TO EVALUATE THE ACCURACY OF ALVARADO SCORE IN THE DIAGNOSIS OF ACUTE APPENDICITIS-A PROSPECTIVE STUDY

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ABSTRACT

OBJECTIVES

The aim of our study is to correlate the diagnosis of acute appendicitis based on the Alvarado scoring system with histological findings of the operated specimen and to analyse the incidence of negative appendectomy using this scoring system.

METHODS

A prospective study on 100 patients with clinical suspicion of acute appendicitis at MGIMS, Jaipur, from July 2011 to Dec 2012 was carried out. All patients were divided into three groups on the basis of Alvarado scoring system. USG, TLC and urinalysis was carried out in all patients. The decision of admission and surgery was made independent of the score. All removed appendix specimen were sent for histopathological examination.

RESULTS

Patients were in the range of 10-59 years with a mean age of 26.27. The male:female ratio in our study was 2.3:1. Abdominal pain was localized to RLQ in 89 patients, migration of pain from the umbilical region to right lower quadrant was present in 60%. Right lower quadrant tenderness was seen in 95% cases. Rebound tenderness was present in 68% cases. Seventy five (75%) cases were in the last score range of 7-10, suggestive of acute appendicitis with 54(72%) males and 21(28%) females. A statistically significant association between Alvarado score and histopathological diagnosis was found. The sensitivity, specificity and positive predictive value, negative predictive values of the scoring system were 80%, 70%, 96% and 28% respectively. The diagnostic accuracy of the scoring system was 79%.

CONCLUSION

Though Alvarado score is easy, cheap and useful tool in preoperative evaluation of suspected cases of acute appendicitis, the final decision to operate cannot be based on Alvarado score only, particularly in the score below 7, as the diagnostic accuracy in our study was 79% only. Additional investigations like ultrasonography and computerized tomography required to arrive at a final diagnosis, especially in elderly patients, female patients and patients with equivocal score and low scores.

KEYWORDS

Alvarado Score, Acute Appendicitis.

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INTRODUCTION

The diagnostic accuracy of acute appendicitis remains unsatisfactory ranging from 25% to 90%, being worse in females. Negative appendectomy rates of 20% to 40% has been documented and many surgeons accept the rate of 30% as inevitable.¹ removing a normal appendix poses an economic burden to both the patient and the health resource. However, misdiagnosis can lead to perforation, abscess, lump formation, obstruction and peritonitis, thereby increasing the risk of morbidity and mortality particularly in the elderly where symptoms may be mild despite presence of a severely inflamed appendix.

Difficulties in diagnosis often arise in very young, elderly and female patients of reproductive age because they usually have an atypical presentation and literature shows that 2%-7% of all adults on exploration have diseases other than appendicitis.² despite advances in diagnostic modalities diagnosis of acute appendicitis still remains challenged. Alvarado.³ 1986 proposed a scoring system based on 3 symptoms, 3 signs and 2 lab findings criteria for acute appendicitis.⁴

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Alvarado Score for Diagnosis of Acute Appendicitis	
Criteria	Score
Symptoms	
Migratory RIF pain	1
Anorexia	1
Nausea and vomiting	1
Signs	
Tenderness in right iliac fossa	2
Rebound tenderness	1
Elevated temperature (Pyrexia $\geq 37.5^{\circ}\text{C}$)	1
Laboratory	
Leucocyte count $>10 \times 10^9/\text{L}$	2
Shift to left (Neutrophilia)	1
Total	10

Table 1

AIM

The aim of our study is to correlate the diagnosis of acute appendicitis based on the Alvarado scoring system with histological findings of the operated specimen and to analyse the incidence of negative appendectomy using this scoring system.

METHODS

A prospective study on 100 patients who visited the surgical OPD at MGIMS, Jaipur, from July 2011 to Dec 2012 with clinical suspicion of acute appendicitis based on history and clinical examination were included in the study. Both males and females were included in the study. Patients with appendicular lump, generalized peritonitis, pregnancy, interval appendectomy were excluded from our study. A detailed history of site of pain, migration of pain, aggravating and relieving factors, fever, anorexia and vomiting was taken. All patients underwent physical examination for right iliac fossa tenderness, rebound tenderness and guarding. USG, TLC, DLC, and urine routine was done in all patients. The patients were scored on the basis of the Alvarado scoring system, but the decision of admission and surgery was made independent of the score. All removed appendix specimen were sent for histopathological examination.

