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Role of modified alvarado score system and ultrasonography in diagnosis of acute appendicitis

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Abstract

Background: Appendicitis is most common surgical emergency encountered in emergency department if not managed carefully leads to complication like perforation which may increase morbidity and mortality. Different modalities including scoring system and imaging study are used in diagnosis of appendicitis. Management including diagnosis of Acute appendicitis , decision of surgery is very crucial and important to avoid negative exploration.

Methods: The present study was observational descriptive type of prospective study conducted in department of general surgery, Dr. S.N. Medical College & Associated Hospitals along with 110 patients over duration 18 months with aims to compare and evaluate modified Alvarado score and ultrasonography with correlation to histopathology report for diagnosis of acute appendicitis and to reduce negative exploration of abdomen.

Results: Maximum number of patients were male (57%) compared to female (43%). There were 110 patients were operated and histopathological proved appendicitis was present in 108 (98.2%) patients. There were 2 patient had healed appendix on histopathology. Negative exploaration rate was 1.82%. In our study Sensitivity, Specificity, PPV,NPV of modified Alvarado score was 87.85%, 100%, 100% ,18.75% and of ultrasonography was 95.37%, 100%,100%,25.7%. When combining the modified Alvarado score & Ultrasonography findings in diagnosis of acute appendicitis p value=0.032 which was statistical significance.

Conclusion: Ultrasonography is operator dependent and has reasonable sensitivity and specificity in diagnosis. Modified Alvarado score cut off 7 has more sensitivity and specificity. When combining two modalities, sensitivity and specificity in diagnosis of

acute appendicitis is increased as well as decrease rate of negative exploration.

Keywords: Appendicitis, Modified Alvarado score , Ultrasonography

Introduction

Acute appendicitis is one of the most common surgical emergencies and if not managed carefully can lead to appendiceal perforation and peritonitis, which are associated with high mortality and morbidity[1]. The decision for a surgical operation based only on the patient's signs and symptoms results in removing normal appendices (negative appendectomy) in 15% to 30% of cases.[2-4] The rational approach is to decrease the negative exploration as well as appendiceal complications rates. A decrease in negative exploration should not cause an increase in perforation rates[5,6]. For this reason, a number of diagnostic modalities have been proposed, including clinical scoring systems, ultrasonography, CT scans and diagnostic laparoscopy[7-9]. Imaging techniques are fairly accurate[10,11]. Graded compression ultrasonography is an inexpensive, fast and noninvasive method with an accuracy rate of 71%–90% for the diagnosis of acute appendicitis[12-14], but there is no certainty about the effect of ultrasonography on the clinical outcomes of patients [13-15]. Furthermore, clinical judgment should not be abandoned because of the lack of ultrasound findings in patients with a high probability of acute appendicitis [16]. Also, ultrasonography is an operator-dependent modality, and the diagnostic values are different in various studies.[2.17-19] The likelihood of appendicitis is ascertained by the Alvarado Scoring System[20.] 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 leukocytosis and a left shift in the leukocyte count[14,20] patients who get a score of 7 to 10 should undergo appendectomy, and patients with a score of 5 or 6 are candidates for a CT scan for the diagnosis [14]. Taking into consideration that counting the white blood cell (WBC) differentials is not routine in many laboratories, the Modified Alvarado Scoring was developed by omitting the left shift of leukocytosis from the Alvarado Scale[21]. Therefore, we decided to evaluate the diagnostic value of the Modified Alvarado Scoring and the accuracy of graded compression ultrasonography in our setting for the diagnosis of acute appendicitis, comparing it with the gold standard of eventual pathology in order to obtain a combined efficacy of modified alavarado score and USG and also to assess the sensitivity and specificity of ultrasonography.

Methods

The present study was observational descriptive type of prospective study conducted in department of general surgery, Dr. S.N. Medical College & Associated Hospitals along with 110 patients over duration 18 months with aims to compare and evaluate modified Alvarado score and ultrasonography with correlation to histopathology report for diagnosis of acute appendicitis and to reduce negative exploration of abdomen. All patients presenting to the surgical emergency with pain in right lower quadrant of abdomen & strong suspicion of acute appendicitis were included in study. Each patient underwent detailed history about symptoms, previous surgery, and clinical examination including Modified Alvarado score. After clinical examination all patients underwent ultrasonography and finding like diameter of appendix, presence of appendicolith, fluid collection ,mesenteric lymphadenopathy were noted. Patients having Palpable lump in right iliac fossa, urological

problems, gynecological or surgical problems other than acute appendicitis were excluded from study. The diagnosis of acute appendicitis confirmed by operative findings and histological assessment of the appendicectomy specimen. All patients were managed by standard protocol postopervatively. All patients were analysed with modified Alvarado score, this was compared with ultrasonography finding and final histopathological report of excised appendix. The sensitivity, specificity, positive predictive value, negative value and diagnostic accuracy calculated and compared with each other. Yates continuity correction test, Chi square test, Fisher's exact test and Fisher Freeman Halton test were used for comparison of qualitative data. P Value < 0.05 was accepted as statistically significant.

