

Original Research Article

Evaluation of accuracy of four clinical scores and comparison with ultrasonography for diagnosis of acute appendicitis

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ABSTRACT

Background: The vagaries of presentation and the variability of signs in acute appendicitis are such that even the most experienced surgeons may remove normal appendices or conserve those with perforation. Diagnostic scoring systems and imaging techniques may reduce the number of unnecessary appendectomies.

Methods: 75 patients who presented with acute right Iliac fossa pain were analyzed using four different scoring systems. An abdominal ultrasound was also performed when necessary. The results of these scores, USG findings were compared to the intra operative findings and final histopathological report.

Results: The Alvarado score had the best positive predictive value with high sensitivity. The Fenyo score was most sensitive for males, whereas the Teicher score was most sensitive for females. The Teicher score was the most specific. The Ohmann score had the highest negative predictive value. Ultrasonography showed a low sensitivity and specificity.

Conclusions: There was a 24% negative appendectomy rate in our study. The Alvarado score is ideal for borderline cases where a quick decision needs to be taken. Ohmann's score can be used to rule out appendicitis in the casualty setting as it has the best negative predictive value. Fenyo and Teicher's score with their high sensitivity can be used to reduce the number of negative appendectomies.

Keywords: Appendicitis, Ultrasound, Scoring system

INTRODUCTION

The vagaries of presentation and the variability of signs in acute appendicitis are such that even the most experienced surgeons may remove normal appendices or conserve those that have perforated. Many studies have shown that 20-25% of the appendices removed are normal.^{1,2} This indicates a need for diagnostic aids such as scoring systems or imaging techniques in order to reduce the number of unindicated appendectomies. The high-resolution ultrasound is a practically and economically feasible imaging technique used for diagnosis of acute appendicitis. We evaluate and compare

the efficacy of four such clinical scores and ultrasound in the diagnosis of acute appendicitis.

The objective of this study was to study the efficacy of Alvarado, Teicher, Fenyo and Ohmann score to improve on clinical diagnosis of acute appendicitis. And to study the role of ultrasound in comparison with these clinical scores as a diagnostic modality for acute appendicitis.

METHODS

A prospective study was conducted on 75 patients who underwent emergency appendectomy in a tertiary teaching hospital in Mumbai, Maharashtra, India.

Inclusion criteria

All patients irrespective of age and sex with right iliac fossa pain who underwent emergency appendicectomy were included in the study.

Study protocol

All patients with acute onset lower abdominal pain were evaluated by the emergency surgical team. Routine haematological and biochemical blood investigations were carried out in all patients. If found necessary, an ultrasonography was carried out with a 7.5 Mz high resolution probe on a duplex ultrasound machine using the graded compression technique.¹

A positive diagnosis of acute appendicitis on ultrasound was made if one or more of the following criteria were satisfied.³

- Presence of a tubular non-compressible immobile appendix
- Diameter of the appendix > 6 mm
- Mural thickness of appendix >2 mm
- Hyperechoic submucosa
- Presence of periappendicular collection.

After consideration of all investigations, if a decision to perform an emergency appendicectomy was taken, the investigator was informed. The investigator performed an independent clinical evaluation as per criteria of the following scores.

Table 1: ALVARADO score.⁴

Variable	Score
Migration of pain	1
Anorexia and or acetone in urine	1
Nausea/vomiting	1
Localised tenderness in RLQ	2
Fever	1
Rebound tenderness	1
Leukocytosis (>10000)	2
Shift to left (>75%)	1

- Score of ≥ 6 is suggestive of acute appendicitis
- Score of ≤ 6 is suggestive of non-appendicular pain.

The inference from each of the scores was noted. If USG was performed, the findings were noted. The emergency surgical team was not informed about score values so as to not influence their decisions.

The intraoperative findings were noted under the following headings.

- Acutely inflamed turgid appendix
- Perforated appendix
- Gangrenous appendix

- Presence of fecoliths
- Normal appendix
- Presence of any other pathology.

The specimen was sent for histopathological examination. A positive diagnosis of appendicitis was made if one or more of the following criteria were satisfied.

Table 2: IRA TEICHER Score.⁵

Variable	Score
Sex	
Male	+2
Female	-1
Age	
20-39 years	-1
>40 years	+3
Duration of pain	
1 day	+2
2 days	+1
3 days	-3
Genitourinary symptoms	
Yes	-3
No	0
Muscle spasm in RLQ	
Involuntary	+3
None	-3
Rectal mass on right side	
Yes	-3
No	0
WBC count	
<10000	-3
>13000	+2

Score ≥ -3 suggestive of acute appendicitis.

