

A one year prospective study to compare and evaluate diagnostic accuracy of modified Alvarado score and ultrasonography in acute appendicitis, in adults

Sanjot B. Kurane · M. S. Sangolli · A. S. Gogate

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Abstract

Objectives To compare and evaluate diagnostic accuracy of modified Alvarado score and ultrasonography in co-relation to histopathology report for diagnosis of acute appendicitis.

Methodology A prospective study of the patients who underwent appendectomy for suspected acute appendicitis at K.L.E.S. Hospital and M.R.C. Belgaum. The clinical, radiological and ultrasonographic data of 60 patients with suspected appendicitis was collected. These patients were evaluated by modified Alvarado here and ultrasonographically, which was correlated with histopathological finding.

Results Out of 60 patients, 38.33% had acute appendicitis. 40% had modified Alvarado score ≥ 7 and 38.33%

patients were ultrasonographically positive. In the present study, modified Alvarado score has sensitivity of 78.26%, specificity 83.78%, positive predictive value 75.00%, negative predictive value 86.11%, diagnostic accuracy 81.00% false positive error rate 16.22% and false negative error rate 21.74%. Ultrasonography had sensitivity of 82.61%, specificity of 89.19%, positive predictive value of 82.61, negative predictive value of 89.19. Diagnostic accuracy of 86.67%, false positive error rate of 10.81%, false negative error rate of 17.39%. When modified Alvarado score and ultrasonography were positive, 17 true positive cases and no false positive cases. The false negative cases in modified Alvarado score were five. When it was combined with ultrasonography the false negative cases reduced to two that is 60% reduction in false negative cases.

Conclusions Modified Alvarado score is useful tool in clinical decision making. When compared with ultrasonography neither one is advantageous. However, additional information provided by ultrasonography improves diagnostic accuracy.

Keywords Modified Alvarado Score · Ultrasonography · Acute Appendicitis

S. B. Kurane · M. S. Sangolli · A. S. Gogate
Department of General Surgery,
J.N. Medical College and K.L.E.S. Hospital and MRC Belgaum,
Belgaum, Karnataka,
India

S. B. Kurane (✉)
Ganga Hospital, Kurane building,
Station road,
Miraj - 416 410, Maharashtra,
India
Ph: 0233 2222966, +919823880620
e-mail: dr_sanjot@rediffmail.com

Introduction

Acute appendicitis is one of the commonest surgical emergencies. Simple appendicitis can progress to perforation, which is associated with a much higher morbidity and mortality, and surgeons have therefore been inclined to operate when the diagnosis is probable rather than wait until it is

certain [1]. A clinical decision to operate leads to the removal of a normal appendix in 15–30% of cases 1 (although the figure may be higher or lower in certain demographic groups). This proportion may be reduced by observing equivocal cases for a period of time, a practice that seems to be safe for most patients [2].

It has been claimed that diagnostic aids can dramatically reduce the number of appendicectomies in patients without appendicitis, the number of perforations and the time spent in hospital [1]. These aids include laparoscopy, scoring systems, ultrasonography, computer programs, computerized axial tomography scans, and magnetic resonance imaging, which are each available in different settings and have different advantages and disadvantages [3].

Graded compression ultrasonography in diagnosis of acute appendicitis has greatly improved the ability to diagnose acute appendicitis with ultrasound [4]. Ultrasonography is critically operator dependant, and care to be taken to avoid over interpreting a technically inadequate examination. Graded compression sonography plays an important role in reducing the number of negative surgical exploration for acute appendicitis. The accuracy offered by sonography should keep negative laprotomy ratio at approximately 10% which is improvement over the rate achieved by instinct alone [5]. CT scan is complimentary to sonography. However CT scan is associated with greater cost, exposure ionizing radiation and exposure to contrast agents. The Modified Alvarado score is a 9 point scoring system for the diagnosis of appendicitis based on clinical signs and symptoms and a leucocytes count. Score of 7 or more were recommended for surgery [6].

In our hospital acute appendicitis remains one of the most common acute abdominal emergencies warranting surgery in patients presenting with atypical clinical finding. So diagnosis become difficult. Modified Alvarado scoring system and ultrasonography play a definite role in diagnosis of acute appendicitis, because of its easy availability, cost effectiveness and radiation free. Till now in our hospital no one has done a study to evaluate diagnostic accuracy of modified Alvarado score and ultra sonography in adults, in acute appendicitis. Hence this study is undertaken.

Method

The present study was conducted in the Department of Surgery, K.L.E.S.'s Hospital and Medical Research Centre during the period of December 2004 to December 2005.

Study Design A prospective study.

Source of Data Patients with suspected clinically acute appendicitis and undergone appendicectomy in K.L.E.S. Hospital and MRC Belgaum were selected for the study.

Sample size 60 adults having acute appendicitis who underwent modified Alvarado score evaluation and ultraso-

nography at K.L.E.S. Hospital & Medical Research Center Belgaum were selected for the study.