Results

Table 1: Age & Sex Distribution of Patients

Age Group	Number of Patient		
	Male	Female	Total
0-10	02	01	03
11-20	15	17	32
21-30	24	15	39
31-40	11	06	17
41-50	04	03	07
>50	07	05	12
Total	63	47	110

Maximum number of patients in male were between age group of 21-30 years are 24(21%) and in female were between age group 11-20 are 17(15.5%). Youngest patient was 6 year old male and oldest was 82 years female.

Table 2: Presentation of Symptoms & Sign in Patients

Symptoms	No. of Patients	Percentage
Migrating Pain in RIF	110	100
Nausea / Vomiting	96	87
Anorexia	96	87
Tenderness	109	99
Rebound Tenderness	107	97.2
Elevated Temperature	46	41.8

Migrating pain was present in all patients(100%). Anorexia and nausea was present in 87%. Tenderness was present in 99% patients. Almost 42 % patients were febrile.

Table 3: Result of Exploration

Finding	Intra Operative (Macroscopic) Findings	Histopathological Findings	Percentage
Acute Appendicitis	110	108	98.18
Healed Appendicitis	00	02	01.82

There were 110 patients were operated and histopathological proved appendicitis was present in 108 (98.2%) patients. There were 2 patient had healed appendix on histopathology. Negative exploaration rate was 1.82%.

Table 4: Correlation between modified alvardo score and histopathological proved appendicitis

Score	Patients	Operated	Appendicitis
3	00	00	00
4	03	03	03
5	02	02	01
6	11	11	10
7	28	28	28
8	43	43	43
9	23	23	23
Total	110	110	108

Twenty eight patients, 43 patients,23 patients were operated with score of 7,8,9 respectively. In all patients we found histological proven appendicitis. In 2(0.01%) patients we found normal appendix which have score of 5and 6.

Table 5: Correlation between USG findings an histopathological prove appendicitis

No. of cases	USG Findings	Histopathological Diagnosis
103	Acute appendicitis	Acute appendicitis
04	Not visualize	Acute appendicitis
02	Normal abdominal scan	Healed appendicitis
01	Normal abdominal scan	Acute appendicitis

Normal scan was found in 3 patients out of them, 2 (66%) patients were found with normal appendix and 1(33%) patient with acute appendicitis. In 4 patients on ultrasonography appendix was not visualize, in all 4 (100%) patients we found acute appendicitis.

Table 6: Analysis of Findings Modified Alvarado Score and USG

Parameter	Sensitivity	Specificity	PPV	NPV	ODA
Modified Alvarado Score	87.85%	100%	100%	18.75%	88.18%
USG	95.37%	100%	100%	28.57%	95.45%

Table 7: Combined use of modified alvarado score and USG

Sn.	Modified Alvarado Score	USG Findings	No. of cases
01	04	Positive	02
		Negative	00
02	05	Positive	01
		Negative	01
03	06	Positive	09
		Negative	02
04	07	Positive	27
		Negative	01
05	08	Positive	40
		Negative	03
06	09	Positive	23
		Negative	00

Modified Alvarado score (9) is more likely to have positive findings of appendicitis in ultrasonograph

Discussion

Appendicitis is most common surgical emergency encountered in surgical emergency. Management including decision of surgery is very crucial and requires lot of experience. In the present study, 110 patients with right lower quadrant pain with suspected acute appendicitis were evaluated by clinical findings incorporating modified Alvarado score and ultrasonography finding. In this study 71 patients were between the age group of 11 to 30 years, out of them 32 patients were between the ages of 11 to 20 years.(Table 1) The youngest patient was 6 years old male and oldest was 82 years female. Majority of the studies have also reported and concluded that no age is exempted from acute appendicitis. Kazarian et al.[22] reported youngest patient was 2 years old and oldest was 90 years where as in our study youngest was 6 year old. Pieper and Kagar[23] in their epidemiological study observed that maximum numbers of patients (75%) were in second and third decade of life, out of 931 eases studied.

In our study, there were 63 males and 47 females, the ratio being 1.34:1. Similarly male preponderance was noted in studies by Collins[24] and Kazarian[22]. More strain and consumption of diet rich in proteins can be attributable facts for high incidence of appendicitis in male.

Pain was present in every patient (100%) while anorexia, nausea & vomiting were associated in 96 (87%) patients depicted in Table 2. In the present study, the duration of symptom varies from patient to patient. Chemel et al.[25] 1998 also reported that duration of symptoms varies from patient to the patient and irrespective of stage of inflammatory process (whether catarrhal, phlegmonous or gangrenous).