Table 3: FENYO Score.⁶

Variable	Score
Constant	-10
Sex	
Male	+8
Female	-15
WBC count	
$\leq 8900/\text{cmm}$	-15
9.0 -13900/cmm	+2
$\geq 14000/\text{mm}$	+10
Duration of pain (hours)	
≤ 24 hours	+3
24-48 hours	0
>48 hours	-12
Progress of pain	
Yes	+3
No	-4
Relocation of pain	

Yes	+3
No	-4
Vomiting	
Yes	+7
No	-5
Aggravation by coughing	
Yes	+7
No	-5
Rebound tenderness	
Yes	+5
No	-10
Rigidity	
Yes	+15
No	-4
Tenderness outside RLQ	
Yes	-6
No	+4

- All patients start with - 10 points
- A score of -2 or higher - suggestive of acute appendicitis
- A score of -17 or lower - suggestive of non-specific abdominal pain
- In between scores calls for observation.

Table 4: OHMANN'S Score.⁷

Variable	Score
Tenderness in RLQ	4.5
Rebound tenderness	2.5
No dysuria	2.0
Steady pain	2.0
Leucocyte count>10000/cmm	1.5
Age <50 years	1.5
Relocation of pain	1
Rigidity	1

- Score < 6: appendicitis excluded
- Score 6-11.5 observation needed
- Score > 11.5 appendectomy needed.

Macroscopic

- Fibrinous or purulent film over the serosa
- Hemorrhage or necrotic changes on the wall
- Pus on cutting open the appendix
- Gangrenous or perforated appendix.

Microscopic

- Presence of ulceration over the mucosa
- Mucosal edema
- Necrosis
- Presence of pus cells.

The inference of all scores and ultrasound findings were compared to the final histopathology report.⁸

RESULTS

The data collected from 75 patients were analyzed and results were as follows.

Age distribution

The maximum no of patients (34) were in the age group of 21-30.

Sex distribution

41 of the 75 patients were females (54.6%)

Negative appendectomy rate

18 of the 75 patients operated were found to have a normal appendix. The negative appendectomy rate was 24%.

Complicated appendix

Of the 57 patients with acute appendicitis on histopathology, only 4 were above the age of 40 yrs. Of the 57 patients, 7 had perforated appendix (12.2%) and 2 had gangrenous appendix (3.5%). Of the 4 patients >40 years of age, 3 patients had complicated appendicitis (75%) as compared to 11.3% in the <40 years age group. This difference is statistically significant with p value of <0.001

Intraoperative findings versus histopathology

Intraoperative findings of acutely inflamed appendix were noted in 64 patients, of which 7 had a normal appendix on histopathology. In 2 patients, intraoperative diagnosis of normal appendix was made. However, histopathology showed acute appendicitis. Thus, intraoperative findings did not correlate with histopathology in 9 out of 75 patients (14.6%).

Alvarado score

55 patients had a score more than 6, of which 48 had histologically proved acute appendicitis. Of the 20 patients with score less than 6, 9 patients had a histopathological report of acute appendicitis.

Table 5: Results of Alvarado score.

	Males	Females	Total
Sensitivity	85.2%	89.3%	87.3%
Specificity	57.1%	53.8%	55%
Positive predictive value	88.5%	80.6%	84.2%
Negative predictive value	50%	70%	61.1%

Teicher score

- On applying Teicher score, 33 patients had a score more than -3, of which 31 patients had a histologically proved acute appendicitis.
- 12 patients had a score of <-7. Two of these patients had acute appendicitis on histopathology.
- The remaining 30 patients had unequivocal score, of which 24 had histologically proved acute appendicitis.

Table 6: Results of Teicher score.

	Males	Females	Total
Sensitivity	91.3%	100%	93.9%
Specificity	80%	85.7%	83.3%
Positive predictive value	80.8%	32.3%	54.4%
Negative predictive value	50%	60%	55.6%

Fenyo score

- 37 patients had a score ≥ -2 of which 36 patients were confirmed to have appendicitis on histopathology
- 23 patients having a Fenyo score of ≤ -17 . Of these 10 patients had acute appendicitis on histopathology
- 11 of the 13 patients with equivocal scores had acute appendicitis.

Table 7: Results of Fenyo score.