Inclusion Criteria All the patients undergoing appendectomies in K.L.E.S. Hospital, Belgaum. Adults (male and females) age group between 15 to 75 years

Exclusion Criteria Other pathologies like worm infestation, benign and malignant tumours of appendix. Appendicular mass managed conservatively.

Method of collection data

The patients, who were admitted and operated depending on clinical suspicion of acute appendicitis. The clinical diagnosis of acute appendicitis was done by consultants of Department of Surgery K.L.E.S.'s Hospital and Medical Research Centre, Belgaum based on clinical signs and symptoms.

The patients suspected of acute appendicitis undergo thorough evaluation by clinical details, investigation and ultrasonography. Then depending on the clinical details and investigation, they were allotted modified Alvarado score which is as follows.

Modified alvarado score	Score
Symptoms	
Migratory Rt. Iliac fossa pain	1
Anorexia	1
Nausea/Vomiting	1
Signs	
Tenderness Rt. Lower quad.	2
Rebound Tenderness Rt. Iliac Fossa	1
Pyrexia > 37.3°C	1
Investigations	
Leucocytosis > 10×10^9 /L	2
Total	9

Modified Alvarado score more than or equal to 7 are considered acute appendicitis i.e. positive and scores less than or equal to 6 are considered negative. The ultrasonography findings are noted depending upon the findings they were divided in two groups. One is ultrasonography positive and ultrasonography negative.

The appendix specimen is sent for histopathology report and the report is noted. Histopathological diagnosis is considered as final. The modified Alvarado score and ultrasonography findings are compared to histopathology report. With the help of 2×2 table, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were calculated individually. And then compared with each other.

Results

Total numbers of cases in this study were 60. Out of 60 patients, 31(51.67%) were male and 29 (48.33%) were females. The age distribution of the patients in the study is shown in figure 1.

Out of all the patients undergone appendectomy, 23 (38.33%) were histologically positive for acute appendicitis and 37 (61.67%) were histologically negative. All the 60 patients were assigned modified Alvarado score among which 40.00% were positive (≥ 7) and 60.00% were negative (≤ 6). And the patients undergone for ultrasonography. Had 23 (38.33%) sonographically positive cases and 37 (61.66%) were sonographically negative cases.

In the present study, modified Alvarado score has sensitivity of 78.26%, specificity 83.78%, positive predictive value 75.00%, negative predictive value 86.11%, diagnostic accuracy 81.00% false positive error rate 16.22% and false negative error rate 21.74%. Ultrasonography had sensitivity of 82.61%, specificity of 89.19%, positive predictive value of 82.61%, negative predictive value of 89.19%. Diagnos-

tic accuracy of 86.67%, false positive error rate of 10.81%, false negative error rate of 17.39%. When modified Alvarado score and ultrasonography were positive, 17 true positive cases and no false positive cases. The false negative cases in modified Alvarado score were five. When it was combined with ultrasonography the false negative cases reduced to two that is 60% reduction in false negative cases (Table 1).

Discussion

In 1986, Alvarado followed up patents admitted to surgical unit at the Nazareth Hospital in Philadelphia with suspected acute appendicitis, until surgery confirmed or refuted diagnosis. He found out eight criteria's had high diagnostic accuracy for acute appendicitis. In a randomized controlled trial of ultrasonography in diagnosis of acute appendicitis; in cooperating Alvarado score, the author suggested diagnostic protocol incorporating the Alvarado score was, if anything, safer, faster, more accurate than graded compression sonography alone [7].

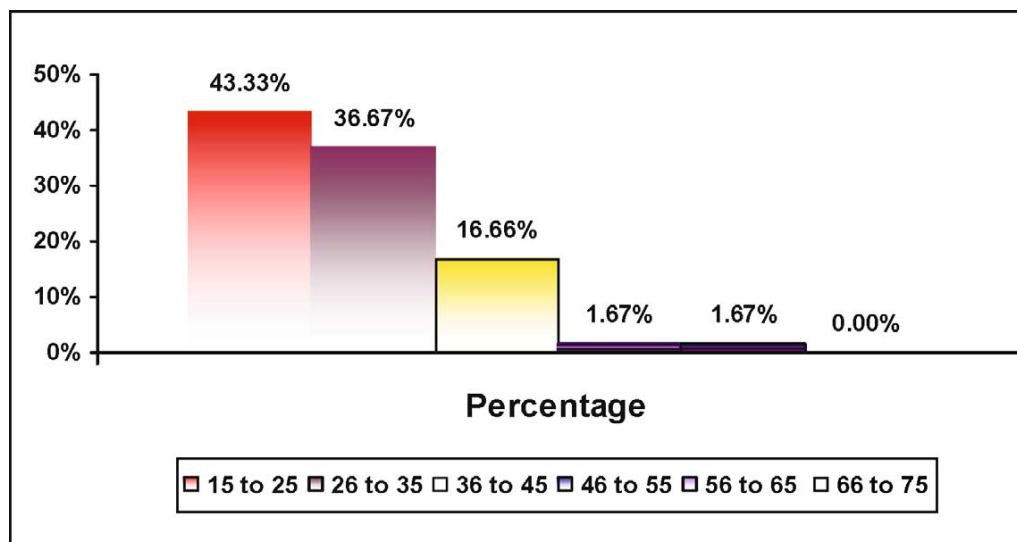


Fig. 1 Age Distribution of the patients

Table 1 Comparison of modified Alvarado score and ultrasonography in diagnosis of acute appendicitis

