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Original Research Article

Modified alvarado score in diagnosis of acute appendicitis: a clinicopathological study

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ABSTRACT

Background: Acute appendicitis is one of the commonest surgical emergencies in all ages. Diagnosis is mainly clinical, delay in diagnosis definitely increases the morbidity, mortality and cost of treatment, more aggressive surgical approach has resulted in increased white appendectomies.
Methods: A total 100 cases hospitalized with abdominal pain, suggestive of acute appendicitis on the basis of modified Alvarado scoring system and were subsequently operated, were included in the present study in our institute for period of 20 Months.
Results: Males belonging to young age group of 21-30 were most commonly affected. Abdominal pain was seen in 100% of patients. Fever seen in 87% of patients and vomiting in78%. Modified Alvarado score of 9 had positive predictive value of 100% while negative predictive value 8.9%, while score between 7-8 had positive predictive value of 98.9% and negative predictive value 27.8%. The sensitivity was 86.1% and specificity was 83.3%. The ultrasonography showed a sensitivity of 94.68%. In present study rate of total white appendectomy was 6%. The Modified Alvarado scoring system is a reliable and practicable diagnostic modality to increase the accuracy in diagnosis of acute appendicitis and thus to minimise unnecessary appendectomy.
Conclusions: Young males are most commonly affected almost always presents with abdominal pain. The Modified Alvarado scoring system is a reliable and practicable diagnostic modality to increase the accuracy in diagnosis of acute appendicitis and thus to minimise unnecessary appendectomy.

Keywords: Acute appendicitis, Modified alvarado score, White appendectomy

INTRODUCTION

Acute appendicitis is one of the commonest surgical emergencies. In 1886 Reginald Heber Fits described the classical signs and symptoms of acute appendicitis as a disease entity.[1] Since then acute appendicitis has remained the common acute surgical condition of the abdomen in all ages and of course, a common disease in surgical practice. Even after elapse of more than 120 years since its first description this common surgical disease continues to remain a diagnostic problem and can baffle best of the clinician.[2] Delay in diagnosis definitely increases the morbidity, mortality and cost of treatment. In equivocal cases, however, aggressive surgical approach as "when in doubt take it out" has resulted in increased white appendectomies. Presentations of acute appendicitis can mimic variety of acute medical and surgical abdominothoracic conditions. Early diagnosis is a primary goal to prevent morbidity and mortality in acute appendicitis. Another important issue is decreasing the white appendectomy rate.[2]

Different scoring systems are there in use to diagnose appendicitis. Like - Alvarado scoring system, Modified Alvarado scoring system, Tzanakis scoring system, RIPASA scoring system, and Anderson scoring system.[3,4] These diagnostic scoring systems has been developed in an attempt to improve the diagnostic accuracy of acute appendicitis.[2]

The most prominent of scoring system developed by Alfredo Alvarado in 1986.[3] He introduced a criterion for the diagnosis of acute appendicitis, was based on a retrospective analysis of 305 patients with abdominal pain suspicious of appendicitis.

The classical Alvarado score included a left shift of neutrophil maturation along with other parameters for assessment. Authors omitted this parameter which is not routinely available in many laboratories, and produced a Modified score.[3,4]

The purpose of this study was to evaluate the diagnostic effectiveness of the Modified Alvarado scoring system in clinical practice for diagnosis of acute appendicitis by correlating the score with operative and histopathological findings.

METHODS

The present study was conducted on 100 patients, hospitalised with abdominal pain, suggestive of acute appendicitis on the basis of modified Alvarado scoring system and were subsequently operated, from January 2014 to August 2015 in Department of General Surgery, Gandhi Medical College and associated Hamidia Hospital, Bhopal.

Inclusion criteria

All cases clinically suspected to be suffering from acute appendicitis between 12-60 years of age with Modified Alvarado score 6 or more than 6.

Exclusion criteria

- All patients with palpable lump in right iliac fossa.
- All patients with previous history of chronic and recurrent appendicitis.
- Children below 12 years of age and adults above 60 years.