	Males	Females	Total
Sensitivity	100%	93.3%	97.3%
Specificity	71.4%	50%	56.5%
Positive predictive value	84.6%	45.2%	63.2%
Negative predictive value	62.5%	80%	72%

Table 8: Results of Ohmann's score.

	Males	Females	Total
Sensitivity	94.4%	82.6%	87.8%
Specificity	43.8%	33.3%	38.2%
Positive predictive value	65.4%	61.3%	63.2%
Negative predictive value	87.5%	60%	72.2%

Ohmann's score

- None of the patients had a score of <6. 41 patients had a score >11.5. 36 of these patients had histologically proved appendicitis

- 34 patients with scores between 6 and 11.5 who needed to be observed according to the score, 21 of these patients had acute appendicitis.

Ultrasound

An ultrasonography was carried out in 51 patients. A positive diagnosis of acute appendicitis was made in 22 patients, of which only 16 had histologically proved appendicitis. In the remaining 29 patients with normal USG findings, 22 had acute appendicitis.

Table 9: Results of ultrasonography in acute appendicitis.

	Males	Females	Total
Sensitivity	75%	71%	72.7%
Specificity	30%	21%	24.1%
Positive predictive value	46.1%	40%	42.1%
Negative predictive value	60%	50%	53.8%

DISCUSSION

Despite improvement in imaging techniques and laboratory investigations, routine diagnosis of acute appendicitis still poses a challenging problem. The major area of concern worldwide is negative appendicectomies (25-30%), perforated appendix (15-20%), delayed operations and longer hospital stay. Over the years, several diagnostic scoring systems have been evolved so as to aid the clinician in making a quick decision. In this study, we have evaluated the usefulness of these scores in an Indian set up and compared the scores with accuracy of ultrasound for early diagnosis of acute appendicitis.

The maximum number of patients was from the 20-30 age group. There was no significant difference in the incidence among males or females.

Study had a negative appendicectomy rate of 24% (18 of 75). This is comparable to other studies 30% in Ohmann's study and 15-30% as reported by Douglas et al.^{2,7}

It was interesting to note that though only 4 patients with acute appendicitis were above the age of 40 years, 3 of them had complicated appendicitis (75%). This indicates the need for early diagnosis in the elderly.

In 14.5% of cases the intraoperative finding was not consistent with histopathological findings.

The accuracy of the scores in our study were as follows

The Alvarado score has the best positive predictive value and a high sensitivity (Table 5). (Macklein and Radcliffe showed a sensitivity of 76% while Malik and Wani had a

sensitivity of 82%; these were comparable with our study where the Alvarado score had a sensitivity of 87%.^{9,10}

It is a simple score and does not have an observation range. It is useful when a decision is needed to be taken on whether to operate on a clinically borderline case since it has a high positive predictive value.

Fenyo score was found to be the most sensitive amongst males (Table 6) and Teicher score was most sensitive in female patients. The Teicher score was the most specific amongst all scores (Table 7).

Both these scores have a significant number of patients who fall in the observation range. Thus, in spite of their high sensitivity and specificity, they have limited value in decision making in borderline cases.

None of our patients had a score <6 in the Ohmann score (Table 8). Thus, appendicitis could not be ruled out in any of our patients. Hence it is safe to say that patients with Ohmann score <6 are unlikely to have acute appendicitis. This score has a high negative predictive value. It can be used as a screening score by interns or paramedical staff. Ohmann's study using his score showed a sensitivity of 91% and specificity of 86%. Our study showed a similar sensitivity (87%) but a poor specificity (38%).⁷ Ultrasonography (Table 9).

It is evident that ultrasound in our setup fared poorly as compared to the clinical scores. The overall sensitivity was only 72.7% and specificity was 24% when compared to other studies. Puylaert had a sensitivity of 86% in his study while Orr et al in their meta-analysis showed a sensitivity of 84.7% and specificity of 92.1%.^{1,11}

CONCLUSION

A 24% negative appendectomy rate was seen in our study. The Fenyo score is the most sensitive clinical score among males, whereas the Teicher score is the most sensitive among females. Usage of these scores could reduce the number of negative appendectomies.

The Alvarado score has the best positive predictive value. It could be used in borderline cases where a quick decision to explore or conserve needs to be taken. Ohmann's score can be used to rule out appendicitis in a casualty setting, as it has the best negative predictive value. Ultrasound examination in our study was less reliable as compared to clinical scores in the diagnosis of acute appendicitis.

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