

Evaluation of Modified Alvarado Score in the Diagnosis of Acute Appendicitis

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Abstract: *Background and Objectives:* Acute appendicitis, the most common surgically correctable cause of abdominal pain, the diagnosis of which remains difficult in many instances and is essentially clinical. However a decision to operate based on clinical suspicion alone can lead to removal of a normal appendix in 15-30% cases. Several diagnostic scoring systems have been devised as an aid to the early diagnosis of acute appendicitis and to reduce the incidence of negative appendectomy. One such scoring system was described by Alvarado and later modified by Kalan et al. The present study is attempted to evaluate the efficiency of modified Alvarado score in pre-operative diagnosis of acute appendicitis. *Methods:* An 83 consecutive patients suspected of acute appendicitis who were admitted, investigated and treated were taken for the study. After detailed examination and investigations a modified Alvarado score was applied to these patients. They were assigned in three groups and were treated accordingly. *Results:* The result of the study showed that high score in men (7-9) had a sensitivity of 92% respectively, where as in females it had sensitivity of 76.4%. The score (5-6) in men & females had a sensitivity of 60% and 50% respectively. *Interpretation and Conclusion:* The high scores in modified Alvarado score is dependable aid in the early diagnosis of acute appendicitis in men and children but it's not true as far as women are concerned. Ultrasonography of abdomen is a useful tool in avoiding negative appendectomy rates particularly in children.

Keywords: Acute Appendicitis; Modified Alvarado Score; Appendectomy; Abdomen pain; Appendix

1. Introduction

Acute appendicitis is the most common surgically correctable cause of abdominal pain, the diagnosis of which remains difficult in many instances. Some of the signs and symptoms can be subtle to both the clinician and the patient and may not be present in all instances. Arriving at the correct diagnosis is essential, however, a delay may allow progression to perforation and significantly increased morbidity and mortality. Incorrectly diagnosing a patient with appendicitis although not catastrophic often subjects the patient to an unnecessary operation.¹

The diagnosis of acute appendicitis is essentially clinical; however a decision to operate based on clinical suspicion alone can lead to removal of a normal appendix in 15-30% cases. The premise that it is better to remove a normal appendix than to delay diagnosis doesn't stand up to close scrutiny, particularly in the elderly. A number of clinical and laboratory based scoring systems have been devised to assist diagnosis. The most commonly used is the Alvarado score and equally its modifications.²

1.1 Modified Alvarado Score

This consists of three symptoms, three signs and a laboratory finding as described by Alvarado³ and later modified by Kalan et al.⁴

1.2 Modified Alvarado Score

Symptoms / Signs / Investigation	Score	
	Yes	No
Symptoms		
Migration of pain to right iliac fossa	1	0
Anorexia	1	0
Nausea / Vomiting	1	0
Signs		
Tenderness over right iliac fossa	2	0
Rebound tenderness over right iliac fossa	1	0
Temperature > 37.3°C	1	0
Investigation:		
Leucocytosis > 10 x 10 ⁹ /L	2	0
Total Score	9	0

Scoring System

- 1-4 - Appendicitis unlikely
- 5-6 - Appendicitis possible
- 7-8 - Appendicitis probable
- 9 - Appendicitis definitive

Patients with a score of 1-4 who are not considered likely to have acute appendicitis will be observed and not operated unless for compelling reasons to do so. Those with scores between 5-6 will be considered to have possible diagnosis of acute appendicitis, but not convincing enough to warrant immediate surgery and these patients will be monitored at 4 hourly intervals and if within 24 hours of observation their score become ≥ 7 or their clinical features are convincing enough to warrant surgery, then irrespective of their scores, appendectomy will be performed. All patients with scores 7 to 9 will be considered to have either probable or definite diagnosis of acute appendicitis and will be considered for appendectomy in first instance.⁵ The aim of the study is to evaluate the efficiency of modified Alvarado score in the preoperative diagnosis of acute appendicitis

2. Methods

This study was conducted on patients presenting with pain in the right lower quadrant of Abdomen, lasting fewer than 7 days who after clinical examination were provisionally diagnosed to have acute appendicitis and were admitted in Karnataka Institute of Medical Sciences Hospital, Hubli in the study period of November 2007 to October 2008.

Modified Alvarado score was applied on all these patients.

2.1 Inclusion Criteria

Patients with provisional clinical diagnosis of acute appendicitis.

