International Surgery Journal
Rithin PS et al. Int Surg J. 2017 Jul;4(7):2118-2122
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20172580

Original Research Article

Evaluation of modified Alvarado scoring system in acute appendicitis at Vydehi Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India

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Received: 23 May 2017
Accepted: 31 May 2017

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ABSTRACT

Background: Despite of much advancement in modern diagnostic technology, decision making in patients with acute appendicitis is still a challenge worldwide. Many diagnostic scoring systems have been developed. Of them modified Alvarado scoring system (MASS) has been reported to be a cheap and quick diagnostic tool which minimizes negative appendectomy rate. The present study was aimed to evaluate the efficacy of MASS in diagnosing acute appendicitis and correlating the same with histopathological results.
Methods: This prospective cohort study conducted from November 2012 to April 2014, over a period of 18 months at Vydehi Institute of Medical Sciences and Research Centre, Bangalore. 100 patients with symptoms of acute appendicitis were enrolled in the study. They were diagnosed using MASS. Patients with a score of 7 to 10 were taken up for surgery. Patients with a score below 7, but with high suspicion of acute appendicitis by the surgeon were taken up for surgery. Following surgery all appendix specimens were sent for histopathologic examination.
Results: A total number of 100 patients were participated in the study. Of them patients under the age group of 21-30 years were more affected with acute appendicitis (51%). Male predominance was observed in the study (74%). The common symptom observed in all patients (100%) was tenderness in right Iliac fossa (RIF). Out of 100 patients, 79% of the patients were presented with a modified Alvarado score of ≥7 and 21% presented with a score of <7. The sensitivity and specificity of the MASS in this study was 89.66% and 92.31% in both males and females respectively. The positive predictive value was 98.73%, negative predictive value was 57.41% and the NAR was 6.75% and 30.76% in male and female patients respectively.
Conclusions: The observations of the study confirm that use of MASS in patients suspected to have acute appendicitis provides a high degree of diagnostic accuracy and subsequently reduces the negative appendicectomy and complication rates.

Keywords: Acute appendicitis, Histopathological examination, Modified alvarado score, Ultrasonography

INTRODUCTION

Acute appendicitis is an acute inflammation of the appendix and is one of the most common surgical emergencies. It is not an easy diagnosis to make. Exact diagnosis of the disease can be made only after surgery and pathological examination of surgical specimen. A failure of early diagnosis can lead to progression of the disease with its attendant morbidity and occasional mortality.[1]

The prevalence rate of acute appendicitis was 1.17 per 1000 and having a life time risk of 8.6% among males and 6.7% in females. The incidence was more in second and third decades of life with little variation between age groups.[2]

The commonly used diagnostic approaches were CT scan, laproscopy, ultrasonography and diagnostic scores. Ultrasonography intensely decreases the number of appendicectomies in patients without appendicitis particularly in children, young adults and in females with a diagnostic accuracy of above 90%. It allows exclusion of gyanecological causes that simulating appendicitis in females of reproductive age.[3]

Various scoring systems have been developed for assisting the recognition of acute appendicitis but most of them were complex and not feasible in emergency cases. Now-a-days modified Alvarado scoring system (MASS) has become popular for diagnosis of acute appendicitis as it is easy, simple and cheap diagnostic tool to identify the disease condition even by junior surgeons. It also lowers the negative appendectomy rate.[4,5]

The present study was conducted to evaluate the efficacy of the modified Alvarado score in facilitating the accurate diagnosis of acute appendicitis and its correlation with histopathology and thereby its significance in reducing the rate of negative appendectomy.

METHODS

A total of 100 patients were analyzed for this prospective cohort study conducted from November 2012 to April 2014, over a period of 18 months at Vydehi Institute of Medical Sciences and Research Centre, Bangalore.

All patients coming to hospital with acute pain abdomen and diagnosed provisionally as acute appendicitis were subjected to a modified Alvarado scoring system as given in Table 1.[5]

Table 1: Modified Alvarado scoring system (MASS).[5]

Symptoms	Score
Migratory right iliac fossa pain	1
Anorexia	1
Nausea/vomiting	1
Signs	
Tenderness at right iliac fossa	2
Rebound tenderness right iliac fossa	1
Elevated temperature	1
Extra sign (cough test and/or Rovsing's sign and/or rectal tenderness)	1
Laboratory	
Leukocytosis	2
Total Score	10

Depending on individual presentation, a score was calculated for each case, using modified Alvarado scoring system. Patients with a score of 7 to 10 were taken up for surgery. Patients with a score below 7, but with high suspicion of acute appendicitis by the surgeon were taken up for surgery. Abdominal ultrasound was performed in all patients. Confirmation of diagnosis of acute appendicitis was done by histopathological examination (HPE) of appendix in all cases. Data are collected in predesigned proforma. The scoring system is then correlated with the histopathology reports, the gold standard.

