

A STUDY ON DIAGNOSTIC UTILITY OF MODIFIED ALVARADO SCORING SYSTEM AND ULTRASONOGRAPHY FOR ACUTE APPENDICITIS AND THEIR CORRELATION WITH HISTOPATHOLOGY

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Abstract

Acute appendicitis is one of the commonest causes of appendicitis and is often and mainly diagnosed based on clinical examination. Diagnostic tools like ultrasonography (USG) and various scoring systems based on clinical and laboratory investigations are increasingly used in order to improve the accuracy of diagnosis and lower the chances for false negative reports on appendicectomy. Modified Alvarado Scoring System (MASS) is one of the commonest used scoring modalities for acute appendicitis in the present times. The present study is an attempt to investigate the diagnostic utility of MASS by confirming the results by USG and histopathological findings.

The study was conducted in the department of Surgery, Heritage IMS, Varanasi, from May 2018-June 2020. All 80 patients were categorised into three groups namely Group A, Group B and Group C based on MASS. These patients were subjected to USG followed by appendicectomy. Surgically removed appendices were taken up for histopathology examination. The results were tabulated and descriptively analysed.

The MASS was 1-4, 5-6 and 7-9 in 7.5%, 15% and 77.5% of patients respectively. The most common symptom was migratory pain (91.5%) followed by tenderness (87.3%) and nausea or vomiting (81.5%). On histopathological examination 8.7% of removed appendix were found to be normal. The MASS is used extensively with a sensitivity and specificity of 95.1% and 78.9% while for USG it was found to be 90.1% and 63.1% respectively. The positive predictive values for MASS and USG were 93.5% and 90.1% while negative predictive values were respectively 61.1% and 63.2%.

Alvarado scoring system is simple and easy non-invasive diagnostic tool to diagnose acute appendicitis, which together with USG increases the diagnostic accuracy and decreases the rate of false positive cases to be taken up for appendicectomy.

Keywords: Appendicitis, Scoring system, Ultrasonography, Histopathology

Introduction

Vermiform appendix, otherwise being considered a vestigial organ^a, is associated with several pathological conditions of which acute appendicitis necessitates emergency surgery. The overall incidence of appendicitis worldwide is about 1.17 individuals per 1000 with 8.6% and 6.7% of lifetime risks among males and females respectively [1].

Variation in the appendix position, patients' age and the degree of inflammation contributes to inconsistent clinical presentation in patients [1], despite advancement in imaging and laboratory techniques. Currently, the commonly practiced aids for the diagnosis of acute appendicitis include ultrasonography (USG) , various scoring systems , laparoscopy and CECT abdomen [4]. But the accurate diagnosis of acute appendicitis still remains a challenge to most of the surgeons, as 50% cases of acute appendicitis manifest with atypical symptoms [5]. Misdiagnosis and surgical delay on the other hand, may lead to perforation and peritonitis. Available statistics state that one out of five cases of acute appendicitis is wrongly diagnosed accounting for 40% of patients undergoing appendicectomy for a normal appendix [6].

Several scoring systems are devised to assist in diagnostic accuracy of acute appendicitis and such scoring criteria are shown to reduce the rate of negative appendicectomy (NAR) to 5-10% [7]. One of the most widely preferred scoring systems for diagnosis of acute appendicitis is Alvarado scoring system. Developed in 1986 by Alfredo Alvarado, this scoring system is based on three basic factors viz; patient history, laboratory investigations and clinical examinations. Alvarado score (Table1) is generated based upon the eight parameters that yield a total score of 10 [7]. Later on, Kalan M et al [8] developed the modified version of Alvarado score also called as Modified Alvarado Scoring system (MASS)(Table1) which omitted the consideration of one parameter, i.e. left shift of neutrophil

maturation, thereby making a total score of 9. MASS further increased the diagnostic accuracy of acute appendicitis and lowered the negative appendectomy rate.

Table 1: The Scoring System

Parameters	Alvarado Scoring System Score	Modified Alvarado Scoring System
Symptoms		
Migratory pain (right iliac fossa)	1	1
Nausea or vomiting	1	1
Anorexia	1	1
Signs		
Tenderness (right iliac fossa)	2	2
Rebound tenderness (right iliac fossa)	1	1
Fever (high temperature)	1	1
Laboratory investigations		
Leucocytosis	2	2
Shift to the left of neutrophils	1	-
Total	10	9

Thus, in this study, an attempt is made to evaluate diagnostic efficacy of MASS and correlate it with that of USG and histopathological findings.

