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Alvarado Score: still relevant in diagnosis of acute appendicitis: a prospective study with histopathological correlation

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ABSTRACT

Background: Acute appendicitis is the most common abdominal emergency. Although abdominal surgeons have been encountering the acute appendicitis for more than 100 years, prompt diagnosis is still elusive in order to reduce morbidity and to avoid serious complications. Present study was conducted to evaluate the usefulness of Alvarado score in diagnosing acute appendicitis and its role in minimizing the negative appendectomy rate and correlating the same with histopathological findings of appendectomy specimens.

Methods: This prospective correlational study was conducted in the Department of General Surgery, Mata Chanan Devi Hospital, New Delhi for a period of one year from January 2014 to December2014. Complete clinical history of the patients was collected in a predesigned proforma. A complete physical and systemic examination was done for all patients. Based on the Alvarado scoring system the patients were divided into three categories. Category 1 (score ranging from 1-4), Category 2 (score ranging from 5-6), Category 3 (score ranging from 7-10). Specimen of removed appendix was sent for histopathological examination and clinically correlated those findings with Alvarado score. Sensitivity, specificity, positive negative likelihood ratios, positive and negative predictive values and negative appendectomy rate were calculated.

Results: Out of 100 cases (56 males and 44 females) 15 belonged to category-I, 30 belonged to category-II and 55 belonged to category-III. Surgical procedures were done in 67 patients along with conservative management. Final diagnosis by histopathology was found in 58 cases. The sensitivity and specificity of Alvarado score was found to be 89.66% and 92.86% respectively. PPV and NPV of Alvarado score is 94.55% and 86.67% respectively. The negative appendectomy rate was 13.4%.

Conclusions: Alvarado score is a simple non-invasive diagnostic procedure, which is reliable, safe, repeatable and economical, easy and can be used in emergency setting, without expensive and complicated supportive diagnostic tool in diagnosing acute appendicitis and thus still very much relevant in today's modern era with availability of gamut of expensive imaging techniques.

Keywords: Acute appendicitis, Alvarado score, Histopathology

INTRODUCTION

Acute appendicitis is one of the most common surgical emergency with a life time prevalence of approximately 1 in 7.1 Surgery for acute appendicitis is the most frequent operation performed (10% of all emergency abdominal operations) about millions of patients coming annually to

emergency worldwide.² Although abdominal surgeons have been encountering the acute appendicitis for more than 100 years, prompt diagnosis is still elusive in order to reduce morbidity and to avoid serious complications.³

Patients with acute appendicitis often present with characteristic symptoms and physical findings but

atypical presentations are not uncommon and accurate identification of patients who require immediate surgery as opposed to those who will benefit from active observation is not always easy. Age and gender confounds the clinical picture like females in reproductive age group, elderly patients because of delay in seeking medical aid and difficulty in obtaining a proper medical history.

Management of patient presenting with right iliac fossa pain is a continuing surgical challenge. Routine history, examination and simple laboratory tests like leucocyte count, neutrophil count remain effective and practical diagnostic modalities.⁴

There is limited role of conventional X-rays in the diagnosis of acute appendicitis. It may rule out other causes of acute abdomen such as bowel perforation. Ultrasonography (USG) is operator dependent and often misses or over - diagnoses the condition. Computerised tomography (CT) has high sensitivity and specificity but is expensive and not available at all centres in developing countries like India. Recent reports suggest that the indiscriminate use of CT scans may lead to the detection of low grade appendicitis that would have otherwise resolved spontaneously. 9.9

Several scoring systems have been devised to increase the sensitivity and specificity in diagnosis of acute appendicitis and reduce rate of negative appendectomies on exploration.

Alvarado score in this context is a 10-point clinical scoring system which is simple, easy to apply and effective mean of stratifying patients according to the risk of acute appendicitis based on history, clinical examination and few laboratory investigations. It helps to reduce negative appendectomy rate and improve quality of patient care.¹⁰

This study is an attempt to evaluate the usefulness of Alvarado score in diagnosing acute appendicitis and its role in minimizing negative appendectomy rate. The scoring system will be correlated with histopathological findings of appendectomy specimens.

METHODS

This prospective correlational study was conducted in the Department of General Surgery, Mata Chanan Devi Hospital, New Delhi for a period of one year from January 2014 to December 2014. Patients were recruited from O.P.D. /I.P.D. including emergency patients. This study was conducted on 100 consecutive patients with suspected appendicitis. Each patient attending the General Surgery O.P.D./I.P.D. and emergency department and fulfilling the inclusion and exclusion criteria was included in the study. All patients were informed about the nature of study and informed consent was taken from the patient or relative to participate in the

study. Permission for the study was obtained by the local ethics committee.

As per the hospital record, on an average 8-10 cases per month come for surgery. By taking this assumption into consideration with $\alpha=0.05$ and power = 80%, the minimum number of cases taken for the study was 100 which was satisfying the inclusion and exclusion criteria.