Analysis was done using appropriate statistical test like sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and the negative appendectomy rate (NAR).

RESULTS

In this study, a total of 100 patients were enrolled in the study. Of them 26 were females and 74 were males. Most of the patients affected with acute appendicitis were under the age group of 21-30 years. In the age groups 0 to 40 years, 69 (80.23%) of the affected patients were male and 17 (19.76%) were female patients. In the age groups 41 years and above, 5 (35.7%) patients were males and 9 (64.3%) were females (Table 2).

Table 2: Age group of the study participants with incidence of sex.

Age group (in years)	Male	Female	Total number of patients
0 to 10	2	0	2
11 to 20	16	4	20
21 to 30	40	11	51
31 to 40	11	2	13
41 to 50	2	5	7
51 to 60	3	2	5
61 to 70	0	1	1
71 to 80	0	1	1
Total number of patients	74	26	100

Table 3: Analysis of parameters by MASS.

Parameters of MASS	Number of patients
Migratory right iliac fossa pain	64
Anorexia	59
Nausea/vomiting	90
Tenderness RIF	100
Rebound tenderness	80
Elevated temperature	68
Extra signs	58
Leukocytosis	60

By analyzing the disease parameters by using MASS, tenderness in right iliac fossa (RIF) was seen in all patients. History of migratory right lower abdominal pain was observed in 64% of patients, anorexia was observed in 59% of patients, nausea or vomiting in 90% of patients, 80% patients showed rebound tenderness in right lower quadrant, 68% patients showed raised temperature and other signs like (cough test, Rovsing's sign, rectal tenderness) was seen in 58% of patients (Table 3).

Out of 100 patients, 79% of the patients were presented with a modified Alvarado score of ≥7 and 21% presented with a score of <7. Histological examination confirmed appendicitis in 87% of the patients. PPV score of 9 and 10 was observed in 100% patients and PPV score of 7 and 8 was seen in in 98.21% patients. The remaining 13% of patients diagnosed to have normal appendix. The NPV score of 6 was observed in 33.33% patients, NPV score of 5 in 85.71% and a NPV score of 4 was seen in 100% patients as presented in Figure 1.

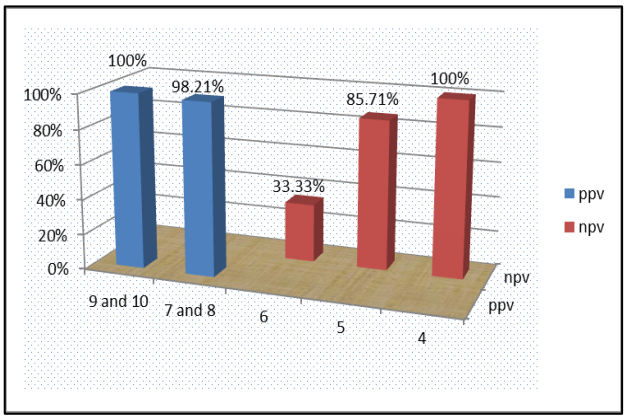

Figure 1: Predictive values of each score.

Table 4: Modified Alvarado score versus HPE in males and females.

MASS	Appendicitis (HPE +ve)	Normal appendix (HPE –ve)	Total	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	NAR (%)
In male patients								
≥7	65	1	66					
< 7	4	4	8	94.2	80	98.48	50	6.75
Total	69	5	74					
In female patients								
≥7	14	0	14					
<7	4	8	12	77.78	100	100	66.67	30.76
Total	18	8	26					

Table 5: Sensitivity of parameters in MASS.

Parameters of MASS	Number of patients	Appendicitis (HPE +ve)	Sensitivity (%)
Migratory right iliac fossa pain	64	57	66.26
Anorexia	59	51	61.45
Nausea / vomiting	90	79	90.8
Tenderness RIF	100	87	100
Rebound tenderness	80	74	85.06
Elevated temperature	68	59	67.82
Extra sign	58	56	64.37
Leucocytosis	60	58	65.91

Table 6: Observations on ultrasongraphy.

Ultrasongraphy observations	No. of patients	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Positive	72	74.71%	46.15%	90.28%	21.43%
Negative	28				

The sensitivity and specificity of the MASS in this study was 89.66% (males 94.2%; females 77.78%) and 92.31% (males 80%; females 100%) respectively. The PPV was 98.73% (males 98.48%; females 100%) and NPV was 57.41% (males 50%; females 66.67%). The NAR was 6.75% and 30.76% in male and female patients respectively (Table 4).

