Original Article

Evaluation of Modified Alvarado Score in The Diagnosis of Acute Appendicitis And Its Correlation With Ultrasonography And Histopathology

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ABSTRACT

Background: *Acute appendicitis is the most common acute surgical condition of the abdomen and approximately 7% of the population will have appendicitis in their life time. The diagnosis of appendicitis is still based primarily on the clinical history examination. Prompt diagnosis and surgical intervention may reduce the risk and prevent complications.*

Objectives: *To evaluate the usefulness of the modified Alvarado score in the diagnosis of acute appendicitis. To quantify it by correlating it with ultrasonological findings and the histopathological report.*

Methods: *100 consecutive patients presenting to the Department of Surgery at R. L. Jalappa Hospital and Research centre with right iliac fossa pain were included in the study. This was a randomized prospective study. The patients with suspected acute appendicitis were evaluated on the basis of the modified Alvarado Scoring System.*

Results: *Patients with a score >7 were confirmed as acute appendicitis and underwent appendicectomy. A total of 94 patients underwent surgery. The sensitivity of the modified Alvarado score was 98.8%. The negative appendicectomy rate was 7.6%.*

Conclusion: *The modified Alvarado scoring system is a good diagnostic indicator for acute appendicitis. It helps in minimizing the rates of negative appendicectomy. It can be used as an adjunct to surgical decision-making along with ultrasonography in doubtful cases.*

Keywords: *appendicitis, Alvarado, scoring system*

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INTRODUCTION

It is goes without saying that the abdomen is a magic box and poses new surprises to the surgeon each time. A meticulous examination of abdomen is one of the most rewarding diagnostic procedures available to the doctor, especially the

surgeon. Whilst clinical skills remain the mainstay of all medical practice, clinical medicine is changing. Increased sophistication of imaging and diagnostic techniques is resulting in greater diagnostic accuracy; however, the first meeting with the patient remains much the same.[1] Acute appendicitis is the most common acute surgical condition of the abdomen.[2] Approximately 7% of the population will have appendicitis in their life time,[3] with the peak incidence occurring between 10 and 30 years.[4]

The diagnosis of appendicitis is still based primarily on the clinical history and the physical examination.[5] Preoperative diagnosis of acute appendicitis is sometimes challenging despite all round improvements in medical field and ultrasonography. This study was designed to assess whether the modified Alvarado score could be used for diagnosing acute appendicitis & as a criterion for surgery.

AIM OF THE STUDY

This study was undertaken to apply and evaluate the usefulness of the modified Alvarado scoring system in the accurate diagnosis and management of acute appendicitis and to quantify the usefulness of the modified Alvarado scoring system by correlating it with ultrasonological findings and the histopathological report.

MATERIALS AND METHODS

One hundred patients who presented to the Department of Surgery at R. L. Jalappa Hospital and Research centre with right iliac fossa pain during the time period of November 2009 to December 2010 were included in the study.

This was a randomized study comprising of 100 patients of suspected acute appendicitis over a period of one year. The patients on admission were evaluated on the basis of the modified Alvarado Scoring System. All patients with right iliac fossa pain were included in the study. Patients with clinically urologic or gynaecological symptoms were excluded.

THE MODIFIED ALVARADO SCORE

Several diagnostic tools and scoring systems have been developed and been characterized as understandable, non invasive and cost effective.[6] The Alvarado scoring system is purely based on history, clinical examination and a few laboratory tests and is very easy to apply.[7] The Alvarado score was first described in 1988 by Alfredo Alvarado as a practical score for the early diagnosis of acute appendicitis that can be instituted easily in the outpatient setting. The Alvarado score was modified by Kalan et al by excluding one laboratory finding shift to left of neutrophil maturation (Table-1). [8]

MANAGEMENT PLAN

Patients with score of 1 - 4 were considered not likely to have acute appendicitis. Those with score of 5 - 6 probably have and those with score of 7 - 9 were considered to have definitive diagnosis (Table-2). The Alvarado score can increase or decrease on reassessment. Ultrasound abdomen of the patients was performed and the ultrasonological findings were correlated with the score. Patients with score of ≥ 7 were subjected to surgery. Operative

and histopathological diagnoses of appendicitis were confirmed.