All patient who were selected between 12 to 60 years of age and either sex was evaluated on the basis of Modified Alvarado Score and a predetermined pro forma, which included, a detailed history from patient and parent's clinical examination, laboratory investigation, and ultrasonography.

"Modified Alvarado score" was calculated by using following chart in all 100 patients which consists of three symptoms, three signs and one laboratory finding.

Table 1: Modified Alvarado score.

Symptoms / Sign / Investigation	Score	
	Yes	No
Migration of pain to right iliac fossa	1	0
Anorexia	1	0
Nausea / vomiting	1	0
Tenderness over right iliac fossa	2	0
Rebound tenderness over right iliac fossa	1	0
Temperature > 37.3ºC	1	0
Leukocytosis > 10 $X10^9$/L	2	0

On the basis of Modified Alvarado score, all patients were classify in to three categories.

- Category (1) Patients with Modified Alvarado score 6
- Category (2) Patients with Modified Alvarado score 7-8
- Category (3) Patients with Modified Alvarado score 9

Category (1) patients are possible case of acute appendicitis and those patients operated only after positive ultrasonography report of acute appendicitis. Category (2) patients were considered to have probable diagnosis of acute appendicitis but not convincing enough to warrant immediate surgery and these patients were monitored at 4 hourly intervals and if within 24 hours of observation their score become constant or increased irrespective of their ultrasonography report, appendectomy will be performed. All patients with score of 9, Category (3) were considered to have definite diagnosis of acute appendicitis and were considered for appendectomy in first instance.

All patients have undergone Ultrasonography of the abdomen primarily to rule out other conditions mimicking acute appendicitis.

All specimens of removed appendix were subjected for histopathological examination according to which the diagnosis was confirmed. Data thus collected was analysed.

Sensitivity, specificity, predictive value for positive and negative test and accuracy of each diagnostic modality were worked out and compare with histopathological outcome. The sensitivity, specificity, positive and negative predictive value and accuracy of the investigation in the diagnosis of acute appendicitis were calculated using following formulae:

$$\text{Sensitivity (\%)} = \frac{\text{Number of true positive cases X 100}}{\text{Number of true positive +false negative cases}}$$

$$\text{Specificity (\%)} = \frac{\text{Number of true negative cases X100}}{\text{Number of true negative +false positive cases}}$$

$$\text{Positive predictive value (\%)} = \frac{\text{Number of true positive cases X100}}{\text{Number of true positive +false positive cases}}$$

$$\text{Negative predictive value (\%)} = \frac{\text{Number of true negative cases X100}}{\text{Number of true negative +false negative cases}}$$

$$\text{Accuracy (\%)} = \frac{\text{Number of true positive cases + Number of true negative case X 100}}{\text{Number of true positive+ true negative+ false positive+ false negative}}$$

RESULTS

Highest incidence of appendicitis 47% observed in the age group of 20 to 29 years of age, which accounts for 47% of total number of cases.

Table 2: Age sex distributions.

Age Groups (Yrs.)	No. of cases	Percentage
<20	28	28%
20-29	47	47%
30-39	8	8%
40-49	13	13%
>50	4	4%

Majority of the patients in the study were male (77%) Male: female ratio was 3.35:1.

Table 3: Sex distributions.

Sex	No. of cases	Percentage %
Male	77	77%
Female	23	23%

Abdominal pain was the most common symptom, which was seen in 100% cases, two other major complaints were fever and vomiting i.e. 87% and 78% respectively.

Table 4: Clinical features.

Symptom	No. of cases	Percentage %
Abdominal pain	100	100%
Fever	87	87%
Vomiting	78	78%
Loss of appetite	06	6%

Table 5: Modified Alvarado score of the patients.

Modified Alvarado score	No. of cases	Percentage
6	18	18%
7	19	19%
8	30	30%
9	33	33%

In the present study most of the patients have Modified Alvarado score 8 and 9, i.e. 30 patients of score 8 and 33 patients of score 9.

The sensitivity of ultrasonography was 94.68%, positive and negative predictive values were 95.70% and 28.57% and accuracy was 91%.

