MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218\makrjms.2023.1038.1042

Role of Alvarado Scoring System (MANTRELS Scoring) as a Diagnostic Aid in Preoperative Diagnosis of Acute Appendicitis

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OPEN ACCESS

Key Words
Acute appendicitis, alvarado score, abdominal pain, negative appendicectomy

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Received: 15 August 2023
Accepted: 26 August 2023
Published: 28 August 2023

Citation: Manish Bhatiya, Rahul Khokhar, Jaydeep V. Bhimani, Mehulkumar S. Aalaja and Maulik Kaneria, 2023. Role of Alvarado Scoring System (MANTRELS Scoring) as a Diagnostic Aid in Preoperative Diagnosis of Acute Appendicitis. Res. J. Med. Sci., 17: 1038-1042, doi: 10.59218\makrjms.2023.1038.1042

ABSTRACT

Acute appendicitis is a common surgical emergency encountered worldwide in emergency departments. Despite advances in diagnostics and surgery, accurate diagnosis can be challenging, leading to delays in treatment. The Alvarado scoring system, using historical data, clinical examination and lab tests, helps guide clinical decisions and surgical planning and reduces unnecessary surgeries. This study evaluates the Alvarado score's accuracy in diagnosing acute appendicitis preoperatively and its correlation with postoperative findings. This investigation was conducted among 100 individuals presenting with suspected appendicitis and admitted to the Department of Surgery at C.U. Shah medical college and hospital, Surendra Nagar, Gujarat India, spanning the period of 2 years. The Alvarado scoring system was employed for assessment and the resulting data were subjected to rigorous analysis. Among the 100 patients admitted with suspected acute appendicitis, 100 cases underwent surgical intervention due to suspected appendicitis with 86 ultimately demonstrating the presence of an acutely inflamed appendix. Alvarado scores among the operated patients were distributed as follows, 48 patients fell within the score range of 7-10, while 38 patients scored between 5-6 and scored less than 5 (14 patients). The Alvarado scoring system is a fast, cost-effective, safe and reliable tool for diagnosing acute appendicitis, particularly valuable in resource-limited healthcare settings. When used alongside ultrasonography, it enhances diagnostic accuracy and reduces negative appendectomy rates, thereby decreasing complications.

INTRODUCTION

In the realm of medical science, acute appendicitis (AA) stands out as the predominant emergent condition affecting the abdominal region across both developed and developing nations[1]. It is noteworthy that the lifetime risk of encountering AA is estimated at 1 in 7 individuals[2], translating to an incidence rate of approximately 6% within the general population. It is imperative to underscore that the exigency of AA necessitates immediate medical intervention. Failing to do so carries a substantial risk of dire consequences, including but not limited to perforation, peritonitis and the formation of abscesses, all of which may further entail complications associated with subsequent surgical procedures[3]. Particularly among the elderly population, it is worth noting that the reported mortality rate for those afflicted with perforated appendicitis varies within the range of 2.3-10%[4].

Definitive diagnosis of acute appendicitis (AA) remains contingent upon surgical intervention and the subsequent histopathologic scrutiny of the excised tissue specimen[5]. Consequently, achieving an unequivocal preoperative diagnosis through the gold standard, histopathology is impracticable. This limitation is compounded by a notable incidence of negative appendectomy, which is reported in global medical literature and ranges from 20-40%, bearing an associated morbidity of approximately 10%. Some surgeons even acknowledge a threshold of up to 20% for acceptable negative appendectomy rates[6,7].

To mitigate the incidence of negative appendectomies, several diagnostic support systems have been devised. Among them, the Alvarado scoring system merits attention as it relies exclusively on historical data, clinical examination findings and a select few laboratory tests, rendering it a facile diagnostic tool[8]. The inception of the Alvarado score dates back to 1986 and it has since been validated within the realm of adult surgical practice. Employing an objective scoring system such as the Alvarado system has been shown to markedly diminish the negative appendectomy rate, with reported reductions to as low as 0-5%[8-10].

The aim of this investigation is to assess the utility of the Alvarado scoring system also known as the MANTRELS scoring system in the diagnostic process of acute appendicitis.

MATERIALS AND METHODS

This study involved the enrolment of 100 patients presenting with pain localized to the right Iliac Fossa region. These patients were admitted to the Department of general surgery within our hospital for a comprehensive assessment and subsequent medical care. Specifically, this research was focused on patients who have been provisionally diagnosed with appendicitis based on their symptoms of right lower quadrant abdominal pain. The assessment of these individuals would encompass the utilization of the Alvarado score, which involved a thorough analysis of their medical history, clinical presentation, laboratory findings and diagnostic imaging through Ultrasonography.