2.2 Exclusion Criteria

1. Patients of age less than or equal to 12 years
2. Patients with generalised peritonitis due to appendicular perforation
3. Patients with appendicular mass or abscess

2.3 Collection of Data

A total of 83 consecutive cases of suspected acute appendicitis who were admitted, investigated and treated were taken for the study. After detailed examination and investigations a modified Alvarado score was applied to each case.

2.4 Modified Alvarado Score

This consists of three symptoms, three sign and a laboratory finding as described by Alvarado and later modified by Kalan et al.

2.5 Modified Alvarado Score

Symptoms / Signs / Investigation	Score	
	Yes	No
Symptoms		
Migration of pain to right iliac fossa	1	0
Anorexia	1	0
Nausea / Vomiting.	1	0
Signs		
Tenderness over right iliac fossa	2	0
Rebound tenderness over right iliac fossa	1	0
Temperature > 37.3°C	1	0
Investigation:		
Leucocytosis > 10 x 10 ⁹ /L	2	0
Total Score	9	0

Following decisions were taken :

Cases with score of 1-4 were observed and not operated and were followed up after discharge for next six months for development of acute appendicitis.

Cases with score 5-6 were observed for next 24 hours for revision of scoring. If score became ≥ 7 or their clinical condition was highly suspicious of acute appendicitis as decided by treating surgeon they were subjected for

appendicectomy. All patients who were considered for appendicectomy underwent ultrasonography of abdomen primarily to rule out other conditions mimicking acute appendicitis.

Patients with score of 7-9 who were considered candidates for appendicectomy were assessed again after ultrasonography. If any other conditions mimicking acute appendicitis was found in them, they were not operated and were considered as false positive cases.

All the specimens of appendix were sent for histopathological confirmation of acute appendicitis. Final correlation between the scoring system and final diagnosis was made.

Eighty three patients who constituted present study group were divided in to 3 groups.

Group -I : Patients who were between score 1-4.

Group -II : Patients who were between score 5-6.

Group -III : Patients who were between score 7-9.

3. Results and Observations

Group – 1 : Eighteen patients were in first group (1-4) who were not considered likely to have appendicitis. They were observed and were treated conservatively. Discharged after 2-3 days and were followed up every month for 6 months and none of them required surgery.

Group – II : Twenty three patients were in second group (5-6) , 7 were operated upon clinical suspicion of high probability of acute appendicitis.

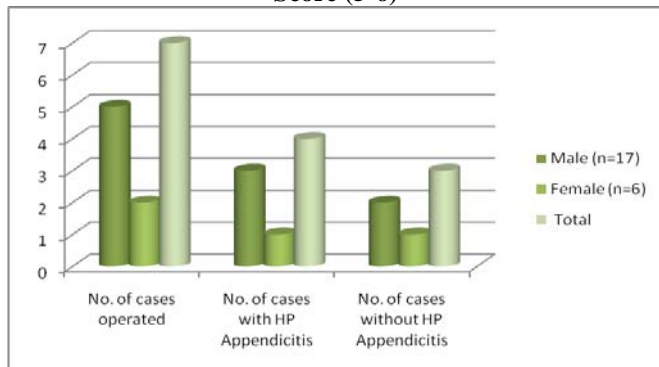
Rest of the 16 cases were not operated, were observed and discharged after 3 to 4 days of stay in hospital and followed up every month for 6 months and none of them required surgery during the period of observation. Of the 7 patients, whose score was 5-6 who were operated, 5 were males and 2 were females.

Category of cases	No. of cases operated	No. of cases with HP Appendicitis	No. of cases without HP Appendicitis	Proportion of true positive
Male (n=17)	5	3	2	60%
Female (n=6)	2	1	1	50%
Total (n=23)	7	4	3	57.1%

Distribution of cases according to modified Alvarado Score (5-6)

3 out of 5 males and 1 out of 2 females, had acute appendicitis. The overall negative appendicectomy rate of patients with scores ≤ 6 is 42.9% .

Distribution of cases according to modified Alvarado Score (5-6)



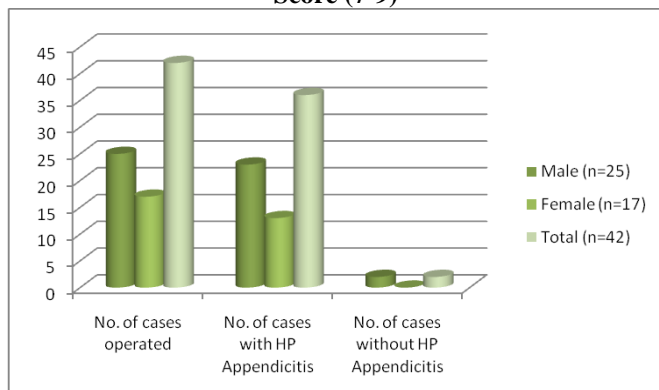
Group – III : Of the 42 patients in third group, 38 patients underwent appendicectomy.

