Original article

Is diagnostic accuracy of Alvarado scoring feasible in acute surgery for management of acute appendicitis?

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Abstract:

Aim: To evaluate the usefulness and feasibility of the Alvarado scoring system in acute surgery in reducing the percentage of negative appendicectomy in our institute. ***Materials and Methods***: A prospective study was conducted, comprising 100 patients, admitted to department of Surgery in Maharishi Markendeshwar Institute of Medical sciences & Research (M.M.I.M.S.R), Mullana, Ambala, India during the period October 2012 to July 2014 with a preliminary diagnosis of acute appendicitis. Patients of both sexes and all age groups were included in the study and their Alvarado scores calculated, on the basis of which patients were divided into three groups: group1 (alv. Score >7) , group 2 (alv. score 5-6), group 3 (alv. Score <4). The signs, symptoms, laboratory values, surgical interventions, and pathology reports of each patient were evaluated. Diagnosis was confirmed by histopathological examination. Sensitivity, specificity, and positive and negative predictive values of scoring system were calculated. ***Results***: Out of 100 cases (82 males, 18 females), 76 Patients belonged to be in group1 (76%), 20 patients were in group 2 (20%) and 4 patients were in group 3 (4%). All 100 patients were operated, of which 86 patients found to have inflamed appendix (86%). 82 (82%) of operated patients were male and 18 (18%) were females. Out of 82 of operated males, 64 were having score > 7, 8 were having score 5-6 and 1 had score <4. Out of 18 operated females, 6 were having score > 7, 4 were having score 5-6, and 2 females had scoring <4. Negative appendectomy rate in our study was 14% which showed that Alvarado score helped in making diagnosis of acute appendicitis; thus reducing negative appendicectomy. Sensitivity and specificity of the Alvarado scoring system were found to be 83.7% and 71% respectively. Positive and negative predictive values were 94.7% and 83.3% respectively. ***Conclusion***: Alvarado score can be used effectively in acute surgery in our setup to reduce the incidence of negative appendectomies in both male and females. It can be applied easily for acute surgery even by junior surgical colleagues with limited diagnostic facilities available to them.ry even by junior surgical colleagues with limited diagnostic facilities available to them

Keywords: appendicitis; Alvarado score; appendicectomy

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Introduction

Acute surgery is rapidly attracting focus of surgeons in recent era spatially for better and prompt approach towards life threatening surgical emergencies. Acute appendicitis is one such surgical condition with lifetime prevalence rate of 7-8% [1]. Management of patient presenting with right iliac fossa pain is a continuing surgical challenge. Although surgeons have been managing this for more than 100 years, prompt diagnosis is elusive in order to reduce morbidity and to avoid serious complication [2]. Negative appendicectomy rate of 15-40% has been reported in literature and many surgeons would accept this rate as inevitable [3]. Although Imaging modalities like ultrasound and CT scan abdomen might improve diagnostic

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accuracy but did not show much improvement in the outcome of acute appendicitis when compared to clinical judgment [4].

The diagnosis of appendicitis is clinical and essentially is based on history, clinical examination and routine laboratory tests. Acute appendicitis may clinically present as non-specific vague abdominal pain to the classic presentation of right iliac fossa pain, tenderness and rebound tenderness. However, when it presents with atypical features, it poses a diagnostic challenge. If left untreated, it has the potential for severe complications like perforation, sepsis or even deaths [1, 2, 3]. Various scoring systems, imaging modalities and novel techniques have been devised, in attempts to increase the diagnostic accuracy and reduce the high negative appendectomy rate. However, most of them are complex, expensive and difficult to implement in emergency situation [1, 4, 5].

In present study we aimed to evaluate the usefulness of Alvarado score in patients with provisional diagnosis of acute appendicitis thereby guiding evidence based clinical decision making in patients presenting with features suggestive of acute appendicitis. Alvarado score is based on history, clinical examination, and few laboratory investigations, which helps to reduce negative appendicectomy rate and improved patient quality of care [5]. It is a simple, easy to apply, a cheap tool and an effective mean of stratifying patients according to the risk of acute appendicitis.

