

Original Research Article

A clinicopathology study to establish the accuracy of diagnosis of acute appendicitis in case of acute right lower quadrant pain of abdomen

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ABSTRACT

Background: Acute appendicitis, one of the most common surgical emergency is also one of the most challenging surgical dilemma for every surgeon, both in diagnosis and treatment. A negative exploration on one hand has to be weighed against the risk of subsequent perforation during expectant management especially in doubtful cases. We conducted a study to find out if diagnosis by scoring systems and graded ultrasonography improves clinical outcomes for patients with suspected appendicitis.

Methods: It was a prospective and observational study including 52 patients of clinically suspected acute appendicitis presenting in the surgical emergency. All patients underwent clinical scoring using Alvarado scores and Ohmann's score and Ultrasonography. Later, based on the intra operative findings and histopathological diagnosis of acute appendicitis, the sensitivity, specificity, positive predictive value and negative predictive value were calculated individually and by combining the scoring systems and imaging together.

Results: The sensitivity, specificity, PPV and NPV of ultrasonography when combined with scoring systems (both Alvarado and Ohmann's) is increased significantly as compared to when used individually for diagnosis of acute appendicitis. As calculated by our study, the sensitivity of USG was 90.32%, specificity 80.95%, PPV 87.5%, NPV 85% and diagnostic accuracy of 86.54% which has been comparable with the other studies in the previous literature.

Conclusions: Combination of scoring systems with Ultrasonography leads to the prompt diagnosis and early treatment of many cases of appendicitis. Hence, improving clinical outcomes in doubtful cases.

Keywords: Alvarado scores, Appendicitis, Ohmann's score

INTRODUCTION

Acute Appendicitis is one of the commonest surgical emergencies that require a prompt diagnosis in order to minimize morbidity and avoid serious complications. There is an evident inclination amongst surgeons to operate when the diagnosis of acute appendicitis is probable rather than wait until it is certain.¹ In this process of making an accurate clinical diagnosis of this condition, identification of patients who require immediate surgery as opposed to those who will get benefit from active observation is not always easy.² Depending on various demographic groups, a clinical

decision to operate leads to removal of a normal appendix in 15% to 30% cases.³ Though some of the cases of acute appendicitis may resolve spontaneously, the number of "non-therapeutic operations should not be achieved at the expense of an increase in the number of complications including abscess formation and perforations."⁴

For solving this 'surgical dilemma' various diagnostic aids and scoring systems have been devised to aid decision making in doubtful cases. There have been claims that these aids can dramatically reduce the number of appendectomies in patients without appendicitis, and the days of hospitalization. The various aids described in

reaching an accurate diagnosis and deciding surgical intervention in such cases include scoring systems, ultrasonography, computed tomography, computer programs, magnetic resonance imaging and laparoscopy.⁵⁻¹² Of these imaging techniques have been shown to have an edge in accurately diagnosing this condition with ultrasonography being a modality which is cheap, easily available, noninvasive and with virtually no side effects. Graded ultrasonography has been reported to have an accuracy of 71 to 95%.¹³ There always have been arguments favoring clinical skills and scoring methods based over ultrasonography especially in patients with high probability of appendicitis.¹⁴

Several scoring methods have been devised to aid decision making in doubtful cases, including, Alvarado, Ohmann's and several others.¹⁵⁻¹⁷ These scores utilize routine clinical and laboratory assessment, thus being simple to use in a variety of clinical settings. The various scoring systems with their sensitivity and specificity offer a sound judgment in deciding which patients require operative measures. We initially designed a protocol incorporating the major clinical scores including Alvarado and Ohmann with ultrasonography on the basis of work in our institution. We then conducted a prospective observational study to see whether the various tests and their combinations were accurate enough to differentiate patients with acute appendicitis from those with a non-inflamed appendix as confirmed later by histopathology studies of the resected specimen.

METHODS

Study 52 cases of clinically suspected acute appendicitis were selected for this study admitted to the surgical casualty of Seth G. S. Medical College and KEM Hospital Mumbai. Patients were selected from both sexes of different socio-economic background with selection done randomly. Age less than 12 years, evidence of generalized peritonitis, palpable mass in the right iliac fossa, evidence of acute confusional state or dementia were excluded. Patients were explained about the study and an informed vital consent about the whole process was taken.