Distribution of cases according to modified Alvarado Score (7-9)

Category of cases	No. of cases operated	No. of cases with HP Appendicitis	No. of cases without HP Appendicitis	Proportion of true positive
Male (n=25)	25	23	2	92%
Female (n=17)	17	13	0	76.4%
Total (n=42)	42	36	2	85.7%

4 female patients on subjecting for ultrasonography of abdomen had other pathology mimicking acute appendicitis and they didn't under go appendicectomy. Two patient had pelvic inflammatory diseases, and two patient had ruptured ectopic pregnancy. 36 cases out of 42 cases had acute appendicitis. The sensitivity of modified Alvarado score of ≥ 7 was 85.7% (proportion of true positive). The sensitivity was highest among males i.e., 92% while in females, it was 76.4%. Negative appendicectomy rates was highest among females (23.6%), where as in case of males it was 8%. 2 males patients with normal appendix had Meckel's diverticulitis.

Distribution of cases according to modified Alvarado Score (7-9)



Sex Distribution

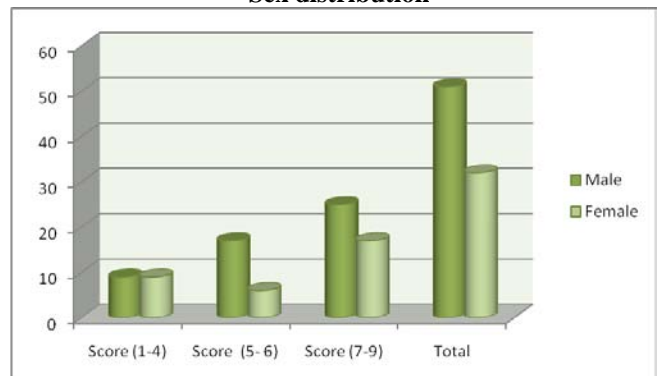
Sex	No of cases with score (1-4)	No of cases with score (5-6)	No of cases with score (7-9)	Total	Percentage
Male	9	17	25	51	61.4%
Female	9	6	17	32	38.6%

Interpretation :

In our study there were 51 (61.4%) male patients , 32 (38.6%) female.

Signs	No of cases with score(1-4)	No of cases with score(5-6)	No of cases with score(7-9)	Total	Percentage
Tenderness over RIF	4	20	39	63	76%
Rebound Tenderness over RIF	0	7	25	32	38.5%
Elevated Temperature $> 37.3^{\circ}\text{C}$	9	18	33	60	72.2%

Sex distribution



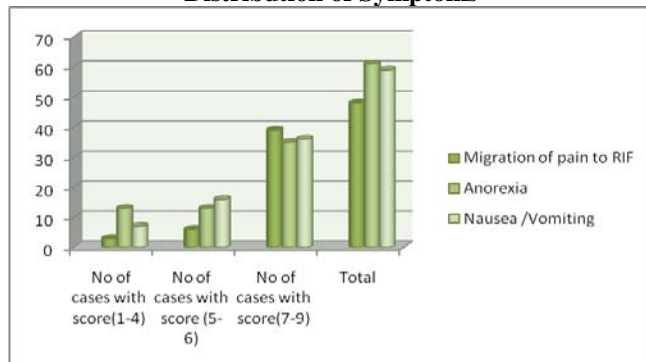
Symptoms Distribution

Symptoms	No of cases with score(1-4)	No of cases with score (5-6)	No of cases with score(7-9)	Total	Percentage
Migration of pain to RIF	3	6	39	48	57.8%
Anorexia	13	13	35	61	73.4%
Nausea /Vomiting	7	16	36	59	71%

Interpretation

The common symptoms seen in the present study were anorexia(73.4%) and nausea and vomiting (71%).