Material and Methods

Hundred patients having clinical features of Appendicitis were admitted in department of Surgery MMIMS&R, Mullana and studied for Alvarado scoring system. This study was ethically approved by local ethical committee. Their results were analysed for accurate diagnosis which finally be proved by investigation like histopathology of surgical specimen. In order to achieve accuracy in early diagnosis of these cases of acute appendicitis, a scoring system described by Alvarado [6] was adopted to limit the negative appendicectomy without increasing morbidity and mortality. The scoring system as described by Alvarado is based on three symptoms, three signs and two laboratory findings. (Table-1)

Patients with a score of ≤ 4 were not considered likely to have acute appendicitis, those patients with a score of 5-6 were considered to be having a possible diagnosis of appendicitis but not convincing enough to warrant immediate surgery and both groups were taken to be negative in our study. Those with a score of ≥ 7 were considered to have acute appendicitis (positive cases).

Female patients with pelvic inflammatory disease

Table 1: Results of Alvarado Score based on symptoms, signs & laboratory findings

Alvarado Score		
Symptoms		Score
	Migrating RIF Pain	1
	Anorexia	1
	Nausea/Vomiting	1
Signs		
	Tenderness/ RIF	2
	Rebound Tenderness RIF	1
	Elevated Temperature	1
Laboratory		
	Leucocytosis	2
	Shift to Left (increased Neutrophils)	1
Total Score		10

Table 2: Results of Alvarado Score (Total Cases = 100)

Variable	≥ 7	5-6	< 4
Male	64	16	2
Female	12	4	2
Total	76	20	4

Table 2(a): Results of Alvarado score (Operated=100)

Variable	Number of Patients	Score≥7	Appendicitis	Normal Appendix
Male	82	64	62	2
Female	18	12	10	2

Table 2(b): Results of Alvarado score (Operated =100)

Variable	Number of Patients	Score5-6	Appendicitis	Normal Appendix
Male	82	16	12	4
Female	18	4	2	2

Table 2(c): Results of Alvarado score (Operated =100)

Variable	Number of Patients	Score≤4	Appendicitis	Normal Appendix
Male	82	2	0	2
Female	18	2	0	2

Table 3a: Statistical data- Diagnostic Accuracy

Variable	Inflamed Appendix	Normal Appendix
Score ≥ 7	72 (a)	4(b)
Score ≤ 6	14(c)	10(d)

Table 3a: Diagnostic Accuracy (Male/female)

Variable	Inflamed Appendix		Normal Appendix	
	male	female	male	female
Score ≥ 7	62(a)	10(a)	2(b)	2(b)
Score ≤ 6	12(c)	2(c)	8(d)	2(d)

were excluded from the present study. All though 24 patients (out of 100) were having Alvarado score of less than 7, they could also be operated based on their strong clinical suspicion of acute appendicitis. All necessary investigations were carried out in all patients. Management options included conservative treatment which was given to all patients and open or laparoscopic appendectomy, performed according to the surgeon's choice. Gross operative findings were also endorsed and all specimens were subjected to histopathological assessment.

Appendicectomy was done in all 100 cases according to Alvarado scoring and general condition of the patient. Diagnostic accuracy was measured by using following methods: - Sensitivity: - a/ (a+c) X 100; Specificity: - d/ (d+b) X 100; Positive predictive value: - a / (a+b) X 100; Negative predictive value: - d/(c+d) X 100[8]. (a = no. of true positive, b = no. of false positive, c = no. of false negative and d = no. of true negative cases).

Results

The present study was conducted on 100 patients with provisional diagnosis of acute appendicitis admitted in Department of General Surgery, MMIMS&R, Mullana (Ambala).

We divided the patients into three groups i:e group1(Alvarado score ≥7) ,group 2(Alvarado score 5-6), group 3 (Alvarado score ≤ 4). 76 Patients were found to be in group 1, 20 patients were in group 2 and 4 patients were in group 3. Patients were evaluated on the basis of history, clinical examination; laboratory investigations and Alvarado score. Various observations made during study are as per various tables (Table:-2, 3, 4).

It was clearly evident in present study tables (2, 2a, 2b, 2c, 3 & 3a) that 72 cases were True Positive =

(a) on Alvarado score, whereas 10 cases were true negative= (d). As also evident here that this scoring system is having very low false positivity (only 4 cases).The overall diagnostic accuracy of Alvarado score was also high with 83.7% sensitivity; 71% specificity and positive predictive value of 94.7%. When compared, we found that the Sensitivity (83%), Specificity (50%) and Positive Predictive Value (83%) in female patients were lower than male patients.

