

The Modified Alvarado Score versus Alvarado Score in the Diagnosis of Acute Appendicitis

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Abstract

Background: Appendicitis is the most common surgical emergency presented daily to emergency surgical department. The Modified Alvarado Scoring System (MASS) is easier and applicable in the diagnosis of acute appendicitis using extra signs instead of neutrophilic left shift. **Objective:** The aim of this study is to compare and evaluate the diagnostic accuracy of MASS versus the Alvarado scoring system. This study was carried out in Duhok Emergency Teaching Hospital, Iraq, over the period of 12 months, from October 2017 to October 2018. **Materials and Methods:** A cross-sectional study including 200 patients, diagnosed with acute appendicitis by the senior surgeon on call and underwent conventional open appendicectomy. MASS were applied to all patients preoperatively by author and results of both scores compared to operative and histopathological findings of excised appendix to analyze the efficacy of both scores in the diagnosis of acute appendicitis. **Results:** Of 200 patients who underwent operation those with Alvarado score of 9–10 had sensitivity of 88% and specificity of 100%. Those with a score of 7–8 had sensitivity of 63% and specificity of 68%. For MASS patients with score of 9–10 had sensitivity of 96% and specificity of 100%, and those with a score of 7–8 had sensitivity of 77% and specificity of 86%. The higher the score, the sensitivity and specificity increased. Positive predictive value and accuracy of neutrophilic left shift of Alvarado were 95% and 65%, positive predictive value and accuracy of extra signs of modified Alvarado score were 97% and 84% respectively. **Conclusion:** Both Alvarado and MASS are fast, simple, and repeatable systems in the diagnosis of acute appendicitis. This study reveals that accuracy of MASS is higher than Alvarado score, and the rate of negative appendicectomy can be reduced using this system.

Keywords: Acute appendicitis, Alvarado score, diagnosis, modified Alvarado score

INTRODUCTION

Appendicitis is the most common surgical emergency that needs emergency surgical intervention, it usually occurs in the young age groups between 10 and 20 years, but all ages are affected with less incidence, there is slight male predominance with average lifetime risk between 6.7% and 8.6%.^[1,2]

The most common etiology of acute appendicitis is luminal obstruction from any causes such as fecaliths, lymphoid hyperplasia, or sometimes by some parasitic infestations. Bacterial and viral infections as a primary cause of appendicitis have been investigated but with little evidence.^[3]

The diagnosis of appendicitis is mostly clinical; the most important symptoms are periumbilical pain that shifts to the right iliac fossa (RIF), anorexia, nausea, and vomiting. The most important clinical sign during examination is tenderness during palpation of the RIF.^[4]

The combination of the clinical findings with some laboratory tests increases the diagnostic accuracy of appendicitis. Many diagnostic scoring systems are made to increase the diagnostic accuracy depending on the presentation, clinical examination, some investigations such as the white blood cell count, and the shift to left of white blood cells such as the Alvarado (MANTREL) scoring system which analyses three symptoms, three clinical signs, and two laboratory findings. MANTREL is the abbreviation of the following: M: Migratory RIF pain, N: Nausea/vomiting, A: Anorexia, R: RIF tenderness, E: Elevation of temperature, R: Rebound tenderness at RIF, L: Leukocytosis, and N: Neutrophilic shift to the left (>75%).^[5,6]

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Submission: 22-07-2019 **Accepted:** 18-08-2019 **Published Online:** 25-09-2019

Access this article online

Quick Response Code:



Website:
www.medjbabylon.org

DOI:
10.4103/MJBL.MJBL_48_19

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How to cite this article: Sulo SS, Al-Atrakchi HA. The modified Alvarado score versus Alvarado score in the diagnosis of acute appendicitis. *Med J Babylon* 2019;16:203-6.

Many modifications were made on the Alvarado scoring system, aiming to increase the diagnostic accuracy, such as the modified Alvarado score, in which the shift to the left of the white blood cells is replaced by the extra signs such as the cough sign, Rovsing's sign, and rectal tenderness.^[7,8]

The preferred modality of treatment is surgery, by performing appendectomy, which is done either by the conventional open technique or through the use of laparoscopy. The time of the surgical intervention is very vital to prevent the subsequent delay, thus preventing the risk of and its serious sequelae such as perforation, mass formation, abscess formation, and even death.^[4,9]

The aim of this study is to compare the diagnostic accuracy of the Alvarado score to the modified Alvarado score in the diagnosis of acute appendicitis, more precisely to compare the last point of each score (the left shift of Alvarado and extra signs of modified Alvarado) to each other.

