity, Specificity, Positive and Negative Predictive Value Predictive value of the tests were calculated. The cutoff value was taken as ≥7 for Alvarado and ≥9 for AIR score for positive diagnosis of acute appendicitis.

RESULTS

The study had 87(56.1%) males and 63(40.6%) females. Ninety-six (61.9%) individuals were below 40 years of age, and 99(63.9%) presented within 48 hours of onset of symptoms.

Comparison of patient's AIR and Alvarado scoring systems can be seen in Table-I.

Table-I: Comparison of Alvarado and Appendicitis Inflammatory Response Scores (n=150)

Diagnostic Score	Inflamed Appendix n(%)	Normal Appendix n(%)
≥7 (Alvarado)	98 (65%)	4 (3%)
<7 (Alvarado)	34 (23%)	14 (9%)
≥9 (AIR)	118 (78%)	4 (2%)
<9 (AIR)	14 (9%)	14 (9%)

Out of 150 appendectomies done, 132(88%) had inflamed appendix on histopathology. Among these patients, open appendectomy was performed on 135(90%) of the patients, while laparoscopic surgery was performed on 15(10%).

The sensitivity, specificity, PPV, NPV and accuracy was calculated using 2x2 table (Table-II) and the results were calculated as 89.4%, 77.8%, 96.7%, 50% and 88% for AIR scoring system and 74.2%, 77.8%, 96.1%, 29.2% and 74.6% for Alvarado score respectively.

The ROC curve plotted (Figure-1) also shows AIR score having AUC of 0.83 as compared to 0.76 in Alvarado scoring system.

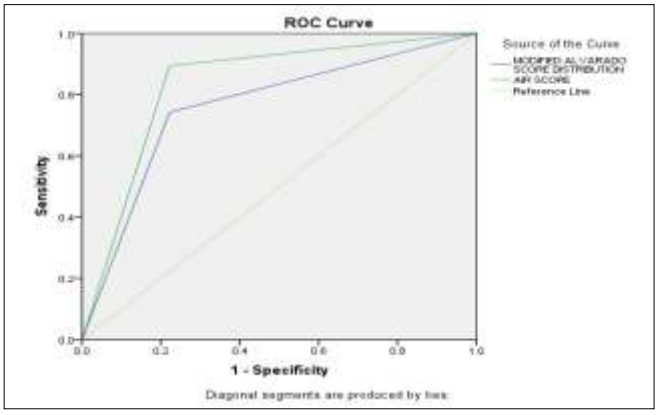

Figure-1: ROC Curve Comparison of Alvarado and Appendicitis Inflammatory Response Systems

Table-II: Diagnostic Efficacy of Appendicitis Inflammatory Response (AIR) and Alvarado Scoring Systems

Parameter	Alvarado	AIR
Specificity	77.8%	77.8%
Sensitivity	74.2%	89.4%
PPV	96.1%	96.7%
NPV	29.2%	50%
Accuracy	74.6%	88%

DISCUSSION

The purpose of designing and executing this cross-sectional research study was evaluate potential ability of the AIR scoring system and Alvarado scoring system in assessing the diagnosis of acute appendicitis and the need for the patients to acquire the immediate surgical removal of the organ. According to one study, the use of scoring systems as tools decreases the risk of inappropriate diagnosis.[13] These scoring systems should be promoted in emergency departments and surgical wards for the purpose of ensuring proper screening. Studies have also addressed that the pace of utilization of these screening tools might serve a crucial role in enabling junior consultants and surgeons to evaluate patients more reliably and increase the terms of their performances within the primary, secondary or tertiary health care settings.[14,15] The selection of these tools plays a viable role in stratifying patients into the low and high probability of having the disease. The patients scoring below 7 on the Alvarado and below 9 in AIR score are kept in observation and on medication, as it is not necessary to perform surgical procedures on these patients right away.[13]

Our study reported that the AIR score was more effective in stratifying the patients with high probability index. This is because the AIR score represented high specificity, sensitivity and positive predictive values in comparison to the Alvarado score and the evaluation maintained by resident surgeons. This is in line with the findings of another study.[16] Research has shown that the Alvarado scoring system expresses lower sensitivity rate. This low sensitivity rate is the major barrier in its rapid and potent consideration or utilization by surgeons.

