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Original Article

A Comparative study between Alvarado Score and Adult Appendicitis Score in Patients with right Lower Quadrant Pain for Diagnosing Acute Appendicitis

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ABSTRACT

Objectives: Acute appendicitis is a typical surgical emergency. This study compared the two scoring systems most commonly utilized to diagnose acute appendicitis.

Material and Methods: This was a prospective comparative study comprising 120 patients presenting with right lower abdominal pain in our hospital's emergency or outpatient department. Patients with Adult Appendicitis Score (AAS) ≥16 or Alvarado Score (AS) ≥9 were considered for surgical intervention. Histopathological confirmation of appendicitis was taken as the confirmatory endpoint.

Results: On analysis, 71 (88.75%) and 68 (88.31%) patients had positive surgical findings as per AAS and AS, respectively. Similarly, 70 (87.50%) were correctly detected as acute appendicitis by AAS, whereas 67 (87.01%) patients were rightly seen as acute appendicitis by AS. The results were compared with histopathological findings. The area under the ROC curve for AAS was 0.930 compared to 0.921 for AS, indicating that AAS was a slightly better predictor for appendicitis.

Conclusion: The AAS was slightly more accurate than the AS in the diagnosis of acute appendicitis.

Keywords: Alvarado score, Adult appendicitis score, Appendicitis inflammatory response Score, appendectomy

INTRODUCTION

Acute appendicitis is the most common cause of acute abdomen in young adults, and appendectomy is the most frequently performed urgent abdominal operation with a lifetime prevalence of approximately 1 in 7.[1,2] However, at the onset, it is often a perplexing diagnostic problem. In many cases, usually during the prodromal phase, clinical manifestations may be vague and uncertain.[3] Although the incidence is highest in younger age groups, the incidence of complicated appendicitis varies slightly among different age groups.[4,5] Although it is a common clinical condition, it remains a diagnostic challenge for surgeons. Clinical diagnosis is associated with a 15–30% negative appendectomy rate. The diagnosis is especially challenging in women of fertile age.[6-8]

A typical patient presents with right lower quadrant (RLQ) pain, nausea, and vomiting and has tenderness and guarding in the RLQ. However, these symptoms and signs are not typical for acute appendicitis. Moreover, signs and symptoms vary with the location of the tip of the appendix.[9] Failure to make an early diagnosis is a primary reason for the low but persistent morbidity and mortality rates.[10] Early surgery is the classical treatment to prevent complications. However, a high rate of unnecessary surgeries leads to increased morbidity and mortality.[8,10] Therefore, acute appendicitis needs to be considered in the differential diagnosis of nearly every patient with an acute abdomen, and early diagnosis remains the most important goal.[11] A negative appendectomy rate of 15–20% has been reported in the literature.[12]

Computed tomography (CT) scan, with its high sensitivity and specificity in diagnosing appendicitis, has helped reduce the number of negative appendectomies.[7,13,14] The use of CT may not be of much help in typical cases as it delays appendectomy and, therefore, even elevates the risk for perforation.[15,16] Increased use of CT is associated with an increased risk of cancer, particularly in young patients whose incidence of acute appendicitis is higher.[17] Removing a normal appendix is an economic burden both on the individual as well as on the healthcare system. On the other hand, delay in surgery can lead to appendicitis-related complications such as abscess, perforation, and peritonitis.[18] This study aims to compare the Alvarado Score (AS) with the Adult Appendicitis Score (AAS) and to identify which is better for an early and correct clinical diagnosis that helps overall management.

MATERIAL AND METHODS

This prospective comparative study was performed in a tertiary care teaching hospital from September 2018 to May 2019. Ethics committee clearance was obtained for the study. Written informed consent was obtained from all the patients before enrollment in the study. All patients admitted, whether through the outpatient or emergency department, with RLQ pain suspected of having appendicitis were included in this study. A total of 120 patients more than 18 years of age were included in the study. Patients with AAS ≥16 or AS ≥9 were considered for surgical intervention except for three who developed appendicular lumps.