Materials and Methods

The present study was conducted in the department of Surgery, Heritage Institute of Medical Sciences, Varanasi from May 2018-June 2020 after obtaining institutional ethical clearance. The total number of patients enrolled were 80 of which 49 were males and 31 were females. Inclusion criteria for being a subject to study was clinical presentation of acute appendicitis in all age groups who willingly provide the consent. Patients with appendicular mass and those taken up for elective appendectomy were excluded from the study.

Patients meeting the inclusion criteria were subjected to detailed examination including history, clinical and routine laboratory investigations. All the patients enrolled were subjected to USG so as to rule out any conditions mimicking the symptoms of acute appendicitis. Using MASS, a score was generated based on which the patients were categorized into 3 groups as shown in table 2.

Table 2: Groups as per MASS

Score	Group	Remark
1-4	A	Unlikely of acute appendicitis
5-6	B	Possibility of acute appendicitis
7-9	C	Most like of acute appendicitis and requiring surgery

Although patients were categorized based on MASS, it was not implicated in the surgical decision. All the patients included underwent surgery and the removed appendix was further histopathological analysis was done to confirm the diagnosis. The MASS and USG findings were correlated with that of histopathology. All the data generated were recorded and analysed.

The specificity, sensitivity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) were calculated as follows:

$$\text{Specificity (\%)} = \frac{\text{no. of cases (true negative)}}{\text{no. of cases (true negative + false positive)}} \times 100$$

$$\text{Sensitivity (\%)} = \frac{\text{no. of cases (true positive)}}{\text{no. of cases (true positive + false negative)}} \times 100$$

$$\text{PPV (\%)} = \frac{\text{no. of cases (true positive)}}{\text{no. of cases (true positive + false positive)}} \times 100$$

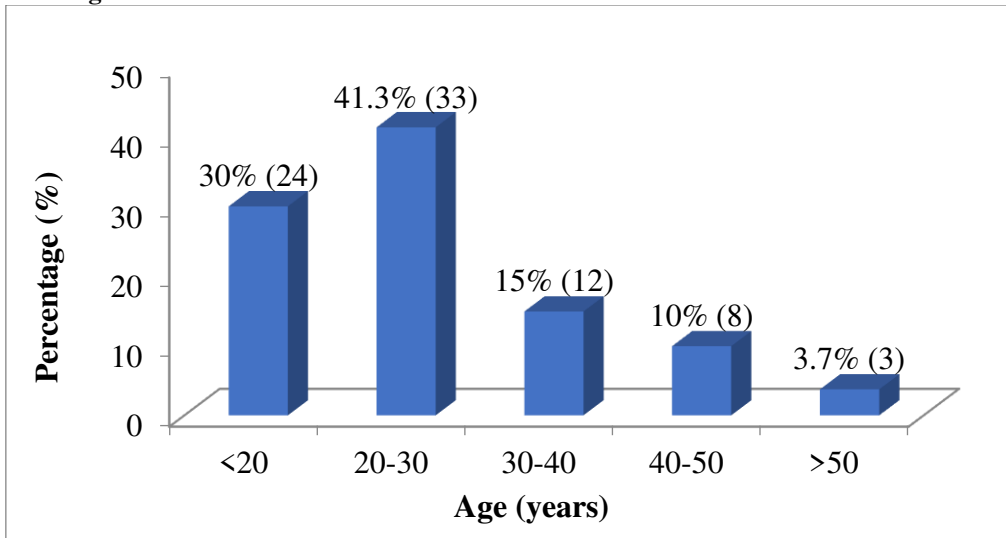
$$\text{NPV (\%)} = \frac{\text{no. of cases (true negative)}}{\text{no. of cases (true negative + false negative)}} \times 100$$

$$\text{Accuracy (\%)} = \frac{\text{no. of cases (true positive + true negative)}}{\text{no. of cases (true positive + true negative + false positive + false negative)}} \times 100$$

Results:

The total number of subjects, categorized as per different age groups, is shown in figure 1. There were 49(61.25%) males and 31(38.75%) females included in the study.

Figure 1: Age wise distribution of cases



The distribution of subjects as per their symptoms and laboratory findings is shown in figure 2 and as per USG findings is shown in figure 3