Graph – 1 showing results of Alvarado Score

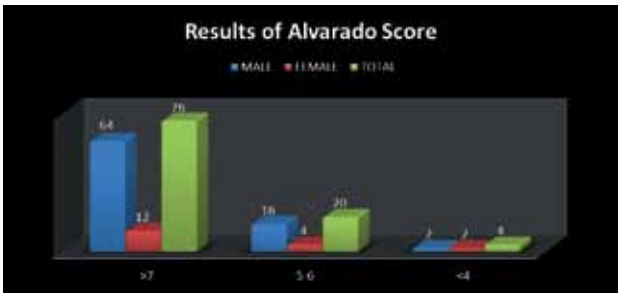
Graph 2: As evident in graph-2, on histopathological confirmation in present study, we found normal appendix in only 14% of cases where as majority showed either acutely inflamed appendix (42%) or Suppurative appendicitis (36%).

Discussion

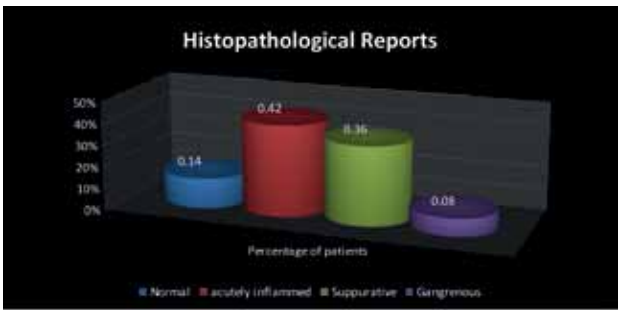
Acute appendicitis remains a common abdominal emergency throughout the world. It is a common, sometimes confusing cause of acute abdomen in all age groups [1,2,4,5]. The diagnosis of appendicitis can be difficult, even for the most experienced surgeon. Though there are a lot of advances in the diagnostic field with the invention of sophisticated investigations diagnosis of acute appendicitis remains an enigma for the attending surgeon. None of the investigations like USG, CT, can determine definitely about appendicitis. The patient having appendicitis suffers from pain abdomen usually starting in the umbilical area and later shifting to right iliac fossa and then presents to a doctor who diagnoses the condition[9].

Time and again it has been proved that some of the investigations already discussed are time consuming, requiring more specialized and expert services, while some are not available everywhere[10].So even today a thorough clinical examination with basic investigation like WBC count remains cornerstone in the diagnosis of acute appendicitis. We find the Alvarado score [7] (AlvaradoA.1986) invaluable in diagnosing acute appendicitis as the score is simple to use and easy to apply. In our present study the usefulness of the scoring system was demonstrated beyond doubt by reducing number of appendicectomies especially in male patients having normal appendix. The scoring system as described by Alvarado is based on three symptoms, three signs and two laboratory findings. Patients with a score of ≤ 4 were not considered likely to have acute appendicitis, those patients with a score of 5-6were considered to be have a possible diagnosis of appendicitis, but not convincing enough to warrant immediate surgery and these both groups were taken to be negative in our study. Those with a score of ≥7 were considered to have acute appendicitis. Appendicectomy was done in all 100 cases depending on Alvarado scoring and general condition of the patient. In our study we divided the patients into two groups. Group A patients having Alvarado score of 7 or above, who were taken as cases of acute appendicitis, group B patients having Alvarado score of 6 or below 6. 100 patients admitted in Department of General Surgery MMIMS&R, Mullana with provisional diagnosis of acute appendicitis made on the basis of Alvarado scoring system were included in the study. In our study of 100 patients all were operated and 86(86%) operated upon were found to be having inflammed appendix as per operative diagnosis while 14 having apparently normal appendix. All these specimens sent for Histopathological examination, 86 (86%) were having acutely inflammed appendix. The study conducted by SoomroAG et al in which it was showing incidence of (58.3%) having acute appendicitis on Histopathological examination[11]. Out of 100 patients 82 were males and 18 were females. The studies shows the males were having higher rates of appendicitis than females for all age groups (overall rate ratio, 1.4:1) [12] .More than half of patients (60, 60%) were in their 2nd and 3rd decade of their life, out of 60 patients 54 were males and 6 were females. The highest incidence of primary positive appendectomy (appendicitis) was found in persons aged 10-19 years (23.3 per 10,000 population per year) [12] .The overall sensitivity of Alvarado scoring system in our study was as high as 83%as compared to Crnogorac S et al where sensitivity is 87% studied on 68 patients of whom 52 were operated[13]. Out of 52, 43 patients were having Alvarado score≥7 were proved appendicitis on histologically. The sensitivity is 87.4% in study done by LimpawattanasiriC in 1000 patients in which 838 underwent surgery and 715 were confirmed histopathologically[14]. DeySet al[15] found sensitivity in their study was 94.2% which is comparable to our study. In our study Alvarado score sensitivity in males is 83.7%. In females sensitivity of Alvarado score is 83%. Baidya et al and Memon ZA et al studied and found sensitivity of 88.8% and 93.5% respectively [16, 17]. The overall specificity of Alvarado scoring system in