Statistical analysis

Statistical analysis was performed using Pearson's Chi-square test. Continuous variables are expressed as mean, median, and standard deviation. The statistical software SPSS version 20 has been used for the analysis. $P < 0.05$ has been considered significant.

RESULTS AND ANALYSIS

Data was collected from 120 patients with RLQ pain who reported as an emergency or to the outpatient department. AS and AAS were calculated for all the patients in the data collection form. All the collected data were entered in a master chart.

Patients were grouped into three categories (definite, possible, and probable appendicitis) per the AS. Among 120 patients, 77 (64.2%) with an AS of 9–10 were categorized in the definite appendicitis group, while 30 (25%) and 13 (10.8%) patients had AS of 7–8 and below 6, respectively.

Patients were grouped into three categories (high, intermediate, and low probable appendicitis) as per the AAS. Among 120 patients, 80 (66.7%) of them had an AAS ≥16 and were thus categorized in the high probable appendicitis group, while 35 (29.2%) and 5 (4.2%) patients had AAS 11–15 and below 10, respectively.

In line with our treatment protocols, 120 patients were managed as per their respective scores. Patients with AS ≥7 or AAS ≥16 were considered for surgical intervention (except three, as they developed appendicular lumps). The remainder was managed conservatively according to the Ochsner-Sherren regimen. Eighty (66.7%) patients were managed surgically and 40 (33.3%) conservatively.

The maximum and minimum value of AS obtained was 10 and 5, respectively. Similarly, for AAS, the extreme values were 18 and 10, respectively. Mean and median values for AS were 8.68 and 9.00, respectively, and for AAS, they were 15.05 and 16.00, respectively. Standard deviations for AS and AAS were 1.45 and 2.81, respectively [Figures 1 and 2].

Twenty-seven (25.23%) and 80 (74.77%) patients were treated conservatively and surgically, respectively. Three patients categorized as possible appendicitis were taken up for surgery as their AAS was ≥16. $P < 0.001$ was significant [Table 1].

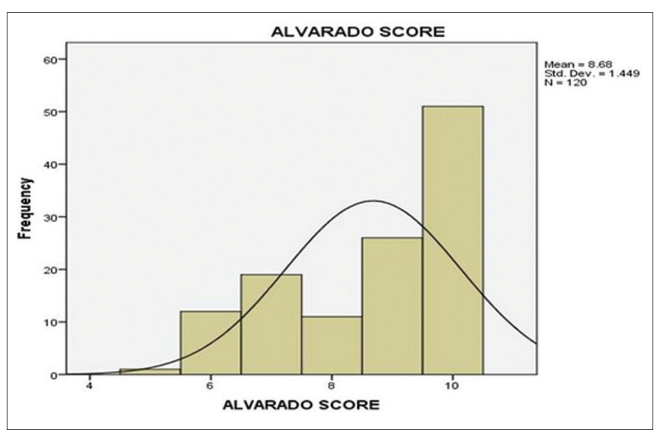

Figure 1: Histogram showing the distribution of Alvarado Score.

According to the treatment guidelines, 35 (30.43%) and 80 (69.57%) patients were treated conservatively and surgically per the AAS. $P < 0.001$ was statistically significant [Table 2].

It was observed that 71 (88.75%) patients ranging in the category of high probable appendicitis (as per AAS) had positive intraoperative surgical findings, compared to 68 (88.31%) patients in the definite appendicitis group (as per AS). Similarly, as per histopathological reports, 70 (87.5%) of operated patients (in the high probable group) had positive findings compared to 67 (87.01%) as per AS [Tables 3 and 4].