Figure 2: Distribution of as per MASS

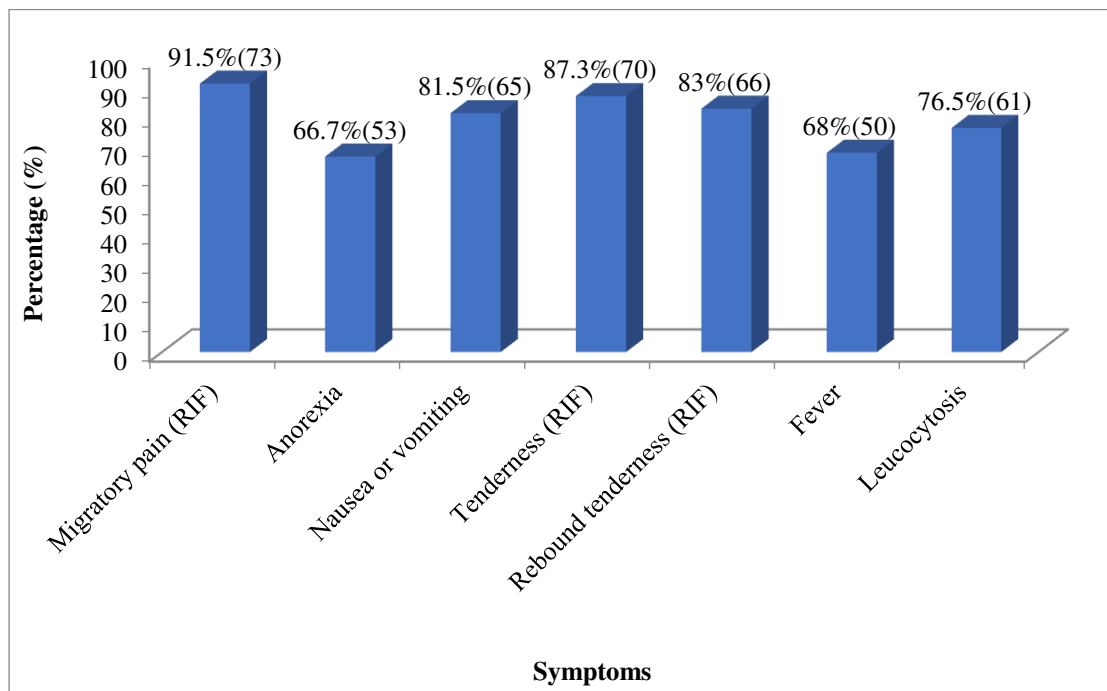


Figure 3: Ultrasonographic analysis

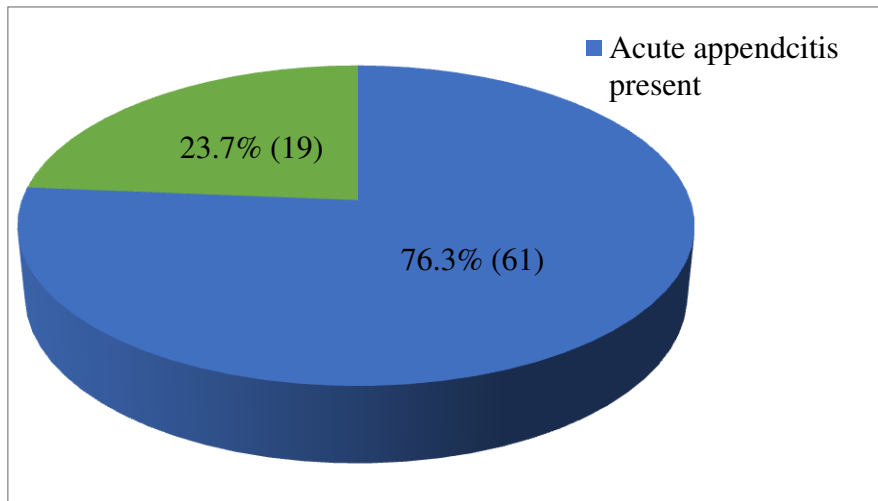


Table 3: Histopathological findings of cases

Histopathology findings		
Acute appendicitis (n=73)		Normal appendix (n=7)
Perforative	1(1.3%)	
Suppurative	2(2.5%)	
Gangrenous	5(6.2%)	
Inflammatory	65(81.3%)	
Total	73(91.3%)	7(8.7%)

The descriptive analysis for MASS score, USG findings and Histopathological findings are shown in tables 4-6.

Table 4: Distribution of patients based on MASS

MASS	Group	Appendicitis	Normal Appendix
1-4	A	4	2
5-6	B	16	4
7-9	C	53	1

Table 5: MASS and Histopathological correlation for acute appendicitis

MASS	Histopathological report		
	Positive for appendicitis	Negative for appendicitis	Total
Score ≥ 7	58	4	62
Score < 7	15	3	18
Total	73	7	80

Table 6: USG and Histopathological correlation for acute appendicitis

USG findings	Histopathological report		
	Positive	Negative	Total
Positive for appendicitis	55	8	63
Negative for appendicitis	15	2	17
Total	70	10	80

Table 7: USG and Histopathological correlation for acute appendicitis

Parameters	MASS	USG
Sensitivity	95.10%	90.10%

Specificity	78.90%	63.10%
Accuracy	86.20%	83.7
PPV	93.50%	90.10%
NPV	61.10%	63.15%
NAR	6.4%	11.4%

Discussion

Acute appendicitis being a surgical emergency requires prompt appendectomy either open or closed in order to reduce complications and case fatality rates. Hence there is necessity of early and accurate diagnosis which can be facilitated by patient history, clinical signs suggestive for acute appendicitis and scoring systems. The MASS has proven to improve diagnostic accuracy with the reduction in negative appendectomy rates.

