Efficacy of Alvarado and Appendicitis Inflammatory Response Scores in the Diagnosis and Management of Acute Appendicitis - A Cross Sectional Study from Nizamabad, Telangana

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ABSTRACT

BACKGROUND

Accurate clinical diagnosis and timely surgical intervention are the two important events that help the surgeon in the management of acute appendicitis. Two diagnostic score systems that help in avoiding the removal of normal appendix are reviewed in this study. The purpose of this study was to evaluate the sensitivity and specificity of Alvarado score (AS) and Appendicitis inflammatory response scores (AIRS) in the diagnosis of acute appendicitis (AA) and correlate their efficacy in the management of acute appendicitis as per the diagnostic scores used.

METHODS

This was a cross-sectional clinical study. 73 patients who attended the emergency ward for clinical features of acute appendicitis were included in the study. Clinical examination included the diagnostic tools 1. The Alvarado score, 2. Appendicitis Inflammatory Response score. Based on their score a provisional diagnosis was made among the patients. All the data was classified and analysed.

RESULTS

The positive predictive value was 63/73 (86.30 %) with Alvarado diagnostic tool and 66/73 (90.41 %) with AIS diagnostic tool. The false positive values using Alvarado system was 06.84 % and 04.10 % with AIS system. The true negative rate of diagnosis of acute appendicitis in this study was 09.58 %.

CONCLUSIONS

Both Alvarado and AIS diagnostic tools were simple and accurate in the early diagnosis of acute appendicitis in the adult population. Both the tools are highly sensitive and specific in nature.

KEYWORDS

Appendix, Acute Appendicitis, Perforation, USG, Laparotomy and Alvarado Score

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BACKGROUND

Among the abdominal emergencies, Acute appendicitis remains the common cause presenting with acute abdominal pain with a lifetime risk of 08.6 % in males and 06.7 % in females.[1] Its incidence during antepartum pregnancy period is about 06.3 % and presents as the most common non-obstetrical emergency when compared to 09.6 per 10,000 non-pregnant women.[2] In less than 10 % of the patients, the chances of removal of a normal appendix was reported all over the world.[3,4] Acute appendicitis was presumed to be caused by obstruction of its lumen from different aetiologies resulting in accumulation of increased mucus production super added by bacterial invasion, resulting in pressure on its walls and eventually leading to ischaemia, necrosis and possible perforation.[5]

Clinical symptoms like pain in the right lower quadrant of abdomen, periumbilical pain, vomiting and fever are common. Periumbilical pain radiating to the right lower quadrant, associated abdominal rigidity are important signs for the diagnosis of acute appendicitis in adults.[6] In children absent/decreased bowel sounds, positive psoas, obturator and Rovsing signs are very useful in the diagnosis of AA in children.[7]

The clinical and laboratory scoring systems to classify the patients into low, moderate and high-risk categories are used. They are : 1. The Alvarado score, 2. Paediatric appendicitis score, and 3. Appendicitis inflammatory response score which make use of common clinical and laboratory data to in the accurate diagnosis.[8] Initial recommended imaging method was ultrasonography (USG) of abdomen and pelvis, computerised tomography (CT) and magnetic resonance imaging (MRI) abdomen should be reserved for selected cases as a complementary study.[9] Surgical intervention either using conventional laparotomy or laparoscopy was the standard accepted treatment for acute appendicitis.[10,11] The incidence of perforation was reported as 17 to 32 % of patients with acute appendicitis from various studies.[12] The duration between the onset of symptoms and surgical intervention was a risk factor in the prognosis of AA.[13]

Surgical intervention should be arranged and completed as soon as possible which reduces the morbidity and mortality resulting from perforation and other complications. The present study was focused on evaluating the efficacy of Alvarado score (AS) and Appendicitis inflammatory response scores (AIRS) in the accurate diagnosis of acute appendicitis.

METHODS

This is a cross sectional clinical study consisting of 73 patients who attended the emergency ward for clinical features of acute appendicitis at Department of General Surgery, Government Medical College and Hospital, Nizamabad, Telangana state from September 2018 to August 2020.

At 95 % confidence interval, the statistic corresponding to level of confidence Z value was 1.96, with margin of error 0.05. The sample size was taken as 73 subjects. An ethical committee approval was obtained and the ethical committee approved consent form was used in this study.

Inclusion Criteria

1. Patients aged above 18 years and below 65 years were included.
2. Patients with acute abdominal pain in the right lower quadrant were included.
3. Patients with pain in periumbilical region radiating to the right lower quadrant were included.
4. Patients of both genders were included.

Exclusion Criteria

1. Patients aged below 18 years and above 65 years were excluded.
2. Patients with complications of acute appendicitis were excluded.
3. Patients with immunodeficiency diseases and other surgical risk factors were excluded.

Patients following initial assessment in the emergency ward were admitted in the general surgery wards and surgical junior residents filled up the proforma consisting of demographic data, diagnostic tools and lab investigations. The formats were completed with pathology reports and post-operative course.