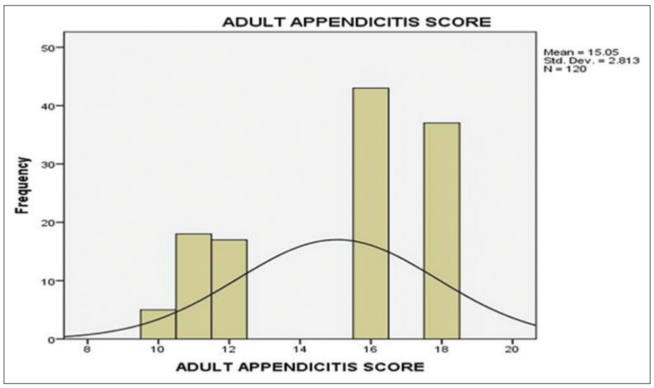

Figure 2: Histogram showing the distribution of Adult Appendicitis Score.

The ROC curves for AS and AAS, with specificity on the X-axis, and sensitivity on the Y-axis, show that the area under the curve (AUC) for AAS is 0.930 (95% CI 0.878–0.982), which is more than that for AS, 0.921 (95% CI 0.865–0.977) [Figure 3 and Table 5]. Thus, from the ROC curve, AAS is a better predictor of appendicitis than AS.

DISCUSSION

Acute appendicitis is a common surgical emergency. Various scoring systems for diagnosing acute appendicitis are in use, but their comparative value is still unclear. This study aimed to clarify the confusion over the different scoring systems by comparing the AAS with the AS.[3,19]

Strategic management in patients with suspected appendicitis remains challenging even after the introduction of USG, CT, and diagnostic laparoscopy. Several other conditions, which mimic the clinical presentation, complicate the diagnosis. CT scan causes ionizing radiation exposure. At the same time, a negative appendectomy can be associated with adverse outcomes. Even today, a competent surgeon's clinical assessment is essential in diagnosing appendicitis. Designating a gold standard scoring system is the need of the hour.

Sammalkorpi *et al*. compared AAS with AS and Appendicitis Inflammatory Response Score (AIR). Their study enrolled 829

Table 1: Treatment distribution as per Alvarado Score.

	ALVARADO SCORE		Total	*P*-value	Significance
	Possible appendicitis	Definite appendicitis			
Treatment				<0.001	Significant
Conservative	27 (90)	0 (0)	27 (25.23)		
Surgery	3 (10)	77 (100)	80 (74.77)		
Total	30 (100)	77 (100)	107 (100)		

Table 2: Treatment distribution as per Adult Appendicitis Score.

	ADULT APPENDICITIS SCORE		Total	*P*-value	Significance
	Intermediate probable appendicitis	High probable appendicitis			
Treatment				<0.001	Significant
Conservative	35 (100)	0 (0)	35 (30.43)		
Surgery	0 (0)	80 (100)	80 (69.57)		
Total	35 (100)	80 (100)	115 (100)		

Table 3: Distribution of data as per surgical findings.

	Alvarado Score		Adult Appendicitis Score
	Probable appendicitis	Definite appendicitis	High probable appendicitis
Surgical finding			
Negative	0 (0)	9 (11.69)	9 (11.25)
Positive	3 (100)	68 (88.31)	71 (88.75)

Table 4: Distribution of data as per histopathological findings.

	Alvarado Score		Adult Appendicitis Score
	Probable appendicitis	**Definite appendicitis**	**High probable appendicitis**
Histopath finding			
Negative	0 (0)	10 (12.99)	10 (12.5)
Positive	3 (100)	67 (87.01)	70 (87.5)

Table 5: Area under the ROC curve.

Test Result Variable (s)	Area	*P*-value	Asymptomatic 95% Confidence Interval	
			Lower Bound	**Upper Bound**
Alvarado Score	0.921	<0.001	0.865	0.977
Adult Appendicitis Score	0.930	<0.001	0.878	0.982