In this study, preponderance of acute appendicitis was found in the age group of 20-30 years. In the study of Harsha BK et al, higher incidence was reported in the group of 21-30 years while as per Talukder DB et al incidences increases in the third decade of life [9, 10].

Our study showed high prevalence of acute appendicitis in male (61.3%) with male to female ratio of 1.58:1. This was in accordance with the studies of Memon ZA et al [11], Subedi N et al [12], and Gujar N et al [13], while Brahmachari S et al showed it to be 1.27:1 [1]. Unlike these studies Thabit MF et al reported the high incidence in females [14]. The main reason of male preponderance in the incidence of acute appendicitis may be social and demographic. Inflicted by various religious, social and economic barriers, females prefer to seek treatment from local health care staffs instead of hospital care.

Most symptom observed in this study were migratory pain (91.5%), tenderness (87.3%) and nausea/vomiting (81.5%) in decreasing frequency. Similar to our study, other studies of Lameris W et al [15], Merhi B et al [16], and Subedi N et al [12] showed comparable findings.

On histopathological examination, it was observed that 81.3% of patients had inflammatory appendicitis followed by gangrenous and suppurative that accounted for 6.2% and 2.5% respectively. 8.7% of patients had normal appendix. As per Subedi N et al [12], 84% of patients had inflamed appendix, 75% had perforated appendix while 3.5% and 1.5% had gangrenous appendix and appendicular lump respectively.

In this study, 7.5% of patients had MAS of 1-4 while 15% and 77.5% respectively had scores of 5-6 and 7-9. Our results were comparable to that of Sing K et al [17]. Similarly on USG, we found that 23.7% of patients had normal appendix while 76.3% had acute appendicitis.

We also determined sensitivity, accuracy and specificity of MASS and USG for the diagnosis of acute appendicitis. They were respectively 95.1%, 86.2%, and 78.9% for MASS and 90.1%, 83.7% and 63.1% for USG.

Study of Kanumba ES et al [18] and Kalan M et al [8] reported the sensitivity of MASS to be 94.1% and 93% respectively. The specificity as per Ramiraz JM et al was 72% [19] while Kalan M et al [8] reported specificity to be 67%. Comparable results were also provided by Gujar N et al [13] and Nautiyal H et al [4]. In contrast Tiecher I et al [20] reported sensitivity and specificity of 48-77% and 73-87% respectively. Likewise Gaurav PD et al [21] demonstrated the same to be 20% and 80%.

The sensitivity and specificity of USG were reported to be 98.4% and 94.4% respectively by Gujar N et al [13] while Jain S et al [22] showed the sensitivity of 94.68%. According to Joshi HM et al [23] sensitivity of USG for acute appendicitis is 96%, while as per Puylaert et al JB [24], Ramachandran P et al [25] and Jaffery RB et al [26] the sensitivity of USG are respectively 89%, 90%, 85.7% and 89%. Higher sensitivity of 99% was reported by Lee JH et al [27] and lower sensitivity of 74.2% was reported by Zidan A et al [28]. Similarly specificity of USG was 96%, 96% and 100% respectively in the study of Jaffery et al [26], Ramachandra P et al [25] and Puylaert JB et al [24].

The PPV was 93.5% and NPV was 61.1% for MASS in this study. Likewise, for USG, they were 90.1% and 63.15% respectively. These results were in line with the study of Mahesh SV et al [29] In the present study, the negative appendectomy rate was 6.4% by MASS and 11.4% by USG. In the study of Denizbassi A et al of [30], the negative appendectomy was 9.6%. Like-wise the negative appendectomy rates were 11.49%, 16% and 15.6% respectively in the study of Talukder DB et al [10], Malik KA et al [31] and Khan I et al [32].

Conclusion

Acute appendicitis requires a prompt diagnosis and is based on detailed patient history, examination and clinical investigations. Modified Alvarado Scoring System is simple, cheap, easy and non invasive pre-operative diagnostic tool for acute appendicitis. It boosts diagnostic accuracy and lowers negative appendectomy rate. It accounts to be a highly sensitive indicator when combined with USG. Further, if a scoring system, compatible to USG findings is also created and used with MASS score to predict

acute appendicitis, probably this would reduce the false positive results on histopathologic examination.

Conflict of interest: Nil

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