Table 6: Correlation of USG findings with histopathology report.

	HPR positive	HPR negative	Total
USG positive	89	4	93
USG negative	5	2	7
Total	94	6	100

In patients with Modified Alvarado score of 7-8, the Positive predictive value was 98.9% and Negative predictive value was 27.8%. Sensitivity was 86.1%, Specificity was 83.3% and Accuracy was 79.1%.

In patients with Modified Alvarado score of 9, the Positive predictive value was100.0 % and Negative predictive value was 8.9 %. Sensitivity was 35.1%, Specificity was100.0% and Accuracy was 39.0%.

Table 7: Correlation of modified Alvarado score with histopathological report.

Modified Alvarado score	Histopathology report		Total
	Positive	Negative	
6	13 (72.2%)	5 (27.8%)	18 (100%)
7-8	48 (98%)	1 (2%)	49 (100%)
9	33 (100%)	0	33 (100%)
Total	94	6	100

DISCUSSION

Clinical examination, laboratory parameters and various scoring system were the only diagnostic tool of acute appendicitis for many years. Perforation rate was high, as well as the white appendectomies. Following the introduction of USG and CT scan in last three decade, the rate of white appendectomies has decreased, but the perforation rate is remained high (22% to 62%).[5-7] All these parameters can be helpful in the diagnosis of appendicitis, but no single test is definitive.[1,5-7]

In present study, maximum incidence of appendicitis was seen in the age group of 20 to 29 years, which is 47%. It the study conducted by authors maximum incidence of acute appendicitis was also seen in age of 21 to 30 years.[2,8,9]

In present study we observed that the acute appendicitis has male preponderance and the male, female ratio is

3.35:1. Other studies have also suggested the male preponderance of disease, Carditello A shown male, Female ratio is 3:1 and Ko Ys Lin Lh male, female ratio was 10:1, studies shows also had similar observations.[10-13]

In present study the most common symptom of acute appendicitis was pain in right iliac fossa (100%) followed by fever (87%) and vomiting (78%). The results are comparable with the series of, where the most common symptom is pain in right iliac fossa followed by fever and vomiting.[14-17]

In present study the rate of total white appendectomy was 6%. In the study, white appendectomy rate was 11.49%, it was reported white appendectomy rate is 16%, white appendectomy rate was 15.6%.[2,8,18] The reason for variation in rate of white appendectomy is small sample size in present observational study as compared to large sample size (more than 200 cases) in all above studies.

In present study the sensitivity of ultrasonography is 94.68%, as compared to sensitivity of other study of authors, in their study sensitivity was 89%, in the study of, sensitivity of ultrasonography was 98.33%, in the study of, sensitivity of ultrasonography was 94.7%. All these studies show that the sensitivity of ultrasonography is comparable with present study.[9,19,20]

In present study, patients with Modified Alvarado score 7-8, have positive and negative predictive value is 98.9% and 27.8% respectively. The sensitivity and specificity is 86.1% and 83.3% respectively. Patients with Modified Alvarado score 9, have positive and negative predictive value is 100.0% and 8.9% respectively. The sensitivity and specificity are 35.1% and 100.0% respectively. In the study the sensitivity of Modified Alvarado score was 93% in patients with score more than 7 and 67% in patients with score less than 7.[4] In the series reported sensitivity of 95% in patient with score of 8-9, and 78% in patients with score of 5-7.[2] Study shows that the sensitivity was 98.44% and specificity was 94.4% for Modified Alvarado Scoring.[9] Study of all patients with modified Alvarado score 7 or more had 100% specificity.[21] The positive and negative predictive values of the Alvarado score were 77.6% and 52.4%.[22] The sensitivity was 93% and a specificity was 83%.[23]

CONCLUSION

The diagnosis of acute appendicitis is primarily a clinical one that is based on proper history and repeated clinical examination. The Modified Alvarado scoring system is a reliable and practicable diagnostic modality to increase the accuracy in diagnosis of acute appendicitis and thus to minimise unnecessary appendectomy. But there is no single test or scoring system is available that can reduce white appendectomy rate to zero.

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