RESULTS

Age (Years)	No. of Patients (n=100)	Percentage (%)
10-20	35	35
21-30	39	39
31-40	17	17
41-50	5	5
51-60	4	4

Table 2: Age Distribution of the Patients

Age in Years						
	10-20	21-30	31-40	41-50	51-60	Total
Male	26	26	12	4	2	70
Female	9	13	5	1	2	30
Total	35	39	17	5	4	100

Table 3: Sex Distribution as Per Age Group of Patients

Complaint	No. of Patients (n=100)	Percentage (%)
Pain abdomen RLQ	89	89
Migration of pain	60	60
Nausea/vomiting	95	95
Anorexia	83	83
Fever	32	32
Others	Dysuria	1
	Diarrhoea	3
	Constipation	1

Table 4: Symptoms

Abdominal pain was localized to RLQ in 89 patients and around the umbilicus in the remaining 11. Migration of pain from the umbilical region to right lower quadrant was present in 60% cases. Nausea or vomiting was a predominant symptom present in 95% cases. Anorexia was experienced by 83% patients. Fever was present in only 32% of patients. Murphy's triad of symptoms, i.e. pain abdomen, vomiting and fever was seen in 29% of the cases (Table 4).

Signs	No. of Patients (n=100)	Percentage (%)
RLQ Tenderness	95	95
Rebound tenderness	68	68
Guarding	34	34
Tachycardia	73	73
Temperature $>99^{\circ}\text{F}$	32	32

Table 5: Clinical Signs

Table 5 shows the clinical signs noted in the patients. Right lower quadrant tenderness was seen in 95% cases. Rebound tenderness was present in 68% cases. Guarding was present in only 34% of cases and it reflects the severity of inflammation; 73% cases had tachycardia; 32% cases were febrile with temperature above 37.5°C .

Diagnosis	No. of Patients	Percentage %
Acute appendicitis	75	90
Gangrenous appendix		
Sub-Acute appendicitis		
Acute catarrhal appendix		
Acute haemorrhagic appendicitis		
Acute haemorrhagic necrotic appendicitis		
Acute appendicitis with carcinoid tumor		
Normal appendix	6	10
Meckel's diverticulitis		
Non-specific mesenteric adenitis		
Salpingitis		
Negative exploration		
TOTAL	100	

Table 6: HPE and Operative Findings

Appendicectomy	Appendicitis on H/P Examination		Negative Appendicectomy Rate	
	No.	Percentage (%)	No.	Percentage (%)
Male (70)	66	94	4	5.71
Female (30)	24	80	6	20
Total (100)	90	90	10	10

Table 7: Negative Appendicectomy Rate

Table 6 show the diagnoses after surgery conducted on 100 patients of suspected acute appendicitis. Appendicitis was confirmed in 90 patients by histopathological examination. Gangrenous appendices were present in 6 patients. The negative appendectomy rate was 10%. (Table 7).

Score	No. of Patients (n=100)	Male		Female	
		No.	Percentage (%)	No.	Percentage (%)
1-4	6	3	50	3	50
5-6	19	13	68.4	6	31.6
7-10	75	54	72	21	28
Total	100	70		30	

Table 8: Showing Distribution of Patients

The frequency of the patients according to Alvarado scoring system is given in Table 8. None of the patients had an Alvarado score below 4. Mean score was 7.4 ± 1.55 . Group wise results were as follows: In the first group, 6(6%) patients had Alvarado score 1-4, which was not suggestive of acute appendicitis. In this group there were two negative appendectomies and no other pathology was found in both these cases. But the other four cases showed acute and sub-acute appendicitis. Nineteen (19%) cases were categorized as within 5-6 (Equivocal score) with a sex distribution of 13(68.4%) males and 6(31.6%) females. In this group there were six negative appendectomies; one case was that of salpingitis, one of mesenteric lymphadenitis and no pathology was found in the remaining four cases.

Seventy five (75%) cases were in the last score range of 7–10, suggestive of acute appendicitis with 54(72%) males and 21(28%) females. There were two negative appendectomies in this group, out of which one case was of Meckel's diverticulitis and one of salpingitis. All the patients with gangrenous appendicitis (n=6) and perforated appendicitis (n=6) in the series were within the score range of 7-10.

Diagnostic Test Result	Histopathological Diagnosis			p value
	Appendicitis	Normal	Total	
Score ≥ 7 positive	73	2	75	0.0021
Score < 7 negative	17	8	25	
Total	90	10	100	

Table 9: Association between Alvarado score and Histopathological Diagnosis

The above table demonstrates a statistically significant association between Alvarado score and histopathological diagnosis. The sensitivity, specificity and positive predictive value, negative predictive values of the scoring system were 80%, 70%, 96% and 28% respectively. The overall diagnostic accuracy of the scoring system was 79%.