Alvarado Score		Appendicitis Inflammatory Response Score (AIS)	
Sign/Symptom	**Points**	**Sign/Symptom**	**Points**
Migration of pain	1	Vomiting	1
Anorexia	1	Right iliac fossa pain	1
Nausea/vomiting	1	Rebound pain, light	1
Right lower quadrant tenderness	2	Rebound pain, medium rebound pain, strong	2 3
Rebound pain	1	Temperature ≥ 38.5°C (101.3°F)	1
Temperature ≥ 37.3°C (99.1°F)	1	Leukocytosis ≥ 10,000 to 14,900 per µL (10.0 to 14.9 × 109 per L)	1
Leukocytosis ≥ 10,000 per µL (10.0 × 109 per L)	2	Leukocytosis ≥ 15,000 per µL (15.0 × 109 per L)	2
PMN ≥ 75 %	1		
Total Possible Score	**10**	PMN 70 % to 84 %	1
		PMN ≥ 85 %	2
		CRP 10 to 49 g per L	1
		CRP ≥ 50 g per L	2
		Total possible score	**12**

Table 1. Diagnostic Tools for the Evaluation of Suspected Acute Appendicitis

CRP = C-reactive protein; PMN = polymorphonucleocytes. Information from reference[14]

Clinical examination included the following diagnostic tools -

1. The Alvarado score
2. Appendicitis inflammatory response score (15) as in (Table 1). Both the diagnostic test tools were applied to all the 73 subjects of the study.

Scoring above 7 was considered as probably acute appendicitis using Alvarado score system. Alvarado score system score above 9 was diagnosed as highly likely acute appendicitis. Similarly, a score above 7 using AIS score system was diagnosed as probably acute appendicitis and scoring above 9 was diagnosed as highly likely of acute appendicitis.

Depending upon the score, the provisional diagnosis arrived at using both the diagnostic tools was classified as tabulated in the Table 2.

Provisional Diagnosis	Alvarado Score	Appendicitis Inflammatory Response Score
Appendicitis not likely	0-4	0-3
Equivocal	5-6	4-6
Probably appendicitis	7-8	7-9
Highly likely appendicitis	9-10	9-12

Table 2. Classification of AA Patients According to Their Diagnostic Tools Scores

All the patients underwent appendectomy after variable hours of observation, and the surgical specimens were examined grossly and pathologically. Based on the final histopathological diagnosis, the true positive and true negative was analysed.

Statistical Analysis

All the data was analysed using mean, standard deviation, percentages. Sensitivity and specificity tests;
Sensitivity = True positives
True positives + false negatives
Specificity = True Negatives
True Negatives + False Positives
Correlation between the two groups of data was done using chi square test.

RESULTS

Among the 73 patients included in this study, 45 (61.64 %) were males and 28 (38.35 %) were females and male to female ratio was 1.6 : 1. The mean age was 24.36 ± 09.85 years (range 18 - 66 years, standard deviation + 09.85 years). Highly likely appendicitis was concluded using Alvarado scoring system in 53/73 (72.60 %) patients, diagnosis of probably appendicitis was made in 11/73 (%) patients, equivocal diagnosis was made in 04/73 (05.47 %) patients and appendicitis not likely was diagnosed in 05/73 (06.84 %) patients. The frequency distribution of patients according to Alvarado scoring system was tabulated and shown in Table 3.

Provisional Diagnosis	Number of Diagnosed	%	True +ve	False +ve	True -ve	False -ve
Appendicitis not likely	05	06.84	02	01	02	00
Equivocal	04	05.47	01	01	01	01
Probably appendicitis	11	15.06	05	01	02	03
Highly likely appendicitis	53	72.60	48	02	02	01
Total	**73**	**100**	**56**	**05**	**07**	**05**

Table 3. Frequency Distribution of Patients According to Alvarado Scoring System (N-73)

Highly likely appendicitis was concluded using Alvarado scoring system in 55/73 (75.34 %) patients, diagnosis of probably appendicitis was made in 10/73 (13.69 %) patients, equivocal diagnosis was made in 05/73 (06.84 %) patients and appendicitis not likely was diagnosed in 03/73 (04.10 %) patients. The frequency distribution of patients according to AIS scoring system was highly likely in 55/73 (75.34 %), probably appendicitis in 10/73 (13.69 %) patients (Table 4).

Provisional Diagnosis	AIC	%	True +ve	False +ve	True - ve	False- ve
Appendicitis not likely	03	04.10	01	01	01	00
Equivocal	05	06.84	01	01	02	01
Probably Appendicitis	10	13.69	06	00	03	01
Highly likely appendicitis	55	75.34	51	01	01	02
Total	73	100	59	03	07	04

Table 4. Frequency Distribution of Patients According to AIS Scoring System (N-73)

With Alvarado score system, the sensitivity was 91.80 % and the specificity was 58.33 %. With AIS scoring system, the sensitivity was 93.65 % and the specificity was 70 %. Using McNemar's test, the sensitivity and specificity of the diagnostic score systems of Alvarado and AIS systems were correlated, and it was observed that there was statistical significance between these two systems helping the diagnosis of acute appendicitis (the P value was 0.0001; P significant at < 0.05). The sensitivity and specificity values of both the diagnostic tools used in the study were tabulated in Table 5.