On the other hand, AIR score represents higher accuracy and predictive values for patients with acute appendicitis, which promotes the use of AIR score in clinical practice. One study also supported the findings, as the AIR score crucially helped surgeons in validating the accuracy of their critical evaluation and clinical assessment efficacy.[16] The major issue that restricts the comprehensive use of the AIR scoring system is that the specificity, sensitivity and predictive values are more reliable for children, young adults and men.[16] For females, AIR score might express the fluctuated results.[17] This issue might cause serious risks in incorrectly stratifying female individuals in high or low probability index, leading to unnecessary surgical procedures or treatment failure.

The chances of medium probability of diagnosis being identified is 37% in terms of utilising the AIR score.[18] If patients are observed with medium probability, the surgeons are responsible to perform further analysis. These diagnostic analysis requires the CT imaging and ultrasounds.[18,19] One study contradicts this, stating that this cannot be the condition always, and the use of the AIR should be rationalised as it not only supports in diagnosis but serves as an effective tool for junior surgeons to understand the patients' concerns, improve the critical understanding and decision making skills in their practicing phases.[20] Further, the utilisation of radiological imaging procedures is only needed for patients who are observed with medium probability.[16]

Further research is needed in this domain to promote its utilisation. The results of this study helped in understanding that low score observed on the Alvarado or AIR scale determines the exclusion of appendicitis and the patients are then evaluated for other clinical issues. While the high score rate obtained, ensure the inclusion and prevalence of appendicitis among patients, which makes it easier for healthcare providers to segment these patients within the groups of low probability and high probability rates.

CONCLUSION

The diagnostic accuracy of AIR score was better as compared to Alvarado in diagnosis of acute appendicitis.

Conflic of Interest: None.

Funding Source: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

PIEA & MAAM: Conception, study design, drafting the manuscript, approval of the final version to be published.