Gender	Below 7	Acute Appendicitis	Normal Appendix
Male	16	13	3
Female	09	04	5
Total	25	17	8

Table 10: Diagnostic accuracy of Alvarado score below 7

The diagnostic accuracy of the score below 7 was only 32%.

Gender	Above 7	Acute Appendicitis	Normal Appendix
Male	54	53	1
Female	21	20	1
Total	75	73	2

Table 11: Diagnostic accuracy of Alvarado score 7 and above

The diagnostic accuracy of the score above 7 was about 97%.

DISCUSSION

Appendectomy is the most frequently performed surgery. Each year 2.5 lakh appendectomies are done in USA for with 15% negative appendectomy rate.

This negative rate has been accepted as an unavoidable consequence of the principal of early operation to prevent complications. Considerable effort has gone into strategies aimed at reducing the negative appendectomy rate. The demographic profile revealed a mean age of 26.27 in our study similar to that shown by Tauro LF et al.⁵ 2009 (26%) and Gaitini D.⁶ et al. in 2008 (28.4%). Our study had male-to-female ratio of 2.3:1, which is comparable to studies by Nautiyal H et al.^{8,6} (2010) 1.89 and Soomro AG et al.⁷ (2008) 1.94:1, Talukder DB et al.⁸ found male-to-female ratio as 1.38:1 (Males-58%, Females-42%); 89% presented with right lower quadrant pain and migration of pain was seen in 60% cases in our study.

These results compared well with MA Alavi's.⁹ study, where 83.37% had right lower quadrant pain and 48.78% had migration of pain. On statistical analysis of the collected data, there were 70 males and 30 females who underwent appendectomy; appendicitis was confirmed in 66 males and 24 females giving a negative appendectomy rate of 5.71% in males and 20% in females with an overall negative appendectomy rate of 10%, which are comparable with that of Jawaaid A et al.¹⁰ (7%), Alavi MA et al.⁹ (10.97%), Ikramullah Khan et al. (2005).¹¹ conducted a study to evaluate Alvarado scoring system for the diagnosis of acute appendicitis in 100 patients at Khyber Teaching Hospital, Peshawar. Their negative appendectomy rate was 15.6% (Male 12%, Female 17.9%). Literature shows that if the negative appendectomy rate is less than 10%-15%, then the surgeon is operating on too few patients, thus increasing the risk of complications.

Various scoring systems are being used to aid the diagnosis of acute appendicitis and bring down the negative appendectomy rates of which the Alvarado scoring system is commonly used. The score ≥ 7 indicates high probability of acute appendicitis. In the present study, the overall sensitivity and specificity of Alvarado score was 80% and 70% respectively. The PPV and NPV were 96% and 28% respectively. The diagnostic accuracy of the scoring system was 79%. The original article by Alvarado.¹⁰ investigated 305 patients and reported sensitivity, specificity and PPV of the scoring system as 81%, 74% and 92% similar to our results, although the NPV of 46% was higher than our study. Our findings echoed those of various other authors as outlined in table 12. However NPV was found to be much higher in most of the studies.

Author	Year	Sensitivity	Specificity	PPV	NPV	N
A Alvarado. ¹⁰	(1986)	81%	74%	92%	46%	305
Fenyo G et al. ¹²	(1997)	73%	87%	-	-	475
Jawaid A et al. ¹⁰	(1999)	78%	89%	97%	-	401
Schneider et al.	(2007)	72%	81%	65%	85%	588
Dey S et al.	(2010)	94.2%	70%	86%	69.8%	155
Present Study	(2012)	80%	70%	96%	28%	100
Table 12: Alvarado Score – Comparison with Other Studies						

The high PPV (96%) and significant association ($P = 0.0021$) of Alvarado score in our study was due to a higher proportion of patients being males with a score of >7 , which is highly indicative of acute appendicitis (Table 7 of observation). However, in our study patients with an equivocal score and low score included elderly patients and females who may have gynaecological conditions simulating appendicitis or vice versa, hence additional investigations (Like ultrasound or CT) is required to confirm the diagnosis.

CONCLUSION

Though Alvarado score is easy, cheap and useful tool in preoperative evolution of suspected cases of acute appendicitis; the final decision to operate cannot be based on Alvarado score only as the diagnostic accuracy in our study was 79%. Additional investigations like ultrasonography and computed tomography required to arrive at a final diagnosis, especially in elderly patients, female patients and patients with equivocal and low Alvarado scores.

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