MATERIALS AND METHODS

This cross-sectional study was carried out at Duhok Emergency Teaching Hospital, Duhok city-Iraq, the duration of the study was 12 months, from October 2017 to October 2018.

Clinical procedure

A total number of 200 patients were included in this study, all patients were >12 years of either gender, who were admitted to the emergency surgical department with acute right lower abdominal pain, diagnosed clinically as acute appendicitis and underwent conventional open appendectomy were included in the study, and all participants were randomly selected. Patients were informed regarding the blood sample and tissue specimen was taken for histopathology by the author, the informed signed consent was obtained from the patient self or parents.

Collected data include: age, gender, duration of pain, frequency of attacks, frequency of admission to hospital and MANTRELS (Migration of pain, Anorexia, Nausea/vomiting, Tenderness in the RIF, Rebound tenderness, Elevation of temperature, Leukocytosis [Alvarado score] and signs [modified Alvarado score]).

The decision to operate was done by the senior surgeon on duty, the first author has not interfered with the decision of operation, only after diagnosis and decision for operation have been made. Both Alvarado and modified Alvarado score were applied to each case by the author later on result of each score compared to operative and histopathological findings. The report of histopathology was correlated to analyze the effectiveness of each score in the correct diagnosis of acute appendicitis to reduce the rate of negative appendectomies.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Science version 22 for Windows (SPSS, Chicago, IL, USA).

Ethical committee approval

The ethical committee approval was obtained from the Kurdistan Board for Medical Specializations by the registration number 632.

RESULTS

Out of 200 cases, majority were female (122 [61%]) patients with a mean age of 22.12 and 78 male patients with a mean age of 22.24, most had their symptoms ≥ 24 h before the admission. The majority of the patients had appendicitis after histopathological examination of the excised appendices [Table 1].

Out of 122 female patients, 32 had a score of 9–10 (Group I), all had acute appendicitis proved by histopathology except for one patient who had ruptured hemorrhagic ovarian cyst. Sixty-four female patients had a score of 7–8 (Group II), seven had a normal appendix, two had pelvic inflammatory disease, and five had ruptured ovarian cyst. The remaining 26 female patients had a score of 5–6 (Group III), four of them normal appendix, one mesenteric lymphadenitis, and three ruptured ovarian cysts. Overall, out of 122 female patients, 12 (9.8%) had a normal appendix.

Table 1: Characteristics of different variables of the involved patients

Variable	Frequency (%)
Age of the patients mean (SD), range	22.18 (8.648), 12-51
Gender	
Male	78 (39.0)
Female	122 (61.0)
Duration of symptoms (h)	
<24	89 (44.5)
>24	111 (55.5)
Frequency of attacks	
Single attack	143 (71.5)
Multiple attacks	57 (28.5)
Number of admissions	
Single admission	156 (78.0)
Multiple admissions	44 (22.0)
Operative findings	
Normal appendix	2 (1.0)
Inflamed appendix	139 (69.5)
Highly inflamed appendix	32 (16.0)
Perforated appendix	7 (3.5)
Gangrenous appendix	4 (2.0)
Mesenteric lymphadenitis	4 (2.0)
Meckel's diverticulitis	1 (0.5)
Ruptures right ovarian cyst	9 (4.5)
Pelvic inflammatory disease	2 (1.0)
Histopathology	
Normal appendix	16 (8.0)
Acute appendicitis	138 (69.0)
Suppurative appendicitis	22 (11.0)
Chronic appendicitis	24 (12.0)

SD: Standard deviation

Among male patients, 30 belonged to Group I,^[9,10] and all had acute appendicitis; 35 fell into Group II,^[7,8] in one of them, no pathology was found, one perforated Meckel's diverticulum and one mesenteric lymphadenitis; 13 fell into Group III,^[5,6] only one normal appendix with mesenteric lymphadenitis found. Of 78 male patients, 4 (5.1%) had a normal appendix.

Out of the 200 patients, 16 (8%) were found to have a normal appendix, operative and histopathological stages of all patients are summarized in Table 1. Table 2 shows the last total score of all patients in each range of both Alvarado and modified Alvarado scoring systems (MASSs).