The cases subjected to emergency surgery were adequately prepared by parenteral fluids, electrolyte supplementation, and administration of broad spectrum antibiotics intravenously (usually combination of Ceftriaxone 1g 12th hourly + Metronidazole 500 mg 8th hourly).

Surgery was done under spinal anaesthesia. Grid iron incision was employed in majority of the cases. Post operatively patients were kept nil orally, till bowel sounds returned; parenteral fluid, electrolytes, antibiotics and analgesics were continued. Patients were monitored for any post operative complications and treated whenever needed. Post operatively sutures were removed on 7-9 days and the patients were discharged after histopathological confirmation.

RESULTS

A prospective study of 100 consecutive patients presenting with right iliac fossa pain was undertaken to evaluate the modified Alvarado score.

Acute appendicitis is more common in males than females. In our series the male to female ratio was 61:39 i.e. 3:2. In our series, the maximum incidence was found in the age group of 21 to 30 years followed by the 11 to 20 years age group.

Pain was the commonest presenting symptom and had been observed in all the cases. The classical shifting of pain from umbilical to right iliac fossa was present in 86% of cases. Other common symptoms observed were nausea and vomiting in 87% case, fever in 83% cases and anorexia 73%. Burning micturation was seen in 23% and bowel disturbance was seen in form of constipation (16%) and diarrhea (10%). Clinically, tenderness at right Iliac fossa was present in all cases. Rebound tenderness was present in 74%. Rovsing's sign was positive in 25%. In the present study the total leucocyte count was increased in 77%, and it was within normal range in 23% of the cases (Figure 1).

All cases were subjected to ultrasonography and high frequency probe was used in some cases. Graded tenderness at the Mc Burney's point was the most common finding seen in 52 cases. The appendix was visualized in 30 cases; 21 of who had acute appendicitis, 3 had appendicular mass and 6 had appendicular abscess. Two cases had mesenteric adenitis. Two cases had right ureteric calculi while one other had a right VUJ calculus. Two cases had twisted right sided ovarian cysts. The ultrasound scan was found to be unremarkable in 10 cases.

Of the 100 cases studied, 95 had a score of 7 and more. The cases with a score of ≤ 5 were diagnosed by ultrasound with right ureteric and VUJ calculus and were managed accordingly.

Two cases with a score of 8 and 7 respectively were diagnosed as mesenteric lymphadenitis by ultrasonography and were managed conservatively. Two patients with scores of 6 & 7 respectively were diagnosed as right ovarian cysts & were referred to the gynaecologist for further intervention.

All the patients with a modified Alvarado score in excess of 7 were subjected to appendicectomy. A total of 94 patients underwent surgery. One patient who had a score of 5 was initially managed conservatively. A

Table 1 - The Modified Alvarado Scoring System

PARAMETERS	MANIFESTATIONS	MANIFESTATIONS
SYMPTOMS	Migratory pain	1
	Anorexia	1
	Nausea/Vomiting	1
SIGNS	RIF* tenderness	2
	Rebound tenderness	1
LABORATORY VALUES	Elevated temperature	1
	Leukocytosis	2
TOTAL SCORE		9

*RIF Right Iliac Fossa

Table 2 - Management Plan

SCORE	MANAGEMENT PLAN
1 to 4	No admission Oral antibiotics To report back if symptoms aggravate
5 to 6	Admission Parenteral antibiotics Repeat Alvarado score at 12, 24 and 48 hours if suggestive of acute appendicitis - Surgery
7 to 9	Definite diagnosis Surgery