In the present study tenderness at McBurney' point and Rebound tenderness was present in 109 (99%) and 107(97%) patients respectively. John H. et al.[26] also emphasized that clinical examination and surgeons experience remains the most important factor in the diagnosis of acute appendicitis. Besides history and

clinical examination, WBC count may be helpful in making the diagnosis of acute appendicitis, though WBC count below 10000 does not exclude acute appendicitis. It is normally found that 95% of normal population has a WBC count between 9000 to 10000/cumm. According to our study, WBC count >10,000 was also supportive and helpful evidence in favor of acute appendicitis but not always definitive, as only 53 patients had TLC >10000 cells/mm^3. Despite the WBC count between 4000-10,000 cells/mm^3 in 57 patients, 55 (96.49%) patients were proved to have appendicitis on histopathological examination. Thus sensitivity and specificity of TLC as supportive evidence can never be 100%. Similarly, Bolton et al.[27] found that Leucocytosis was supportive of clinical diagnosis only in 61% with TLC >10000 and in 39% with TLC< 10000 of patients. So he concluded that Leucocytosis should not be used as the only diagnostic tool for acute appendicitis.

To correct the fallacies of clinical examination and laboratory investigations, many diagnostic scores have been advocated but most are complex and difficult to implement in a clinical situation. The Alvarado score, first described in 1986, is a simple scoring system that can be instituted easily in the outpatient setting. Alvarado A.[20] included the tenderness in right iliac fossa, leucocytosis and raised polymorphs in the score and gave two points to tenderness in RIF, leucocytosis and one point to raised polymorphs according to their diagnostic weight and stated that if Alvarado score is less than 5, the chances of acute appendicitis is less likely and if Alvarado score is 7 or more, the chance of correct diagnosis of acute appendicitis are more.

Alvarado scoring system was modified by Kalen M. et al. [9] and named it as modified Alvarado scoring system.(Table 8) Modified Alvarado scoring system removed one variable of “shift to left of neutrophil“ if modified Alvarado score is <5 the chances of acute appendicitis is less likely and if modified Alvarado score is 7 or more the chance of correct diagnosis of acute appendicitis are more.

Table 8: Modified Alvarado Score

Characteristics		Score
Symptoms	Migration of pain to RIF	1
	Anorexia	1
	Nausea/ Vomiting	1
	Tenderness in RIF	2
Signs	Rebound Tenderness and pain	1
	Temperature	1
Laboratory tests	Leukocytosis >10,000 WBC	2
Total Score		9

In the present study we found 3 patients with modified Alvarado score of 4. They were operated and all of them came out to have appendicitis on histopathology. Thirteen patients had score of 5-6 all were admitted for observation and regular re-evaluation. All patients were operated at the end of 24 hours of observations as their

symptoms persisted, appendicitis was proved histo-pathologically in 11 patients thus gave 11 false negative results.

In 94 patients, the Alvarado score was found to be 7 or more. All were admitted and underwent appendicectomy. Histopathological reports showed that 94 patients had appendicitis. The predictive value of Alvarado score of 7 or more for the diagnosis of acute appendicitis was 100%. Similarly Ikramulhah Khan[28] also reported that predictive value of Alvarado score of 7 or more for the diagnosis of acute appendicitis was 86.5%. Chan et al.[29] found that predictive value of Alvarado score of 9-10 for the diagnosis of acute appendicitis was 100%. In our study Sensitivity of modified Alvarado score was 87.85%, specificity was 100%, positive predictive value was 100% and negative predictive value was 18.75%.

In our study USG alone had a sensitivity of 95.37% and specificity of 100% in the diagnosis of acute appendicitis. Similarly Douglas et al [30] reported the sensitivity and specificity being 94.7% and 88.9% respectively. Skaane et al [31] also found that sensitivity and specificity of USG was 78% & 92% respectively.

The histopathological examination report in present study show acute inflammatory changes in 108 patients. Polymorphonuclear leucocytic infiltration of lamina propia was a constant association in cases of acute appendicitis. In our study, when combining the modified Alvarado score & Ultrasonography findings in diagnosis of acute appendicitis, sensitivity of both were 87.85% & 95.37% and specificity were 100% & 100% respectively and p value=0.032 which was statistical significance depicted in Table 6.

It would be more precise if we could include all patients suspected of having acute appendicitis and follow up those patients who did not undergo surgery. Moreover, we intended to have the pathology result of the resected appendix for the definite diagnosis. The estimated rate of negative appendectomy in our study was 1.82%, which is less than the accepted rate worldwide. We cannot make judgments about this rate until we have studied the perforation rate. Follow up and larger sample size is needed to estimate the precise negative appendectomy rate.

Conclusion

Modified Alvarado Score and Ultrasonography are both beneficial in diagnosis of acute appendicitis. Ultrasonography is operator dependent and has reasonable sensitivity and specificity in diagnosis. Modified Alvarado score cut off 7 has more sensitivity and specificity. When combining two modalities, sensitivity and specificity in diagnosis of acute appendicitis is increased as well as decrease rate of negative exploration.

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