Table 1: Alvarado score system

Parameters	Scores
Symptoms	
Migration of pain to the right lower quadrant	1
Nausea, vomiting	1
Anorexia	1
Sign	
Tenderness in the right iliac fossa	2
Rebound tenderness	1
Elevated temperature (>37.3°C)	1
Laboratory test	
Leukocytosis	2
Differential leukocyte count (neutrophils >75%)	1
Total	10

The inclusion criteria for this study encompassed patients who presented themselves at C.U. Shah hospital with complaints of abdominal pain and received a provisional diagnosis of acute appendicitis, demonstrating their willingness to undergo surgical intervention. Conversely, the exclusion criteria encompassed pregnant females, individuals exhibiting any palpable abdominal masses, patients with a recent history of prior abdominal surgical procedures and those who expressed unwillingness to proceed with surgical treatment.

In this cohort of patients, the Alvarado score was administered through a comprehensive approach that involved the acquisition of clinical history, abdominal examination and the execution of routine laboratory investigations.

Alvarado scoring system:

- **1-4:** Appendicitis unlikely
- **5-6:** Appendicitis possible
- **7-10:** Appendicitis definitive (Table 1)

All patients with scores 7-10 were considered to have either a probable or definite diagnosis of acute appendicitis and were considered for appendicectomy in the first instance. All the patients with right iliac fossa pain underwent ultrasonography. An ultrasonography criterion for diagnosis of acute appendicitis was a maximum diameter of 6 mm or more or wall thickness of 3 mm or more or increased peri-appendicular echogenicity.

Patients were divided into 3 groups:

- Cases with scores of 1-4 were observed and were not operated. These patients were assessed by ultrasonography and were followed up after 6 months for the development of acute appendicitis
- Cases with scores of 5-6 were observed for the next 24 hrs for revision of scoring. If scores became ≥7 or their clinical condition was highly suspicious of acute appendicitis as decided by the treating surgeon they were subjected to appendicectomy. All patients who were considered for appendicectomy underwent ultrasonography of the abdomen primarily to rule out other conditions mimicking acute appendicitis
- Patients with scores of 7-10 who are considered candidates for appendicectomy were assessed again after ultrasonography. If any other conditions mimicking acute appendicitis were found in them. They were not operated and were considered as false positive cases

A final correlation between the scoring system and ultrasonographic findings was done and a final diagnosis was made. All the specimens of appendix after appendicectomy were sent for histopathological confirmation of acute appendicitis.

RESULTS

One hundred patients preoperatively diagnosed with acute appendicitis were admitted and studied. Of the 100 cases that were admitted with suspicion of acute appendicitis, 100 cases were taken up for surgery. Among the cases that were operated 86 cases had acutely inflamed appendix. The percentage of inflamed appendix found on the operation was 86%.

About 72% of the cases of acute appendicitis occurred between the age group of 11-30 years. Among them 70% were male and 30% were female. Abdominal pain was the commonest symptom seen almost in all the patients (100%), followed by nausea and vomiting (70%) and anorexia (56%) (Table 2).

Table 3 shows the different modalities for diagnosis of acute appendicitis. About 64% of cases were diagnosed as acute appendicitis as per ultrasonography and histopathology findings (Table 4).

According to the Alvarado score system, the 48% majority had a score of 7-10 followed by 38% of patients had a score of 5-6 and 14% had a score of <5 (Table 5-9).

DISCUSSIONS

Acute appendicitis is primarily diagnosed through clinical evaluation, although ultrasonography is commonly employed for confirmation.

Table 2: Demographic data of study participants

Parameters	No.	Percentage
Age		
<10	2	2
11-20	48	48
21-30	24	24
31-40	18	18
41-50	6	6
>50	2	2
Gender		
Male	70	70
Female	30	30
Symptoms		
Abdominal pain	100	100
Nausea/vomiting	70	70
Anorexia	56	56
Constipation	16	16
Diarrhoea	10	10
Urinary complaints	8	8
Signs		
RIF tenderness	92	92
Rebound tenderness	50	50
Fever	60	60
Abdominal guarding	14	14
Psoas sign	2	2
Rovsing's sign	12	12
Rectal tenderness	6	6

Table 3: Diagnosis based on various investigation modalities

Modalities	Diagnosis	No.	Percentage
Ultrasonography	Normal	14	14
	Acute appendicitis	64	64
	Subacute appendicitis	20	20
	Appendicular abscess	2	2
Histopathology	Normal	14	14
	Acute appendicitis	34	34
	Acute on chronic appendicitis	28	28
	Chronic appendicitis	24	24

Table 4: Distribution of patients according to alvarado score

Scores	<5	5-6	7-10	Total
No. of patients	14	38	48	100

Table 5: Diagnostic value of alvarado score

Modalities	Findings	<5	5-6	7-10
Operative	Acute appendicitis	6	30	44
	Normal appendix	8	8	4
Ultrasonography	Normal	6	4	4
	Acute appendicitis	6	24	34
	Subacute appendicitis	2	10	8
	Appendicular abscess	0	0	2
Histopathology	Normal	6	4	4
	Acute appendicitis	2	8	24
	Acute on chronic appendicitis	4	16	8
	Chronic appendicitis	2	10	12