Clinical scoring

A detailed history was elicited with due consideration to age, sex, the presenting symptoms, especially the history of migratory pain to right lower quadrant, anorexia, nausea, and vomiting or urinary symptoms. Measurements of body temperature were done. All patients underwent a thorough clinical examination, specially eliciting tenderness in the right iliac fossa, rebound tenderness in the right iliac fossa, involuntary muscular tension. Routine blood examination including hemoglobin, total and differential leukocyte counts, platelets, renal and liver function tests were conducted. Depending upon clinical details and routine blood investigation, every patient was allotted modified

Alvarado score and Ohmann's score. An ultrasonography was also done for all these patients.

Ultrasonography

All the 52 patients in this study had graded compression ultrasonographic evaluation using linear array transducers according to the situation. The normal appendix is compressible with a wall thickness of less than or equal to 3mm. the sonographic hallmark of appendicitis is a 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.¹⁸

The usual findings to diagnose acute appendicitis were

- Visualization of the non-compressible appendix as a blind-ending tubular a peristaltic structure
- Target appearance of more than equal to 6 mm in total diameter on cross section/ maximal mural wall thickness more than or equal to 2mm
- 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.

All these patients underwent the operative procedure of a laparotomy or laparoscopy where suspected appendicitis had an appendectomy. Intraoperatively findings were recorded including position, width, and length of the appendix. The gross appearance of the appendix including the presence of inflammation, obstruction, gangrene and perforation. Other findings including appendicolith were also recorded. Histopathology examination of all the resected specimens was done for tissue diagnosis of appendicular inflammation which was confirmed on the basis of infiltration of the muscular propria by neutrophil granulocytes. Patients were also followed up in their post-operative course.

RESULTS

The total no of cases in this study were 52 of which 28 were males and 24 females. Of all the patients who underwent appendicectomy, 31 (59.62%) were histologically positive for acute appendicitis and 21 (40.38%) were histologically negative (Table 1). All the patients were assigned modified Alvarado score, among which 36 (69.23%) were positive (>7) and 16 (32.69%) were negative. All the patients were assigned the Ohmann's score among which 29 (55.77%) were positive (>12) and 23 (44.23%) were negative (<11). All the patients also underwent ultrasonography of which 32 (61.54%) were positive and 20 (38.46%) were negative.

Table 1: Patients according to histopathology.

| Characteristics | Histopathology positive (n= 31) | Histopathology negative (n=21) |
|-------------------|---------------------------------|--------------------------------|
| Age in years | 14-52 | 17-57 |
| Male | 22 | 6 |
| Female | 9 | 15 |
| Alvarado positive | 28 | 8 |
| Alvarado negative | 3 | 13 |
| Ohmann's positive | 25 | 4 |
| Ohmann's negative | 6 | 17 |
| USG positive | 28 | 4 |
| USG negative | 3 | 17 |

As per the symptomatology, the presenting symptoms was a pain in the right lower quadrant of the abdomen in all 52 cases. Shifting pain to RIF was seen in 42 cases (80.77%). Other symptoms complained by the patients were anorexia 44 cases (84.62%) nausea and vomiting 27 cases (55.77%). Regarding signs, tenderness in right lower quadrant was found in 49 cases (94.23%) and rebound tenderness was seen in 40 cases (76.92%). Total

leucocyte count was found to be more than $10 \times 10^9/L$ in 38 cases (73.08%).