	Modified Alvarado score	Ultrasonography	Modified Alvarado score + Ultrasonography
Sensitivity	78.26%	82.61%	88.8%
Specificity	83.78%	89.19%	96.5%
Positive predictive value	75.00%	82.61%	94.11%
Negative predictive value	86.11%	89.19%	93.33%
Diagnostic accuracy	81.00%	86.67%	93.61%
False positive error rate	16.22%	10.81%	3.44%
False negative error rate	21.74%	17.39%	11.11%

Alvarado scoring system was modified by Kalen et al and named it as Modified Alvarado scoring system [6] later on many studies were conducted with Modified Alvarado scoring system. Few of them were in favour and other were against it. But the author also suggested the need of a prospective study to evaluate modified Alvarado score.

Graded compression ultrasonography was done using 3.5 MHz, 5 MHz or 7.5 MHz linear array transducers according to the situation. Some investigations have reported seeing normal appendices on a sonogram. The normal appendix is compressible with wall thickness of less than or equal to 3 mm. The size of an appendix can differentiate normal from an acutely inflamed appendix.

The sonographic hallmark of appendicitis is direct visualization of the inflamed appendix. The typical appearance is that of concentrically layered, almost incompressible, sausage like structure demonstrated at the site of maximum tenderness [8]. The usual findings are:

- Visualization of noncompressible appendix as a blind-ending tubular aperistaltic structure.
- Target appearance of ≥ 6 mm in total diameter on cross section / maximal mural wall thickness ≥ 2 mm.
- Diffuse hypoechogenicity (associated with higher incidence of perforation).
- Lumen may be distended with anechoic/hyperechoic material.
- Loss of wall layers.
- Visualization of appendicolith
- Localized periappendiceal fluid collection.
- Prominent hyperechoic mesoappendix / pericaecal fat.

If the inflamed appendix becomes non-tender on pressure, one should consider a diagnosis of spontaneous resolving appendicitis. Many clinical 'look alikes' of appendicitis can be demonstrated reliably by ultrasound. The most frequently encountered is the newly described bacterial ileocaecitis caused by yersinia, campylobacter or salmonella. Second in frequency are gynaecological conditions such as ovarian cysts, ectopic pregnancy, adnexal torsion and tubo-ovarian abscess. Other ultrasonically detectable alternative conditions are caecal and sigmoid diverticulitis, cholecystitis, perforated peptic ulcer, Crohn's disease, urological conditions, small bowel obstruction and caecal carcinoma [9].

In experienced hands the inflamed appendix can be visualized in 90% of patients with non-perforated appendicitis, 85% of those with an appendiceal mass and in 55% of those with free perforation of the appendix. Peritonism preventing graded compression probably accounts for the limited success in patients with appendiceal perforation [3]. In addition air filled dilated bowel loops from adynamic ileus may hide the appendix from view.

Modified Alvarado score is simple to use and easy to apply. When the results of present study are compared with other studies [10, 11, 12] we observe that specificity positive predictive value and negative appendectomy rate

are comparable with that of the standard studies. But the sensitivity of the present study is comparable to a study [10] as these studies are prospective studies. Whereas when compared to other studies [11, 12] which have shown low sensitivity as these studies were retrospective studies.

The present study has shown better sensitivity, as it is a prospective study and shortcomings of retrospective study are ruled out. Modified Alvarado scoring system is a dynamic one allowing observation and critical evaluation of the clinical picture. Its application improved diagnostic accuracy and reduces negative exploration and complication rates. When ultrasonography results of the present study are compared to other standard studies, sensitivity, specificity, positive predictive value and diagnostic accuracy of the present study is almost comparable with that of standard studies [13, 14, 15].

When Modified Alvarado score and ultrasonography were compared in terms of sensitivity, specificity, positive predictive value, diagnostic accuracy and false negative cases the results are almost same. Neither one is significantly advantageous. But in cases where Modified Alvarado score is negative or equivocal, the addition of ultrasonography reduces false negative cases.

Thus this study goes on to prove ultrasonography adjunct value in suspected cases of acute appendicitis

Conclusions

Modified Alvarado score is useful tool in clinical decision making. When compared with ultrasonography neither one is advantageous. However, additional information provided by ultrasonography improves diagnostic accuracy

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