

DIAGNOSTIC ACCURACY IN CASES OF ACUTE APPENDICITIS MODIFIED ALVARADO SCORE SYSTEM VS. ULTRASONOGRAPHIC IMAGING

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ABSTRACT

OBJECTIVE

To compare preoperative diagnostic accuracy in cases of Acute Appendicitis with Modified Alvarado Scoring as compared to diagnostic ultrasonographic imaging.

DESIGN

Cross sectional study.

SETTING AND DURATION

Surgical Unit-I of Rama Medical College Hospital and Research Centre, Kanpur, from 1st March 2013 to 31st May 2015.

METHODOLOGY

After ethical approval of ethics committee, Rama Medical College Hospital and Research Centre, a sample of 150 patients was collected by non-probability purposive sampling technique during 26 months, who were admitted in this hospital and included in this study and later underwent abdominal ultrasonography and appendectomy and subsequently pathological evaluation of the appendix done for disease appendicitis. Results of outcome of histopathology compared with MASS and ultrasonography results. Patients underwent appendectomy were assessed by senior consultants of the Surgical Department for exclusion of patients with complication of appendicitis and other causes of lower abdominal pain. Modified Alvarado Score System (MASS) was recorded preoperatively, but its result was not disclosed to effect the decision of surgery. After appendectomy, the appendix was sent for histopathology which was taken as gold standard or confirmation of disease. The results of histopathology compared with ultrasonographic imaging diagnosis and Modified Alvarado Scoring System to assess the diagnostic accuracy of both modalities.

RESULTS

110 males and 40 female patients were assessed. Of these patients, 134 (89.3%) had histopathology positive acute appendicitis. The sensitivity, specificity, PPV, NPV and accuracy rate of ultrasonography was found 77.6%, 75.0%, 96.2%, 28.7% and 77.3%, respectively. By taking a cut-off point of 7 for the MASS score, a sensitivity of 65.67%, specificity of 37.5%, PPV of 89.79%, NPV of 11.5% and accuracy of 62.6% were calculated.

CONCLUSION

Ultrasonography provides more reliable information for helping to diagnose acute appendicitis. A cut-off point of 7 for the MASS score has less sensitivity and accuracy as compared to clinical diagnosis assisted with ultrasonography for better diagnosis of appendicitis and to decrease the rate of negative appendectomy.

KEYWORDS

Acute Appendicitis, Appendectomy, Ultrasonography, Modified Alvarado Scoring System (MASS).

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INTRODUCTION

Acute Appendicitis is the most common cause of acute abdominal pain and appendectomy is the most frequently performed emergency surgery in the world.¹ with lifetime occurrence of 7%. The peak incidence occurs between 10-30 years of age; however, no age is spared.² Approximately, 6% of the population will suffer from acute appendicitis during their lifetime.³

Although, acute appendicitis has been recognized as a clinical entity for 100 years, the differential diagnosis between acute appendicitis and non-specific abdominal pain may still be exigent. Early diagnosis and prompt operative intervention is the key for successful management of acute appendicitis.⁴

So many appendicectomies are performed for non-appendiceal pathologies, so-called unnecessary or negative appendectomies because of similarities in the clinical presentation, especially in young women.⁵ On the other hand, there remains always a possibility of complications in effort to decrease the negative appendectomy rate. Traditionally, most favoured and most effective way to decrease rate of perforation is to have a lower threshold for operating at the expense of increasing negative appendectomy rate.⁶ From the beginning of abdominal complaints to admission in a hospital, delays of few hours to a few days may occur.

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Accurate and prompt diagnosis reduces the risk of perforation and negative appendectomy rate.⁷ Although in acute appendicitis mortality is low, morbidity remains high. Immediate appendectomy has long been recommended treatment of appendicitis, because of the known risk of progression to complications. Rate of appendiceal perforation increases from less than 2% when appendectomy is performed within 36 hours of symptom onset to 5% after this time period.⁸ Diagnosis of acute appendicitis is established primarily on patient's history and physical examination supported by laboratory and imaging examination. Delay in diagnosis and treatment is by far the main cause of appendiceal perforation.⁹

Despite many advances in diagnostic system, acute appendicitis is still a diagnostic dilemma at times and challenge too.¹⁰ An accurate diagnosis can only be obtained at surgery or after histopathological examination of surgical specimen.¹¹ Accurate identification of patients who require immediate surgery as opposed to those who will benefit from active observation is not always easy.¹² Several authors have created diagnostic scoring systems in which a finite number of clinical variables are elicited from the patients and each one is given a numerical value. The sum of these values has been used to predict the likelihood of acute appendicitis.

