

DIAGNOSTIC ACCURACY OF CLINICAL EXAMINATION VERSUS COMBINATION OF ABDOMINAL ULTRASOUND AND ALVARADO SCORE, IN PATIENTS WITH ACUTE APPENDICITIS

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ABSTRACT

Objective: To compare the diagnostic accuracy of clinical examination with that of a diagnostic protocol consisting of ultrasound and Alvarado score in patients with acute appendicitis.

Material and Methods: A study comparing clinical diagnosis (control group) with a diagnostic protocol incorporating Ultrasound and Alvarado score (intervention group) was conducted in surgical A ward Lady Reading Hospital from February 2004 to March 2006. Total of 308 patients with suspected acute appendicitis were considered for the study. 158 patients were randomized to control group and 150 patients to intervention group. Alvarado scoring system assessed all of 150 patient of the intervention group and 130 of these patients underwent ultrasound. The main out come measured were, time to operation, hospital stay, any adverse out come, negative appendicectomy and delayed operation leading to perforation.

Results: Sensitivity and specificity of ultrasound and Alvarado scoring system were 97.91% and 75%, respectively. Patient in intervention group who underwent therapeutic operation had a significantly shorter mean time to operation than the patients in the control group (6.9 Vs 10.1 hours).

There were no difference between groups in mean duration of hospital stay (61.3 Vs 62.5 hours), proportion of patients undergoing non therapeutic operations (1.33% Vs 4.33%) or delayed treatment in association with perforation of the appendix (3.33% Vs 11.9%).

Conclusion: Ultrasound and the Alvarado scoring system is a diagnostic tool that leads to an early diagnosis and rapid surgical treatment of acute appendicitis. However it does not prevent complications or reduce the length of hospital stay.

Key words: Appendicitis, Diagnosis, Alvarado score, Clinical examination, Ultrasound.

INTRODUCTION

Acute appendicitis is a common surgical emergency, needing early diagnosis and prompt surgical treatment to prevent complications. It is for these reasons that some surgeons prefer to operate when the diagnosis is probable than certain¹. Clinical signs and symptoms are the important tools. Radiological investigations have also been used for its diagnosis. In some studies, Alvarado scoring system or its modification the MASS (modified Alvarado scoring system) is helpful in minimizing unnecessary appendectomies.²

According to some studies if the abdominal signs are sufficiently clear to indicate

peritonism in the right iliac fossa in elderly and in female of reproductive age there is little to be gained from Ultrasonography. Laparoscopy is then said to be a better preliminary investigation proceeded by surgical intervention as appropriate.³

The incidence of removing a normal appendix differs in certain demographic groups but is in the range of 15% to 30%¹. This can be reduced by observing equivocal cases for a period of time, a practice that is safe for most of the cases². Some cases of appendicitis may resolve spontaneously.^{3,4}

However this period of observation may result in perforation of appendix that is avoidable, therefore diagnostic accuracy should not be achieved at the expense of an increase in the

OUT COME MEASURES BY PERCENTAGE

S. No	Parameter	Intervention group	Control group
1	No of male patients. Mean age in years	102 20.6	97 20.1
2	Alvarado score Mean score. No(%) with score > 6	7.18 67(44.67%)	6.93 72(45.57%)
3	Hospital data Total No(%) of operations No(%) of therapeutic operations	106(70.66%) 100(66.66%)	122(77.22%) 95(60.13%)
4	Mean time to therapeutic operation (in hrs)	6.9	10.1
5	Mean duration of stay (in hrs)	61.3	62.5
6	No(%) of non therapeutic operations	2(1.33%)	7(4.43%)
7	No(%) with delayed treatment and perforation	5(3.33%)	3(11.91%)
8	Total adverse outcomes (delayed treatment in association with perforation and non therapeutic operations)	7(4.67%)	10(6.33%)

Table 1

number of perforations.⁵

Diagnostic pitfalls in acute appendicitis can be dramatically reduced by Imaging techniques that are of particular value⁷. Ultrasound and Alvarado scoring system is the least expensive and invasive of these and has been reputed to have an accuracy of 71% to 95%⁸ However ultrasound should not supercede the clinical judgment in patients with a high probability of appendicitis⁹. Alvarado score alone is inadequate as a diagnostic test^{9,10}. The objective of this study is to compare the diagnostic accuracy of clinical examination with that of a diagnostic protocol consisting of ultrasound and Alvarado scoring system in patients with acute appendicitis.

MATERIAL AND METHODS

All patients presenting to general out door patient department and casualty with a provisional diagnosis of acute appendicitis were selected for the study. They were then divided into intervention and control groups. The randomization sequence was obtained by card allocation. This was a simple procedure and the patient picked up one of the two envelopes. Each envelope carried one card on which either "intervention group" or "control group" was written. Exclusion criteria was age less than 5 years, peritonitis, mass RIF and acute cofusional state or dementia. A structured clinical assessment was done, from which Alvarado score was calculated. For patients in control group diagnosis making was proceeded with appropriate clinical assessment and management. Ultrasound and Alvarado scoring were not done in these patients. For patients in intervention group,

Alvarado scoring was done. Ultrasound was then organized if Alvarado score was between 4 and 8, inclusive. An Alvarado score of 9 or 10 was taken as an indication for surgery and ultrasound was considered optional. Patients with an Alvarado score of 3 or less were not considered for ultrasound. The result of ultrasound was labeled as:-

Positive. Appendix identified, tender and non-compressible or appendiceal phlegmon or abscess seen.