our study was as high as 71%.This is comparable to study conducted by Crnogorac S et al where specificity is 60%[16,17] .The specificity is 74.3% in study done by Limpawattanasiri C[14].JalilA et al found specificity was 81%[18] . Baidya et al studied 231 patients and found specificity of 75% [21]. Memon ZA et al studied 110 patients and found specificity of 80.6%[17] . DeyS et al studied 155 patients and found specificity is 70% in which 92 were operated, and 80 were confirmed having appendicitis on histology reports [15]. In our study Alvarado score specificity in males is 75%. In females specificity of Alvarado score is 50%. In our study when the score was ≥ 7 indicating strong possibility of acute appendicitis, the surgery was performed. A total of 76 patients were having Alvarado score ≥ 7. Out of these 72 were proved to be having inflammed appendix on Histopathological Examination (HPE). 4 patients were found to have normal appendix on HPE, so normal appendicectomy rate for score ≥ 7 was reduced to 5.2%. Overall normal appendicectomy rate in our study is 14% which was comparable to other normal appendicectomy rates included in literature. In Dey S etal (13%) reported series, out of 92 operated cases 12 were found having normal



Graph – 1 showing results of Alvarado Score



Graph 2: As evident in graph-2, on histopathological confirmation in present study, we found normal appendix in only 14% of cases where as majority showed either acutely inflamed appendix (42%) or Suppurative appendicitis (36%).

appendix or any other pathology, 80 were confirmed as appendicitis on histology reports [15]. Limpawattanasiri C reported that out of 838 operated cases 715 were confirmed having appendicitis, 123 were found having normal appendix or other pathology in abdomen giving negative appendicectomy rate (14.7%) [14] .Chan MY et al[14]studied 148 patients, out of 148, 63 patients were having appendicectomies, the normal appendicectomies rate was found to be 21%.The overall Positive Predictive Value (PPV) in our study is 94.7%. In our study Alvarado score predict positively males (96%) more as compared to females (83%).Positive Predictive Value in study of Shrivastav UK et al [19][19]is 77.6%, in Jalil A et al[18] is 96%, in Limpawattanasiri C is 83.7%, in Chan MY et al is 77%, in study by DeyS et al[15] is 86.9% which are compared to our study.The overall negative predictive value in our study is 41.6%. In present study negative predictive value of males is 33.3% and in females is 50%. Negative Predictive Value in study of Shrivastav UK et al[19] is 52.4%, in Jalil A et al is [18]29%, in Chan MY et alis[20] 97.6%, in study by DeyS et al[15] is 69.8% which are compared to our study.In present study on histological examinations 14(14%) patients were having normal appendix, 86(86%) patients were having acutely inflammed appendix,42 patients were having catarrhal appendix, 36(36%) patients were having diffuse suppurative appendix, 8(8%) patients were having gangrenous appendix.

Conclusion: the Alvarado score can be used effectively in our setup to reduce the incidence of negative appendectomies. The patients are not unduly exposed to risks of delay in intervention or significant increase in number of false negative cases. It can be applied easily for acute surgery even by junior surgical colleagues with limited diagnostic facilities available to them. Alvarado score provides an economical alternative to the other available costly diagnostic modalities such as CT scan, MRI scans etc. Such economic implications are particularly important in the context of our poor patients.

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Conflict of Interest:

All authors declare that there is no conflict of interests or any financial relation with the commercial identities.

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