Clinical scoring systems for adults have been developed to increase the diagnostic accuracy and decrease the unnecessary appendectomy rate.¹³ Some developers of the diagnostic scores have suggested a decrease of unnecessary appendectomy rate of up to 50%.^{14,15} Scoring system such as Madan score, Ohmann score, Eskelinen score, DeDombal score, Francois Score and Alvarado score has been devised to aid diagnosis of acute appendicitis.¹⁶ Apart from scoring systems number of other diagnostic modalities have also been proposed including laparoscopy, computer programs, ultrasonography, CT scans and MRI. Imaging techniques are fairly accurate.^{17,18,19}

Graded compression ultrasonography is an inexpensive, fast and non-invasive method with an accuracy rate of 71%–90% for the diagnosis of acute appendicitis. But there is no certainty about the effect of ultrasonography on the clinical outcomes of patients. Furthermore, clinical judgment should not be abandoned because of the lack of ultrasound findings in patients with a high probability of acute appendicitis. Also, ultrasonography is an operator-dependent modality and the diagnostic values are different in various studies.²⁰

The likelihood of appendicitis is ascertained by the Alvarado Scoring System. It is accepted that according to the Alvarado Scoring System which consists of right lower quadrant tenderness, rebound tenderness, migrating pain, nausea and/or vomiting, anorexia, fever, leucocytosis and a left shift in the leukocyte count. Patients who get a score of 7 to 10 should undergo appendectomy and patients with a score of 5 or 6 are candidates for observation. Modified Alvarado Scoring System (MASS) was developed by omitting the left shift of leucocytosis from the Alvarado Scale to make it more clinical and not lab dependent.^{21,22}

Most hospitals do not count the neutrophils and also the CT scans are not available; therefore, we decided to evaluate the diagnostic value of the Modified Alvarado Scoring System (MASS) and the accuracy of graded compression ultrasonography in our setting for the diagnosis of acute appendicitis, comparing it with the gold standard of eventual

histopathology in order to consider sensitivity, specificity, NPV (Negative Predictive Value), PPV (Positive Predictive Value) and accuracy of MASS score as compared to the sensitivity, specificity, NPV, PPV and accuracy of ultrasonography assisted diagnosis of appendicitis in our medical college.

METHODS

This prospective observational study was conducted at Surgical Unit-I of Rama Medical College Hospital and Research Centre, Kanpur, from 1st March 2013 to 31st May 2015. All patients >12 years of age of either sex, clinically diagnosed as having acute appendicitis were enrolled. Alvarado score was also scored, but not accounted in decision making. All patients subjected to preoperative ultrasonography, a formal informed consent was duly taken. Patients with appendicular mass, appendicular abscess and those found to have perforated appendix at surgery were excluded.

Similarly, patients found to have obvious pathology other than or in addition to an inflamed appendix (e.g. right-sided ovarian cyst, inflamed Meckel's diverticulum, etc.) were not included. After standard pre-operative optimizations, the subjects underwent appendectomy through a right grid-iron incision centered at the McBurney's point. The specimen was appropriately labelled and sent for histopathology. All specimens were sent to a Medical College Pathology Dept.

With a pre-defined protocol for pathological diagnosis of acute appendicitis (Two essential criteria: Subserosal congestion and neutrophil exudation in mucosa, submucosa and muscularis; two supportive criteria: foci of suppurative necrosis and those of gangrene). Patients with uneventful post-operative course were discharged after 36-48 hours of surgery; those with some morbidity were retained longer, depending on the nature of complication and its management.

All patients were called for follow-up in the outpatient, a week after the discharge with the biopsy report. All data were entered on a predesigned proforma including patient's demographic features (Age and gender), Modified Alvarado score, histopathological findings (Normal or inflamed appendix as per pre-set criteria enumerated above) and preoperative ultrasonographic report (Based on prefixed criteria of graded compression method and > than 6 inch non-compressible intestinal loop) and final outcome, i.e. negative appendectomy. In order to minimize any bias in favour of or against the hypothesis, Modified Alvarado scores were entirely calculated by senior residents who were not privy to the research.

RESULTS AND DISCUSSION

Demographic Results

One hundred ten (110) males and forty (40) females were assessed. The mean age of the patients was 27.97 years (9 to 84 years old). Although the average age seemed to be higher in the female group (30 years in comparison with 25.9 years in males), the difference was not significant (p value >0.05).

Pathology Results

Acute appendicitis was confirmed in 134 (89.3%) of the patients and the remaining 16 (10.7%) patients had undergone negative appendectomies.

| Characteristics | Frequency (n=150) |
|----------------------|-------------------|
| Age (mean±SD) | 27.97±11.56 years |
| Gender (male/female) | 110/40 |

Table 1: Patient Characteristics

| | Female | Male | Total % |
|-----------------|-----------|------------|-------------|
| Appendicitis | 32 | 102 | 134 (89.3%) |
| Normal appendix | 8 | 8 | 16 (10.7%) |
| Total | 40 | 110 | 150 |

Table 2: Pathology Results

Ultrasound Results

Ultrasonography was performed on all 110 male patients and 40 females.

| | Appendicitis in Ultrasonography | Normal Ultrasonography | Total |
|---------------------|---------------------------------|------------------------|------------|
| Appendicitis | 108 | 26 | 134 |
| Normal Appendicitis | 4 | 12 | 16 |
| Total | 112 | 38 | 150 |

Table 3: Ultrasonographic Data

The sensitivity for diagnosing acute appendicitis by ultrasound was 77.6%, the specificity was 75.0% and the accuracy rate was 77.3%. The Positive Predictive Value (PPV) for ultrasonography was 96.2% and the Negative Predictive Value (NPV) was 28.7% in our study.