DISCUSSION

Scoring system analysis

As pre-the scoring systems used, Alvarado score of >6 was present in 69.23% and 7.7% had a score of less than equal to 4. Among the 36 cases of positive Alvarado score (>7), 28 were histopathologically positive and only 8 were negative. But, among 16 cases of negative Alvarado score (<7) 13 cases were histologically negative and only 3 cases were histologically positive. It gave a sensitivity of 90.32%, specificity of 61.90%, positive predictive value (PPV) of 77.78%, Negative predictive value (NPV) of 81.25% and diagnostic accuracy of 78.85% which was very much consistent with the previous studies (REF).¹⁸ In fact, our study has shown better sensitivity, as it is a prospective study and shortcomings of retrospective studies are ruled out. Modified Alvarado scoring system is a dynamic one, allowing observation and critical evaluation of the clinical picture.^{19,20}

Table 2: Comparison of modified Alvarado score, Ohmann's score Ultrasonography in the diagnosis of acute appendicitis.

| Values | Modified Alvarado score (%) | Ultrasonography (%) | Ohmann's (%) | Modified Alvarado score+ ultrasonography | Ohmann's score +ultrasonography |
|---------------------|-----------------------------|---------------------|--------------|--|---------------------------------|
| Sensitivity | 90.32 | 90.32 | 80.65 | 96.3 | 92.31 |
| Specificity | 61.90 | 80.95 | 80.95 | 100 | 88.24 |
| PPV | 77.78 | 87.5 | 86.21 | 100 | 92.31 |
| NPV | 81.25 | 85 | 73.91 | 90 | 88.24 |
| Diagnostic accuracy | 78.85 | 86.54 | 80.77 | 97.22 | 90.69 |

Table 3: Comparing the different scoring methods and ultrasonography in the diagnosis of appendicitis.

| Scoring system | Total positive | Total negative | False positive | False negative |
|-------------------------|----------------|----------------|----------------|----------------|
| Modified Alvarado score | 28 | 13 | 8 | 3 |
| Ohmann's score | 25 | 17 | 4 | 6 |
| Ultrasonography | 29 | 17 | 4 | 3 |

Ohmann et al, performed a multivariate analysis, and of initial 15 parameters, 8 were included in the regression model, resulting in different values being attributed to each parameter. Patient with scores 6 or more should undergo observation and those with score 12 or more should proceed to immediate appendectomy.²¹ In this study (Table 3) 29 cases (55.77%) were positive Ohmann's score (>12) and 23 cases (44.23%) were negative (Ohmann's <11). Majority i.e. 18 cases (34.62%) had Ohmann's score of 12 to 14: only 3 cases (5.77%) had a score <6 . Among 29 cases (positive Ohmann's score) histopathologically positive was 25 and

only 4 cases were histopathologically negative. But among 23 cases (negative Ohmann's score) only 6 cases were histopathologically positive and 17 cases were histopathologically negative. In our study (Table 2), the Ohmann's score yielded sensitivity of 80.65%, specificity 80.95%, PPV 86.21%, NPV 73.91% and diagnostic accuracy of 80.77%.

Ultrasonography analysis

Out of the total 52 patients in our study, appendicitis was diagnosed by ultrasonography in 32 patients (61.54%).

Among them, appendicitis confirmed in 28 patients (87.5%) on histopathological examination and only 4 cases (12.5%) were histopathologically negative. but among the 20 sonographically negative cases, 17 patients (85%) were histologically negative and only 3 patients (5%) were histologically positive. As calculated by our study, the sensitivity of USG was 90.32%, specificity 80.95%, PPV 87.5%, NPV 85% and Diagnostic accuracy of 86.54% which has been comparable with the other studies in the previous literature.²²

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. In our study both the specificity and the negative predictive value were 100% when both Alvarado scoring system and ultrasonography was used together. This hence proves ultrasonography has an adjunct value in suspected cases of acute appendicitis.

Similarly, it was seen that when ultrasonography was used along with Ohmann's score, the sensitivity, specificity, positive predictive value and diagnostic accuracy were all increased. The increase in all the test parameters when the scoring system and USG are used together than used individually have been compared.

Follow up

Patients were followed up for a period ranging from 2 to 7 months. No significant complication was detected in any of the patients.

CONCLUSION

Our study showed that when any of the two scoring systems i.e. modified Alvarado score and Ohmann's score was used along with USG, it increased the sensitivity, specificity, PPV, NPV, diagnostic accuracy and reduced the negative appendectomy rates. So, the combination of a scoring system with ultrasonography is very helpful to correctly diagnose acute appendicitis in patients presenting with acute right lower quadrant pain of abdomen.

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