Figure - 1: Manifestations as per modified alvarado score

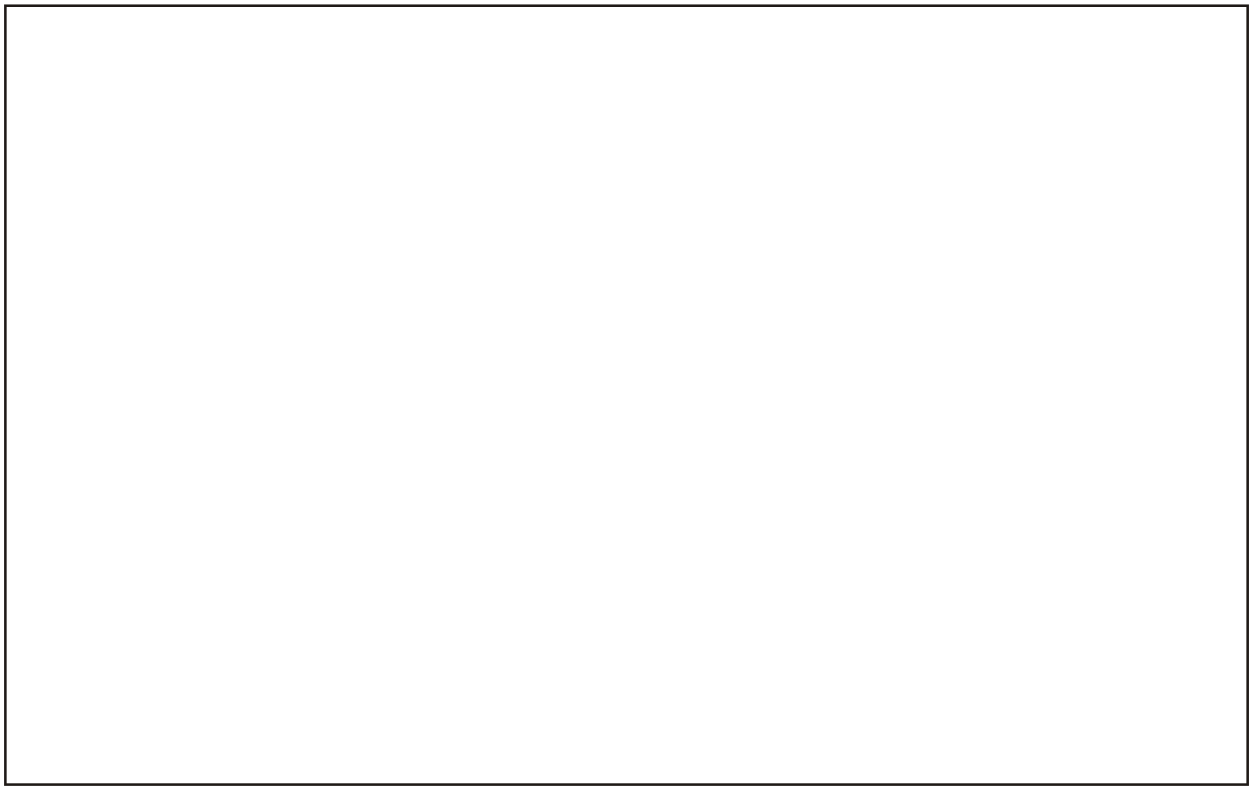

Figure - 2: Intra-operative findings

second assessment 24 hours later revealed clinical deterioration and an increase in the score from 5 to 8. The patient was then subjected to surgery which revealed acute appendicitis. This was confirmed by histopathological examination.

At laparotomy 68 patients had an elongated, inflamed appendix. Appendicular mass was present in 2 patients, 1 had a gangrenous appendix, 7 had a perforated appendix with local peritonitis and 7 had an appendicular abscess. In 7 patients the appendix was found to be normal (Figure 2). Meckel's diverticulum was not found in any of the patients.

The post operative complications seen in our study were wound infections and lower respiratory tract infections.

The histopathological examination confirmed the diagnosis of acute appendicitis in 69 cases. Necrotizing and gangrenous changes were seen in 6 and 8 cases respectively. The appendix was found to be normal in 7 cases.

The statistical analysis was done to determine the sensitivity and specificity of the modified Alvarado score and ultrasonography. The positive and negative predictive values were also calculated. The histopathological examination was considered confirmatory of the diagnosis. Both the variables of the score and ultrasonography were compared with histopathology and the following results were obtained. Modified Alvarado score had sensitivity (Sn) of 98.8%, specificity (Sp) of 93.3%, positive predictive value (PPV) 89.3% & negative predictive value (NPV) of 83.3% while ultrasonography had Sn 88.8%, Sp 93.4%, PPV 91.4% & NPV 84.4%.