Patients (both male and female) with a score of 9–10, almost certain to have appendicitis showed sensitivity and specificity of 96% and 100% in the MASS, 88% and 100% in Alvarado scoring system, respectively. Patients with a score of 7–8 showed sensitivity and specificity of 77% and 83% in MASS, 63% and 68% in the Alvarado scoring system, respectively. Patients with a score of 5–6 showed sensitivity and specificity of 72% and 83% in MASS, 29% and 50% in the Alvarado scoring system, respectively.

Evaluation of extra signs and neutrophilic left shift is listed in Table 3. Extra signs of MASS are more sensitive and specific in the diagnosis of acute appendicitis than the left shift of neutrophil maturation in Alvarado scoring system. Accuracy of 84% and 65% was found in the modified Alvarado and Alvarado scoring system, respectively.

DISCUSSION

Acute appendicitis remains the most common surgical emergency that requires an emergency operation. Prompt diagnosis and timely management are essential to avoid the associated morbidity and mortality. Most of the patients present with the classical signs, but there may be difficulties in the diagnosis in certain groups of patients such as pregnant patients, the elderly, and the patients that presenting with complications.^[10-14]

The Alvarado scoring system is easy to be applied and very valuable in the diagnosis of acute appendicitis. Some authors

are using the Alvarado scoring system as an admission criterion. Patients having low score, that is, <4 are treated conservatively and do not require admission to the emergency department.^[15,16]

There has been some improvement in the diagnosis of acute appendicitis, and various scoring systems have been developed. Clinical scoring systems are proved to be very useful in the early diagnosis of appendicitis, most rely on the clinical presentation, the addition of extra clinical signs (cough sign, Rovsing's sign, and rectal tenderness in the MASS) to increase the diagnostic accuracy is also a very useful modification that reduced the rate of the unnecessary surgery, improves the diagnostic accuracy, and consequently reduce the rate of negative appendicectomies and complications.^[2,7]

Results of our study show that acute appendicitis is more common in the first decade of life among teenage group of 12–20 years with a mean age of 22.18. These results are similar to other studies, also female preponderance in this study is in agreement with other studies.^[17]

Pain in the RIF was present in all cases, and majority of them present to hospital with the duration of their symptoms <24 h. this study reveals that the rate of negative appendectomy was higher among women than men with ratio of 9.8% to 5.1%. overall negative appendectomy rate was 8% compare to the other studies with similar subject its slightly lower.^[18,19]

To be useful, a scoring system must be both sensitive and specific. This study demonstrates that modified Alvarado score is effective in the diagnosis of acute appendicitis, and extra sign proved to be more accurate than the left shift. However, there are no signs/symptoms or laboratory tests that are 100% reliable in the diagnosis of acute appendicitis. In our study, patients with modified Alvarado score of 5–6, 7–8, and 9–10 had accuracy of 74%, 78%, and 96%, respectively, compared to patients with Alvarado score of 5–6, 7–8, and 9–10 with accuracy of 31%, 64%, and 75%, respectively. To be more specific, extra signs have higher accuracy than the left shift, 84%–65%, respectively; also extra signs found to have higher sensitivity, specificity, and positive predictive value than neutrophilic left shift in the diagnosis of acute appendicitis. These results are comparable with other studies performed in India in 2016.^[20,21] Thus, modified Alvarado score can be used as dependable and acceptable score preoperatively for the diagnosis of acute appendicitis as well to decide whether the patient needs surgery or observation; patients with score ≥ 7 almost certainly have appendicitis according to our study, the surgery is recommended. Patients with score <7 can be kept under observation and reevaluation if score increased, or the patient does not respond to medical management surgery

Table 2: The last total score of both system

Range of the scores	Alvarado score		Modified Alvarado score	
	Appendicitis disease	Other	Appendicitis disease	Other
9-10	58	2	61	1
7-8	87	11	88	11
5-6	39	3	35	4

Table 3: Evaluation of extra signs and neutrophilic left shift

	Sensitivity (%)	Specificity (%)	Positive predictive value	Negative predictive value	Accuracy (%)
Left shift	65	64	0.95	0.14	65
Extra signs	84	80	0.97	0.42	84

when it is preferred. Cases with score <4 are extremely unlikely but not impossible to have appendicitis.

CONCLUSION

Modified Alvarado score and Alvarado score are both simple and useful complementary methods, hence, Modified Alvarado score proved to be more accurate in the diagnosis of acute appendicitis and its sensitivity and specificity increased when score increased, it proved to have lower negative appendectomy rate. We found that the modified Alvarado score is more easy and rapid because measuring the neutrophilic left shift of Alvarado score usually takes some time and is not routinely available in our emergency departments.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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