Modified Alvarado Score System results (MASS)

MASS scoring was assessed in all 150 patients taking cut off as 7.

| | Mass >7 | Mass <7 | Total |
|---------------------|------------|-----------|------------|
| Appendicitis | 98 | 36 | 134 |
| Normal Appendicitis | 10 | 6 | 16 |
| Total | 102 | 42 | 150 |

Table 4: Mass Results

The sensitivity for diagnosing acute appendicitis by MASS was 65.67%, the specificity was 37.5% and the accuracy rate was 62.64%. The Positive Predictive Value (PPV) for MASS was 89.79% and the Negative Predictive Value (NPV) was 11.5% in our study. Among the MASS components, right lower quadrant tenderness was the most common and nausea and/or vomiting was significantly related with acute appendicitis (p value 0.001).

| Manifestations | Value | % |
|-------------------------------------|----------|------|
| Migration of pain | 1 | 85.3 |
| Symptoms Anorexia | 1 | 84.8 |
| Nausea and/or vomiting | 1 | 68.8 |
| Signs | | |
| Right lower quadrant tenderness | 2 | 88.3 |
| Rebound | 1 | 87 |
| Elevated temperature | 1 | 81.8 |
| Laboratory Values | | |
| Leukocytosis >11000/mm ³ | 2 | 90.9 |
| Total Score | 9 | |

Table 5: Modified Alvarado Scale Findings

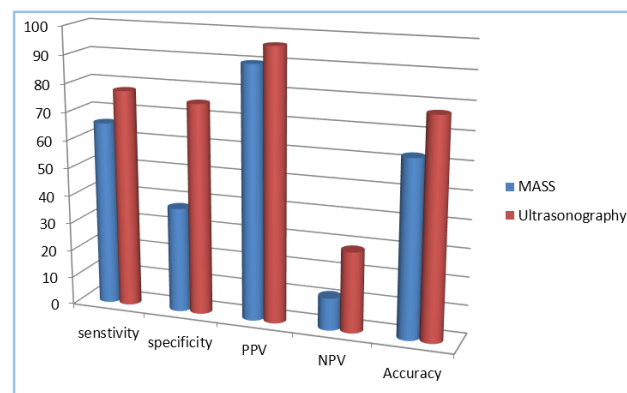


Fig. 1: Comparison of Results of Predictive Values of Ultrasonography versus MASS Scoring in Patients of Acute Appendicitis

DISCUSSION

This study was conducted to assess the predictive value of ultrasonography and MASS scoring systems to assist and improve the diagnosis of acute appendicitis. Ultrasonography is an affordable, non-invasive tool whose result can be obtained more quickly. Ultrasound has already been proved to have a high sensitivity and specificity in the diagnosis of acute appendicitis. Many data about this are available and 55% to 98% sensitivity and 78% to 100% specificity have been reported for ultrasonography. Variations in reported data may be due to differences in study design, sample size, physician experience or applied statistical techniques of various studies. Ultrasound is an operator-dependent technique and the results vary depending on who is performing the ultrasonography.

In our study ultrasound had 77.6% sensitivity, 75.0% specificity and 77.3% accuracy. Comparing this study with others reveal that ultrasound provides reliable findings for the diagnosis of acute, even though it is done by radiology residents without much experience. The PPV of ultrasonography was 96.2% and the NPV was 28.7%. These results emphasize again that a positive ultrasonography for appendicitis is strongly in favour of a diagnosis of acute appendicitis. However, a negative ultrasound is not sufficient to rule out the diagnosis and discharge the patient.

The Modified Alvarado Scoring System is based on signs, symptoms and laboratory data. It is a very sensitive tool for classifying patients with suspected acute appendicitis. Making it more clinical oriented, the Modified Alvarado Scoring System (MASS), omitting the neutrophil count, has been used as a clinical predictor of acute appendicitis diagnosis. In our study, MASS had 65.67% sensitivity, 37.5% specificity and 62.6% accuracy.

The PPV of MASS was 89.79% and the NPV was 11.5% comparing this study with ultrasonography reveals that ultrasound provides reliable findings for the diagnosis of acute as compared to MASS, even though it is done by radiology residents without much experience. The MASS has been shown to be a quick and inexpensive diagnostic tool in patients suspected of suffering acute appendicitis in clinical settings. However, different accuracies have been reported for the MASS in different studies.

CONCLUSION

Decision-making in patients suspected of having acute appendicitis is still a diagnostic challenge worldwide despite the advances in appendiceal surgery and the decrease in mortality because of appendicitis. According to some articles, negative appendectomy has been reported in 15% to 30% of appendectomies, because of difficulties in making the diagnosis. This can impose a significance burden on the health system.

Ultrasonography and Modified Alvarado Score are both beneficial in diagnosis of acute appendicitis. Though Ultrasonography is operator dependent, it has reasonable sensitivity and specificity in diagnosis and superior diagnostic tool as compared to MASS scoring.

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