NA & AIM: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

UBA & SA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Al Awayshih MM, Nofal MN, Yousef AJ. Evaluation of Alvarado score in diagnosing acute appendicitis. Pan African Med J 2019; 34(1).
2. Hashemi SA, Teshnizi SH, Vafaei F, Ganji A, Sadeghi MM, Mizani A, et al. Incidence of Enterobius vermicularis in acute appendicitis: A systematic review and meta-analysis. J Acute Dis 2020; 9(4): 152-156. https://doi.org/10.4103/2221-6189.288592
3. Sulo SS, Al-Atrakchi HA. The modified alvarado score versus alvarado score in the diagnosis of acute appendicitis. Med J Babylon 2019; 16(3): 203-206. https://doi.org/10.4103/mjbl.mjbl_48_19
4. Ramya E, Nagalekshmi G. Role of Alvarado Score in Diagnosing Acute Appendicitis: A Prospective Observational Study. Int J Sci Stud 2021; 8(10): 170-173.
5. Petroianu A. Diagnosis of acute appendicitis. Int J Surg 2012; 10(3): 115-119. https://doi.org/10.1016/j.ijsu.2012.02.006
6. Farmer DL. Clinical practice guidelines for pediatric complicated appendicitis: the value in discipline. JAMA Surg 2016; 151(5): e160193. https://doi.org/10.1001/jamasurg.2016.0193
7. Luiz P, Teixeira C, Petroianu A. Differences between inflamed and non inflamed appendices diagnosed as acute appendicitis. Ann Med Surg 2021; 62: 135–139. https://doi.org/10.1016/j.amsu.2021.01.044
8. Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. BMC Med 2011; 9(1): 1-3. https://doi.org/10.1186/1741-7015-9-139
9. Alvarado, A. Improved Alvarado Score (MANTRELS) for the early diagnosis of acute appendicitis. Int J Surg Res Pract 2019; 6(1): 1-6. https://doi.org/10.23937/2378-3397/1410098
10. Chisthi MM, Surendran A, Narayanan JT. RIPASA and air scoring systems are superior to alvarado scoring in acute appendicitis: Diagnostic accuracy study. Ann Med Surg 2020; 59: 138-142. https://doi.org/10.1016/j.amsu.2020.09.029
11. Karami MY, Niakan H, Zadebagheri N, Mardani P, Shayan Z, Deilami I. Which one is better? Comparison of the acute inflammatory response, Raja Isteri Pengiran Anak Saleha Appendicitis and Alvarado scoring systems. Ann Coloproctol 2017; 33(6): 227. https://doi.org/10.3393/ac.2017.33.6.227
12. Von-Muehlen B, Franzon O, Beduschi MG, Kruel N, Lupselo D. AIR score assessment for acute appendicitis. ABCD-Arq Bras Cir Di 2015; 28(3): 171-173. https://doi.org/10.1590/S0102-67202015000300006
13. Pogorelić Z, Mihanović J, Ninčević S, Lukšić B, Elezović S, Polašek O, et al. Validity of Appendicitis Inflammatory Response Score in Distinguishing Perforated from Non-Perforated Appendicitis in Children. Children 2021; 8(4): 309. http://dx.doi.org/10.3390/children8040309
14. Malik AM, Rasheed G, Mazhar T, Malik S, Asif M, Hafeez A, et al. Histopathological analysis of appendectomy specimens in a tertiary care hospital; a descriptive study. Professional Med J 2020; 27(8): 1570-1574. https://doi.org/10.29309/TPMJ/2020.27.08.4189
15. Majid M, Maqsood R, Ali M, Malhi MAA, Hussain Z, Abbasi MH, et al. Comparison of Alvarado Score and RIPASA Score in the Accurate Diagnosis of Acute Appendicitis in Combined Military Hospital Rawalpindi. Pak Armed Forces Med J 2021; 71(5): 1519-1523. https://doi.org/10.51253/pafmj.v71i5.3596
16. Goyal MK, Chamberlain JM, Webb M, Grundmeier RW, Johnson TJ, Lorch SA, et al. Racial and ethnic disparities in the delayed diagnosis of appendicitis among children. Acad Emerg Med 2021; 28(9): 949-956. https://doi.org/10.1111/acem.14142
17. Mantoglu B, Gonullu E, Akdeniz Y, Yigit M, Firat N, Akin E, et al. Which appendicitis scoring system is most suitable for pregnant patients? A comparison of nine different systems. World J Emerg Surg 2020; 15(1): 1-8. https://doi.org/10.1186/s13017-020-00310-7
18. Rud B, Vejborg TS, Rappeport ED, Reitsma JB, Wille-Jørgensen P. Computed tomography for diagnosis of acute appendicitis in adults. Cochrane Colorectal Group, editor. Cochrane Database Syst Rev [Internet]. 2019 Nov 19 [cited 2022 May 15] Available from: http://doi.wiley.com/10.1002/14651858.CD009977.pub2
19. Fu J, Zhou X, Chen L, Lu S. Abdominal Ultrasound and Its Diagnostic Accuracy in Diagnosing Acute Appendicitis: A Meta-Analysis. Front Surg 2021; 8: 707160. https://doi.org/10.3389/fsurg.2021.707160
20. Bhangu A, RIFT Study Group on behalf of the West Midlands Research Collaborative. Evaluation of appendicitis risk prediction models in adults with suspected appendicitis: Identifying adults at low risk of appendicitis. Br J Surg 2020; 107(1): 73–86. https://doi.org/ 10.1002/bjs.11440