Diagnostic Scores	Sensitivity	Specificity
Alvarado score	91.80	58.33
AIS score	93.65	70

Table 5. Frequency Distribution of Patients According to AIS Scoring System (N-73)

The true negative rate of acute appendicitis in this study was 09.58 %. The positive predictive value was 63/73 (86.30 %) with Alvarado diagnostic tool. The positive predictive value was 66/73 (90.41 %) with AIS diagnostic tool. The two tools of diagnosis of acute appendicitis were compared and correlated statistical significance using Mc Nemar's test. The two tailed P value was < 0.0001 (significant at P < 0.05).

DISCUSSION

In spite of the availability of advanced diagnostic methods, acute appendicitis being the most common surgical abdominal emergency remains a great challenge to the surgeon in accurately diagnosing it. Both the diagnostic tools used in the study were of combination of clinical and laboratory tests. The negative appendectomy rate observed in this study was 09.58 % which was similar to the reports in the literature varying from 8 % to 33 %.[15] Different scoring systems are available in the literature using clinical symptoms and signs useful in the diagnosis of acute AA.[16] But many of them are truly sophisticated and cumbersome to use in the emergency clinical situations.[16] Alvarado system as a diagnostic tool for AA was very simple, easily followed by the junior surgical team members in the clinic or emergency department.[17] In the present study the sensitivity and specificity of both the methods were reviewed to know their usefulness and concluded that there was no significant difference between them (the P value was 0.499 (not significant at P < 0.05)).

The sensitivity and specificity values of both the methods were almost similar (Table 5). Similar views were expressed by Al Hashemy and Seleem.[15] But Lone et al. of 88 %[18] reported lesser values of specificity. In this study the positive predictive value was 63/73 (86.30 %) with Alvarado diagnostic tool and the positive predictive value was 66/73 (90.41 %) with AIS diagnostic tool. These values are almost similar to studies reviewed in the literature, which may actually reflect the high prevalence of acute appendicitis.[19,20] The false positive values using Alvarado system was 06.84 % and 04.10 % with AIS system. In a study by Awayshih MMA, Yousef AJ et al.[21] the false positive values using Alvarado system was 10 %. Ana Jalil, Syed Aslam Shah et al.[22] in a similar study observed the overall sensitivity, specificity and positive predictive values of Alvarado score for acute appendicitis as 66 %, 81 % and 96 % respectively. In the present study, however, the overall sensitivity, specificity and positive predictive values of Alvarado score for acute appendicitis were 91.80 %, 58.33 % and 90.41 % respectively. In a comparative study S.M.M. de Castro et al.[23] reported that the AIR score outperformed the Alvarado score when analysing the more difficult patients, including women, children, and the elderly. But in this study using the chi-square test for correlation, it was observed that there was no significant difference between the two diagnostic scoring systems (Alvarado and AIS) as the P value was > 0.05. In low risk patients, both Alvarado score system and AIS system were not accurate in the diagnosis but in middle and high-risk patients they were more useful.[24]

Hence, when both these systems are used in the decision making of diagnosing acute appendicitis, there is no risk of missing the diagnosis.[25] In cases of doubtful diagnosis, a middle or high-risk score in either systems, should be taken as criteria to intervene surgically in patients with acute appendicitis.[26] Highly likely appendicitis was concluded using Alvarado scoring system in 55/73 (75.34 %) patients, diagnosis of probably appendicitis was made in 10/73 (13.69 %) patients, equivocal diagnosis was made in 05/73 (06.84 %) patients and appendicitis not likely was diagnosed in 03/73 (04.10 %) patients.

The frequency distribution of patients according to AIS scoring system was high likely in 55/73 (75.34 %), probably appendicitis in 10/73 (13.69 %) patients (Table 4). There was no indication that there was clinically important distinction between medium and low-risk classes. Radiological imaging could be supplementary at arriving at accurate diagnosis of acute appendicitis. But the disadvantages are that ultrasound was variously advocated in the diagnosis. Pershad et al.[27] observed that ultrasound was a low-cost effective mode of diagnosis especially in the children. Few authors have reported ultrasound imaging to be in appropriate as it delays treatment.[28] In the present study, ultrasound examination had no effect on the time taken to shift the patient to the operation theatre because the treatment strategies were always not based on the negative USG reports. Reporting by the sonographer about the presence of free fluid and thickened bowel loops was frequent but their sensitivity and specificity concluding the diagnosis was uncertain.[29]

Whereas CT scan imaging was found to be more accurate in the paediatric population in the diagnosis of acute appendicitis.[30] but the chances of exposure to radiation cannot be avoided. The AIR score was found to be more confidently identify those patients with a high probability of appendicitis in whom supplemental imaging is unlikely to change management and thus an early decision to operate should be made. This is of benefit as imaging is also shown to increase time to theatre.

CONCLUSIONS

Both Alvarado and AIS diagnostic tools were simple and accurate in the early diagnosis of acute appendicitis in the adult population. Both the tools are highly sensitive and specific in nature. The sensitivity and specificity of Alvarado system and AIS system were 91.80 %, 58.33 % and 93.65 %, 70 % respectively.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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