Distribution of Symptoms

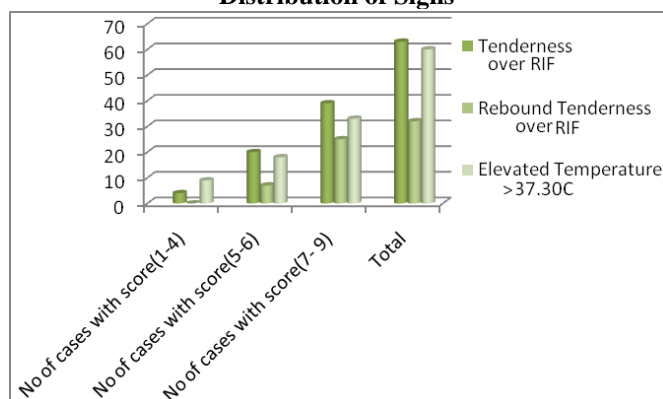


Distribution of signs

Interpretation

The most common sign seen in the present study was tenderness over RIF (76%). The next common signs were elevated temperature $> 37.3^{\circ}\text{C}$ (72.2%) and rebound tenderness over RIF (38.5%).

Distribution of Signs



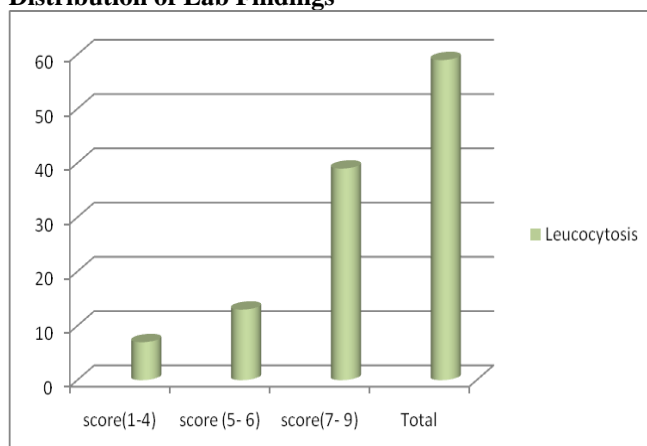
Lab Diagnosis Distribution

Lab Diagnosis	No of cases with score (1-4)	No of cases with score (5-6)	No of cases with score (7-9)	Total	Percentage
Leucocytosis	7	13	39	59	71.1%

Interpretation

The leucocytosis seen in present study is 71.1%

Distribution of Lab Findings



4. Discussion

The result of present study showed that a high score (≥ 7) in men was a satisfactory aid in the early diagnosis of acute appendicitis, the overall sensitivity in men with scores ≥ 7 was 92%, with a negative appendectomy rate of 8%. But in females the negative appendectomy rates were quite high in groups with score of 5 to 6 as well as 7 to 9. The negative appendectomy rate in the above groups being 50% and 23.6% respectively. Sensitivity of acute appendicitis 92% for males in the present study with score of 7 to 9 correlates well with the figures of studies by Kalan M, Rich AJ, Talbot D, Cunliffe WJ (who have reported 93%) and P.K. Bhattacharjee, T. Chowdhary, D.Roy (who have reported 94.1%). Sensitivity of acute appendicitis 76.4% for females in the present study with score of 7 to 9 correlates well with the figures of studies by Kalan M, Rich AJ, Talbot D, Cunliffe WJ (who have reported 67%) and P.K. Bhattacharjee, T. Chowdhary, D.Roy (who have reported 71.9%). The overall sensitivity of acute appendicitis being 85.7% in the present study with score of 7 to 9 correlates well with the figures of studies by Kalan M, Rich AJ, Talbot D, Cunliffe WJ (who have reported 83.7%) and P.K. Bhattacharjee, T. Chowdhary, D.Roy (who have reported 82.7%).

Comparison of Modified Alvarado score (5-6)

Category	Present study	Kalan M, Rich AJ, Talbot D, Cunliffe WJ	P.K. Bhattacharjee, T. Chowdhary, D.Roy
Male	60%	67%	83.3%
Female	50%	50%	66.7%
Total	57%	62.5%	73.7%

Comparison of Modified Alvarado score (7-9)

Category	Present study	Kalan M, Rich AJ, Talbot D, Cunliffe WJ	P.K. Bhattacharjee, T. Chowdhary, D.Roy
Male	92%	93%	94.1%
Female	76.4%	67%	71.9%
Total	85.7%	83.7%	82.7%

5. Conclusion

From the present study it may be concluded that high scores (7-9) in modified Alvarado score is dependable aid in early diagnosis of acute appendicitis in men but the same is not true as far as women are concerned, because of other conditions mimicking appendicitis like pelvic inflammatory disease, ruptured ectopic pregnancy. Ultrasonography of abdomen is a useful tool in avoiding negative appendectomy rates particularly in females.

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