DISCUSSION

Acute appendicitis remains a common abdominal emergency throughout the world. Despite the advances in the diagnostic field, the diagnosis of acute appendicitis remains an enigma for the attendant surgeon.[9] None of the investigations like USG, CT, MRI can give a confirmatory diagnosis of acute appendicitis.[10] It has been proved that most of the aforementioned investigations are costly, time consuming, requiring more specialized and expert services, while some are not feasible and not available everywhere. So a thorough clinical examination with basic investigations is one of the best diagnostic tools for acute appendicitis. With this background many eminent surgeons and physicians have been adopting different scoring systems in order to decrease negative appendicectomy rates.

It is a well established fact that acute appendicitis is more common in males than females. It has been attributed to the fact that young males are more subjected to strain and trauma and that their diet is usually rich in protein than that of the females.[11] In our series the male to female ratio was 3:2. In our series, the maximum incidence of acute appendicitis was found in the age group of 21 to 30 years.

Of the 100 cases studied, 94 had a score of $\geq$7. All these patients with a modified Alvarado score in excess of 7 were subjected to appendicectomy.

Statistical analysis revealed a sensitivity of 98.8% and a specificity of 93.3%. The high

sensitivity suggests that the scoring system is very effective in diagnosing acute appendicitis when the scores are above 7. These results were comparable to other studies done both in India and internationally.

All cases were subjected to ultrasonography and high frequency probe was used in some cases. Graded tenderness at the Mc Burney's point was the most common finding. The appendix was visualized in 30 cases. Ultrasound scan was found to be unremarkable in 10 cases. These statistics were comparable to other Indian and international studies. In 82 patients, ultrasonography was suggestive of appendicitis. Histopathological examination confirmed the diagnosis in 75 of these patients and was normal in 7 patients.

Statistical analysis revealed a sensitivity of 88.8% and a specificity of 93.4%. The high sensitivity suggests that it is very effective in diagnosing acute appendicitis. Also specificity suggests that ultrasonography is also useful in diagnosing other conditions which may clinically mimic acute appendicitis. These results were similar to those seen in other studies although the specificity in the present study was lower than that in other studies.

At laparotomy 68 patients had an inflamed appendix. In 7 patients the appendix was found to be normal. Meckel's diverticulum was not found in any of the patients.

Appendicular perforations and abscesses were more common in perdiatric age group. This is important keeping in mind the shortness of omentum in children which can cause early perforation and peritonitis with its attendant morbidity and mortality.[12]

In the present series a total of 94 patients underwent surgery. Two of these patients underwent surgery for twisted ovarian cysts. Among the 92 patients who underwent surgery for acute appendicitis, histopathology confirmed the diagnosis in 85 cases. Histopathological examination was normal in 7 cases.

A negative appendicectomy rate of 7.6% was observed. Hence we can conclude that the application of the modified Alvarado score has helped immensely in minimizing the rates of negative appendicectomy.

The higher rates of complications were predominantly seen at the extremes of ages. Paediatric and geriatric groups were more prone for appendicular perforation, abscess and mass formation. The incidence of post operative wound infections were higher in patients who had appendicular perforations or abscesses as compared to those patients who had acute appendicitis. Lower respiratory tract infections were more common in patients above the age of 50 years. Most of these patients had co-morbidities like COPD or diabetes mellitus.

In our present study, the usefulness of the scoring system was demonstrated beyond doubt by correctly diagnosing acute appendicitis and by reducing the number of negative laparotomies and their complications.

CONCLUSION

The modified Alvarado scoring system is a good diagnostic indicator for acute appendicitis. It is highly sensitive in diagnosing acute appendicitis.[13] It helps in reducing the number of negative appendicectomies. It can work effectively in routine practice as an adjunct

to surgical decision-making in questionable acute appendicitis. It is effective in children and men but diagnostic laparoscopy is advised to minimize the unacceptably high false-positive rate in women.[14] It is simple to use and easy to apply since it relies only on history, clinical examination and basic laboratory investigations. It is cost-effective and can be used in all set ups with basic laboratory facilities. Ultrasonography is also a sensitive investigation which also helps in diagnosing any other condition that may mimic acute appendicitis.[15] It can be used as an adjunct in doubtful cases where diagnostic dilemma arises. When combined, modified Alvarado score and ultrasonography can work very effectively in diagnosing acute appendicitis correctly and in reducing the number of negative appendicectomies.

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