Negative. Appendix not identified and no other relevant abnormality seen.

Equivocal. Appendix not identified but abnormal amount of free fluid seen with thickened, dilated or non-peristaltic bowel in the region of right iliac fossa.

Ultrasound was not available between 10 PM and 8 AM, and these patients has had their ultrasound done at around 10am in the morning, unless the admitting surgeon deemed an urgent operation to be necessary.

Operation was considered therapeutic if appendix was inflamed on nacked eye appearance (latter confirmed by histological examination). All other operations were classified as non-therapeutic operations. Appendix was considered to be perforated if the surgeon clearly identifies a perforation or if gangrene or full thickness necrosis was present on histopathological examination. Patients were considered to be delayed if operated after 10 hours of randomization and perforation of appendix found at operation.

SUBGROUP ANALYSIS BY AGE

S. No	Parameter	Intervention group	Control group
1	Adults > 14 years No of patients.	100	110
2	Mean time to therapeutic operation (in hrs)	7.1	9.7
3	Mean duration of stay in hospital (in hrs)	60.1	59.2
4	No(%) of non therapeutic operations	1(1%)	3(2.73%)
5	No(%) with delayed treatment and perforation	3(3%)	2(1.82%)
6	Total adverse outcomes (delayed treatment in association with perforation and non therapeutic operations)	4(4%)	5(4.55%)
	Children 6-14 years		
1	No of patients	50	48
2	Mean time to therapeutic operation (in hrs)	6.7	10.5
3	Mean duration of stay in hospital (in hrs)	45	40
4	No(%) of non therapeutic operations	1(2%)	4(8.33%)
5	No(%) with delayed treatment and perforation	2(4%)	1(2.08%)
6	Total adverse outcomes (delayed treatment in association with perforation and non therapeutic operations)	3(6%)	5(10.42%)

Table 2

Follow up was arranged at 3 weeks and 3 months. The diagnostic accuracy of ultrasound and Alvarado scoring system was assessed by the following four outcome measures. The main outcome measured were, time to operation, hospital stay, any adverse outcome, negative appendectomy and delayed operation leading to perforation.

RESULTS

A total number of 312 patients were referred for inclusion. Two patients fail to meet the inclusion criteria and two patients refused consent, thus 308 patients were enrolled for the study, with 150 in the intervention group and 158 in the control group.

The mean age was almost equal in both groups. (20.6 Vs 20.1 in intervention and control

group respectively). 98 patients were between 6 to 14 years and 210 patients were 14 years and above. There was little difference between groups with respect to sex, mean Alvarado score or proportion with Alvarado score greater than 6.

Table-1 summarizes the outcome measures by percentages. Subgroup analysis by age is shown in table 2.

Ultrasonography

Ultrasound was performed in 130 patients (Table No 3). The sensitivity and specificity of ultrasound for diagnosing appendicitis was 97.91% and 75% respectively. There were 2 false negative results. 6 patients with a positive or equivocal result on ultrasound recovered without surgery.

Surgery

RESULTS OF ULTRASOUND WITH ALVARADO SCORE AND ITS SENSITIVITY* AND SPECIFICITY* FOR DIAGNOSIS ACUTE APPENDICITIS

Results	Appendicitis H/P confirmed	Not appendicitis Histopatology confirmed	Not operated	Total
Positive or Equivocal	94	2**	6	102
Negative	2	6***	20	28
Total	96	8	26	130

*Sensitivity 97.91%

*Specificity 75%

*Calculation based on histopathology proven cases

**Both equivocal reports and both had typhoid ileal perforations.

*** Non therapeutic operations.

Table 3

PATHOLOGICAL FINDING AT SURGERY FOR THERAPEUTIC OPERATIONS IN PATIENTS WITH SUSPECTED APPENDICITIS, ACCORDING TO ALLOCATION TO DIAGNOSIS WITH ULTRASOUND AND ALVARADO SCORE OR CLINICAL DIAGNOSIS ONLY.

S.No	Pathological Findings	Intervention Group	Control Group
1	Appendicitis	96 (90.56%)	85 (69.67%)
2	Typhoid enteric perforation	2	0
3	Iliocaecal tuberculosis	2	0
4	Perforated meckel's diverticulum	1	0
5	Omental infarction	1	0
6	Acute cholecystitis	0	2
7	Mid gut valvulous	0	1
8	Ectopic pregnancy	0	2
9	Twisted right sided ovarian cyst	0	2
10	Mesenteric lymphadenitis	0	2
11	Tubo-ovarian abscess	0	1

Table 4

Total number of 228 operations were performed. 106 of 150 in intervention group underwent surgery as compared to 122 of 158 in control group. (70.67% Vs 77.22%).