Table 5 presents the sensitivity of various parameters in patients with histologically positive acute appendicitis. Of various symptoms of acute appendicitis, tenderness in RIF was seen in all patients. Of them 87% showed histologically positive results with sensitivity score of 100%. 90% of patients had nausea and vomiting. On histology, 79 patients showed positive results with sensitivity of 90.8%. Similarly rebound tenderness was seen in 80 patients of which 74 had shown histologically positive results with sensitivity of 80%.

In our study, 72 patients were found to have acute appendicitis on ultrasonography. The sensitivity, specificity, PPV and NPV on USG was 74.71%, 46.15%, 90.28% and 21.43% respectively (Table 6).

Table 7: Special cases with MASS and HPE results.

Condition	Number of patients	MA score	HPE (appendicitis)
HIV +ve	2	6	+ve
Obesity	1	5	+ve
Appendiceal parasite	1	8	+ve

In this study, two patients who were HIV positive had modified Alvarado (MA) score of 6. These patients had histologically confirmed appendicitis. One obese patient with a BMI of 38.6 kg/m^2 had a modified Alvarado score of 5 had histologically confirmed appendicitis and a 4-year-old male child with a modified Alvarado score of 8 had histologically confirmed appendicitis, caused due to obstruction of the lumen of the appendix by *Enterobius vermicularis* parasite.

DISCUSSION

Acute appendicitis is one of the most common surgical emergencies. Surgery for acute appendicitis is the most frequent operation performed. It is a condition which is diagnosed clinically, and imaging modalities and laboratory tests are a useful adjunct to such diagnosis.[6]

In the past few years, various scores have been developed to aid in the diagnosis of acute appendicitis. Although many diagnostic scores have been advocated, most are complex and difficult to implement in the clinical situations. The modified Alvarado score, is a simple scoring system that can be used easily for classifying patients with acute appendicities.[5,7]

From the results of our study, it is evident acute appendicitis was more common in the age group of 21-30 years (51%) followed by 11-20 years (20%). Male predominance was observed in the study. This incidence of age and sex with acute appendicitis was similar to previous studies of Kodliwadamath et al and Jade et al.[8,9]

The common symptom observed in all patients was tenderness in right iliac fossa. This is in accordance with the study of Gujar et al conducted in 350 patients.[10]

In our study, the number of patients with modified Alvarado score ≥7 was 80% with positive histopathology reporting in 65 males and 14 females. And with modified Alvarado score <7 was observed in 20% with positive histopathology in 4 males and 4 females where negative histopathology was reported in 4 males and 8 females. These results were comparable with the observations of Thabit et al.[11]

In this study, the negative appendectomy rate in males was 6.75%, whereas in females it was 30.76%. The NAR were found to be higher in females compared to males. This may be due to misdiagnosis in females of reproductive age with other pelvic diseases. In these cases, MASS should be replaced with ultrasound scan or CT scan or laparascopy to minimize the NAR.[12]

To be useful, a scoring system should be sensitive and specific. Our study demonstrates that modified Alvarado score applied to all patients is substantially superior in diagnosis of acute appendicitis with a sensitivity of 89.66% and a specificity of 92.31%. These observations were comparable with the other studies having sensitivity and specificity of 94.2% and 70% respectively.[13] Our study had a slightly lower sensitivity but a better specificity.

The positive predictive value of the scoring system in this study was 98.73%, i.e. better when compared with other studies of Chan et al and Subhajeet et al in which PPV value was 86.9% and 97.6% respectively.[12,13]

The negative predictive values of the scoring system in this study was 57.41% which is comparable with the studies of Subhajeet et al (69.8%).[13]

According to literature, sensitivity of USG in diagnosing acute appendicitis ranges from 55-96% and the specificity from 85-98%.[14,15] In our study the sensitivity and specificity of ultrasonography was 74.71% and 46.15% respectively. Positive predictive value and a negative predictive value of ultrasonography was 90.28% and 21.43% respectively. These results infer that, USG is an operator dependent tool.

CONCLUSION

In diagnosis of acute appendicitis, modified Alvarado score has a high diagnostic value. The sensitivity of the test is good for the male population compared with the females. This can be easily attributed to the pelvic pathological conditions which require a diagnostic ultrasound and laparoscopy is advised to minimize negative appendectomy rate in women. The study also concludes that modified Alvarado score increases the diagnostic certainty of clinical examination in diagnosis

of acute appendicitis, reducing the progression of the disease to perforation. Misdiagnosis leading to negative appendectomy can also be avoided, thus reducing the morbidity of the procedure.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Rithin PS, Agarwal A, Budigi B. Evaluation of modified Alvarado scoring system in acute appendicitis at Vydehi Institute of Medical Sciences and Research Centre, Bangalore, Karnataka, India. Int Surg J 2017;4:2118-22.