Table 6: Correlation of other modalities with modified alvarado's scoring

Modalities	Findings	<5	5-6	7-10
Clinical findings	Positive	14	38	48
	Negative	0	0	0
Operative	Positive	6	30	44
	Negative	8	8	4
Ultrasonography	Positive	8	34	44
	Negative	6	4	4
Histopathology	Positive	8	34	44
	Negative	6	4	4

Table 7: Sensitivity of modified alvarado score system

	Scores (%)		
Sensitivity	<5	5-6	7-10
Operative finding	42.86	78.95	91.67
Ultrasonographic findings	57.14	89.47	91.67
Histopathological finding	57.14	89.47	91.67

Table 8: Test of significance between different diagnostic modalities and modified alvarado score system

Modalities	Findings	<5	5-6	7-10	p-value
Operative	Acute appendicitis	6	30	44	0.01
	Normal appendix	8	8	4	
Ultrasonography	Acute appendicitis	8	34	44	<0.05
	Normal appendix	6	4	4	
Histopathology	Acute appendicitis	8	34	44	<0.05
	Normal appendix	6	4	4	

Table 9: Negative appendicectomy rate

Score	No. of negative appendicectomy	Percentage
<5	6	6
5-6	4	4
7-10	4	4
Total	14	14

Ultrasonography exhibits high sensitivity (up to 90%) and specificity (80-90%) in diagnosing acute appendicitis. The Alvarado scoring system is a valuable tool for general practitioners and primary healthcare professionals to assess the need for surgical referral, helping avoid delayed or unnecessary referrals. Key predictive indicators include right iliac fossa pain with guarding, fever and elevated leukocyte count. Alvarado recommended surgery for patients with a score of 7 or higher, while those with a score below 6 were typically observed. Although, visual examination during appendectomy often confirms the diagnosis, occasional instances of a seemingly normal appendix necessitate histological confirmation as the definitive diagnostic criterion for acute appendicitis.

The findings derived from our investigation indicate a notable incidence of acute appendicitis within the 11-20 age group, accounting for 48% of cases, followed by the 21-30 age group, comprising 24% of cases. Epidemiological studies have consistently reported a higher prevalence of appendicitis among individuals aged 11-30 years[11-13]. Additionally, our study revealed a male predominance with 70 male patients compared to 30 female patients, resulting in a male-to-female ratio of 2.23:1. This contrasts with the ratios reported in previous studies, specifically 1.27:1 in Brahmachri and Jajee[13] and 3.2:1 in Patra *et al*.[14].

In our research, the predominant presenting symptom was abdominal pain, observed in 100% of the patients, followed by nausea/vomiting in 70% of cases and right iliac fossa (RIF) tenderness in 92% of cases. Leukocytosis was noted in 78% of patients, with a left shift observed in 22%. These observations align with the findings of previous studies. Specifically, Lameris *et al*.[15] and Subedi *et al*.[16] reported a high prevalence of pain in the peri-umbilical region migrating to the right iliac fossa in patients with acute appendicitis, with leucocytosis noted in 65% and 98% of cases, respectively which is consistent with the present study. Furthermore, Merhi *et al*.[17] emphasized the significant correlation between anorexia, neutrophil left shift and rebound tenderness in achieving an accurate diagnosis of appendicitis.

In our investigation, 48% of the patients fell within the Alvarado score range of 7-10, while 38% were in the range of 5-6 and 14% scored between 1-4. These findings closely mirror those reported by Kailash *et al*.[1]. Further analysis in our study revealed that patients with Alvarado scores in the ranges of 1-4, 5-7 and 8-10 exhibited appendicitis confirmation rates of 57.14, 89.47 and 91.66%, respectively. This diagnostic accuracy is notably consistent with the established literature where negative appendectomy rates typically range from 20-40%[11,18,19]. In our study, the negative appendectomy rate was observed to be 14%.

In a prospective study encompassing a cohort of 215 patients, including both adults and children, the application of the Alvarado score resulted in a noteworthy reduction of the initially elevated false-positive appendectomy rate from 44-14%[20]. This reduction aligns with the consensus among surgeons worldwide who generally consider a negative appendectomy rate of up to 15-20% as an acceptable threshold[20].

While the removal of a normal appendix may appear to be a reasonable measure for mitigating the complications associated with acute appendicitis, it is essential to acknowledge that unnecessary appendectomy exposes patients to long-term risks and morbidity[21].

CONCLUSION

The Alvarado scoring system serves as a swift, straightforward, cost-effective, dependable, non-invasive, replicable and safe diagnostic tool for acute appendicitis. It offers an effective solution for routine clinical practice and proves particularly valuable in peripheral or rural healthcare settings where access to advanced imaging modalities such as ultrasonographic scans or CT scans may be limited. The incorporation of this scoring system enhances diagnostic precision. When complemented with Ultrasonography, it can contribute significantly to the reduction of negative appendectomy rates and consequently, lower complication rates.

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