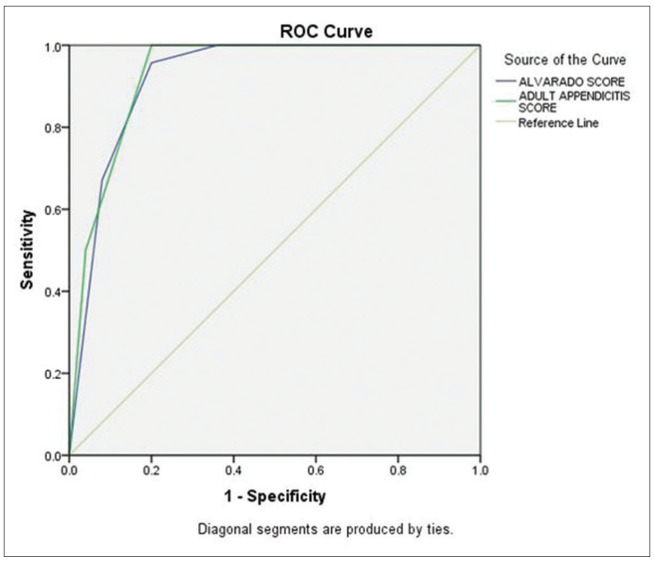

Figure 3: ROC curve for Alvarado Score and Adult Appendicitis Score.

adults with clinical diagnoses, including 47% patients with proven appendicitis.[19] Their collected data included clinical history as well as laboratory values.[19] About 58% of patients had a score of 16 or above (high probability), and were placed in the category of high probability with 93% specificity.[19] The area under the ROC curve was significantly higher as compared to previously existing scoring systems. Therefore, from the above observations, AAS seems to be more accurate and may reduce the need for further investigations in 50% of cases.[19]

A recent article by Bouali *et al*. suggested that AS is simple and highly sensitive for appendicitis with a negative appendectomy rate of 4.8%.[20] The main limitation of that study is a non-comparative design.

Podda *et al*. performed a systematic review and suggested that AS, AIR, and AAS had good sensitivity to exclude acute appendicitis.[21] They also concluded that various scoring systems help in reducing the negative appendectomy rate.[21]

From the above studies, it is still not clear which system is superior. Our study enrolled 120 patients with RLQ pain. Alvarado and AAS were calculated for all of them in the data collection forms. Among them, 80 patients were managed surgically and the rest conservatively. Patients with high AAS and AS, that is, ≥16 and/or ≥9, respectively, were considered for surgical intervention. The exception was three patients where appendicular lump formation occurred, who were conservatively managed.

As per the AS, 77 (64.2%), 30 (25.0%), and 13 (10.8%) patients were categorized as definite, possible, and probable appendicitis, respectively. Likewise, as per the AAS, 80 (66.7%), 35 (29.2%), and 5 (4.2%) patients were grouped in high probable, intermediate probable, and low likely appendicitis groups, respectively.

Seventy-one (88.75%) and 68 (88.31%) patients had positive surgical findings as AAS and AS. Similarly, 70 (87.5%) were correctly detected as acute appendicitis after applying the AAS. Sixty-seven (87.01%) patients were rightly seen as having acute appendicitis on applying AS. The results were compared with the histopathological reports. The area under the ROC curve for AAS was 0.930 compared to 0.921 for the AS, indicating that AAS is a better predictor for appendicitis than the AS.

Although many studies have been conducted with various scoring systems for appendicitis, comparison of AS and AAS has not been widely studied. This is the first Asian study that compares AAS and AS in an adequate sample size. In the analysis performed by Sammalkorpi *et al*, the AUC of the AS was 0.790, and for Appendicitis Inflammatory Response Score, it was 0.810.[19] Taking this value as reference, δ as 0.06, and a 5% level of significance, the calculated sample size is 113 patients. Hence, our total sample size was taken as 120.

We have not included radiological investigations such as USG and CT scans abdomen. We have also not compared these scores with the AIR Score and other available scoring systems. The main strength of our study is an adequate sample size and its comparative prospective design.

CONCLUSION

Although the ROC curves for AAS and AS are only slightly different, AAS is marginally better at predicting appendicitis than AS. However, a large randomized controlled trial will help to confirm this conclusion.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

Nil.

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