Appendicitis was confirmed histologically in 181 patients, 96 in the intervention group and 85 in the control group. (90.56% Vs 69.67%).

There were 16 patients with other conditions that met the criteria for a therapeutic operation. (Table No 4) Nine operation were non-therapeutic, 2 in the intervention group and 7 in the control group.

Perforations

22 patients had perforations, 15 had a perforated appendix (of all cases of appendicitis) and 3 had other bowel perforations.

Delayed treatment in association with perforation: Eight patients had perforated appendicitis (4.41%) and two had other bowel perforations. Of all the perforation 5 were in the intervention group and 3 were in the control group.

Follow up

There was no readmission for appendicitis, in patients discharged un-operated during the follow up period.

Two complications were noted, one in the intervention group for drainage of a subcutaneous abscess in the scar and one in the control group for sub acute intestinal obstruction.

DISCUSSION

Acute appendicitis is a common cause of abdominal pain for which a prompt diagnosis is rewarded by a marked decrease in mortality and morbidity.¹¹ The addition of scoring system^{2,12,13} and imaging modalities^{3,14,6} markedly reduce the negative appendectomy rate. The role of histopathological examination of the removed appendix is to prove the diagnosis beyond any doubt.⁴ In our study all patients diagnosed as acute appendicitis on ultrasound and Alvarado score proved to have the same diagnoses on histopathology. Patients in whom the diagnosis was in doubt were observed for a day or night, this approach is especially useful in children presenting with pain abdomen.^{5,15} These patients can then be subjected to further diagnostic investigations like laparoscopy^{16,17}, other scoring systems^{1,12,13,26}, computer programs¹⁸, ultrasound^{14,15,19}, computer tomographic scanning²⁰, magnetic resonance imaging^{21,22}, Transvaginal ultrasonography²³ etc to reach to a proper diagnosis. Patients who were diagnosed as appendicitis on ultrasound and Alvarado score, under went an immediate operation i.e. within 10 hours of admission. The diagnostic accuracy of ultrasound and Alvarado score was 96.15%, whereas its sensitivity and specificity was 97.91% and 75% respectively. The Equivocal cases on routine abdominal ultrasonography, although needing an operation (typhoid ileal perforations) were not having appendicitis. In such cases the addition of graded compression ultrasound provides a highly accurate, specific and sensitive test.¹⁴ Adding ultrasound and Alvarado score thus significantly reduce mean time to therapeutic operation (6.9 hours Vs 10.1 hours). Combination

of trans-vaginal ultrasound in particular provides an opportunity to distinguish between appendicitis and acute pelvic inflammatory diseases in females.²³

In a study there was no statistical difference between the emergency medical residents and the general surgery residents in terms of suspecting the diagnosis of appendicitis.²⁵ However when this is added with ultrasound and Alvarado score in addition to clinical examination as in our study, there is a decrease in time to therapeutic operation and the incidence of adverse outcomes in terms of delayed treatment and perforation (3.3 Vs 11.9%)²⁴. However it has no effect on the reduction of hospital stay (61.3 hours Vs 62.5 hours). The accuracy of ultrasound and Alvarado score in our study was found to be 93%, equal to computed tomography without contrast.²² However magnetic resonance imaging is said to be superior to sonography in revealing suspected acute appendicitis in cases with sub optimal or non-diagnostic sonography.²¹ The number of non-therapeutic operation are also less in intervention group as compared to control group (1.33% Vs 4.43%). In an other study a relatively high rate of non therapeutic operation rate was observed in both intervention and control groups²⁶ (8.1% Vs 10.6% respectively). This may be because of the fact that Alvarado score alone was used in the intervention group and no ultrasound was done.

Some cases of appendicitis may resolve spontaneously.^{4,27} However this period of observation may result in perforation of appendix that is avoidable. Therefore diagnostic accuracy should not be achieved at the expense of an increase in the number of perforations.⁵ This can be avoided by seeking the help of senior consultants to examine these patients, as eliciting clinical findings and experience remain of major importance in appendicitis diagnosis.²⁸ We have found little difference in the number of perforation associated with delayed treatment (4.67% Vs 6.33%). Two patients had a non-therapeutic operation after a negative ultrasound report. If surgeon had relied on the ultrasound, these unnecessary operations would have been avoided. On the other hand 2 patients, who were given negative reports of ultrasound were found to have perforated gangrenous appendix. Had ultrasound been relied on, these patients would have had an indefinite delay in treatment.

Alvarado score can be used as an objective mean of sorting patients according to risk so that unnecessary ultrasound could be avoided at the extreme of Alvarado score.²⁹

Our diagnostic protocol incorporating ultrasound and the Alvarado Score was, if any

thing, safer, faster and more accurate than clinical examination alone.

Looking at the false negative results of ultrasound in the intervention group, patients cannot be safely sent home after a negative result, unless there are also clinical grounds for their discharge. Such patients should be further investigated with computer tomographic scan^{30, 31} and diagnostic laparoscopy.¹⁹

CONCLUSION

Ultrasound and Alvarado score is an accurate combination that leads to an early diagnosis and rapid surgical treatment of acute appendicitis. However it does not prevent complications or reduce the length of hospital stay

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