Inclusion criteria were patients of all age groups and both sex having clinical features suggestive of acute appendicitis like abdominal pain, rebound tenderness, nausea, vomiting, and elevated temperatures. Exclusion criteria were patients with malignancy, urological problems, pregnancy and gynecological problems.

Complete clinical history of the patients was collected in a predesigned proforma. A complete physical and systemic examination was done for all patients. The basic investigations like complete blood count (Hb, TLC, DLC, platelet count), random blood glucose level, urine routine microscopy and USG (if needed, to rule out gynaecological and other problems) was done.

After thorough work up, the patients were divided into three categories based on Alvarado score.¹⁰

- Category 1: Patients with score ranging from 1-4 were followed up on OPD basis
- Category 2: Patients with score ranging from 5-6 were admitted for the observation
- Category 3: Patients with score ranging from 7-10 underwent surgery after complete pre-operative evaluation.

Intraoperative findings were noted down. Specimen of removed appendix was sent for histopathological examination. Histopathological report was clinically correlated.

Follow up

Patients with score ranging from 1-4 were followed up when the patient returned back in emergency department or in the OPD. Patients with score ranging from 5-6 were admitted for the observation. When the condition of patient improved, he/she was discharged and asked to come for follow up in OPD. If patient's condition did not improve, then patient was re-evaluated for acute appendicitis or any other medical /surgical problems and was managed accordingly.

Statistical analysis

The diagnostic accuracy of Alvarado score (>7 as a positive case) versus histopathology as a gold standard was calculated in terms of sensitivity, specificity, positive predictive value, negative predictive value, and measurement of agreement (kappa statistics). The statistical significance between Alvarado score and

histopathology was determined by Chi square/Fischer exact test. The statistical significance of distribution of Alvarado score among histopathology was determined by nonparametric test Mann Whitney test. The level of statistical significance was taken p≤0.05. The data was analysed by using SPSS statistical software.

RESULTS

In our study, a total of 100 patients with clinical features allusive of acute appendicitis were included in the study. The largest age group was 21-30 years (n =48). Among them males were 26 (46.43%) and females were 22 (50.00%) as given in Table 1.

Table 1: Age and sex wise distribution of cases.

Age distribution	Sex		Total
	M	F	
10-20	12 (21.43%)	8 (18.18%)	20 (20.00%)
21-30	26 (46.43%)	22 (50.00%)	48 (48.00%)
31-40	10 (7.86%)	8 (18.18%)	18 (18.00%)
41-50	4 (7.14%)	4 (9.09%)	8 (8.00%)
51-60	4 (7.14%)	2 (4.55%)	6 (6.00%)
Total	56	44	100
Total	(100.00%)	(100.00%)	(100.00%)

The symptoms at presentation included migratory pain in right iliac fossa (48%), anorexia (63%) and nausea and vomiting (63%). Clinical examination demonstrated tenderness in right iliac fossa in 92 cases, rebound tenderness in 69 cases, and elevated temperature in 36 cases. Laboratory analysis presented raised total leukocyte count in 72 cases and shift to left in 66 cases (Table 2).

Of 100 patients 15 patients belonged to category-I including 4 males and 11 females, 30 patients were under category - II with 18 males and 12 females and 55 belonged to category-III consisting of 34 males and 21 females (Table 3).

Table 2: Distribution of cases according to symptoms, signs and laboratory findings.

Symptoms	Frequency	Percentage				
Migratory RIF						
Present	48	48				
Absent	52	52				
Anorexia						
Present	63	63				
Absent	37	37				
Nausea and vom	iting					
Present	63	63				
Absent	37	37				
Signs						
Tenderness RIF						

92	92						
08	08						
Rebound tenderness							
69	69						
31	31						
ture							
36	36						
64	64						
ngs							
72	72						
28	28						
66	66						
34	34						
	08 eess 69 31 eture 36 64 egs 72 28						

Table 3: Age and sex wise distribution of patients in different categories.

Category	Sex	Sex	
of patient	M	F	Total
I	4 (7.14%)	11 (25.00%)	15 (15.00%)
II	18 (32.14%)	12 (27.27%)	30 (30.00%)
Ш	34 (60.71%)	21 (47.73%)	55 (55.00%)
Total	56 (100.00%)	44 (100.00%)	100 (100.00%)

Table 4 presents the management plan in all the three categories of patients. Out of 15 patients placed in category I, 13 patients were conservatively managed and 2 patients had to undergo operation later on due to increased severity of symptoms. In category II, 20 patients were conservatively managed and 10 patients operated later. All 55 patients in category III underwent surgery at the initial stage only. The result is significant with p value <0.005.

Out of 100, a total of 67 patients were operated. The maximum numbers of operated patients in both males and females were in the age group of 21-30 years as shown in Table 5.

Table 6 depicts the intraoperative findings in operated patients of three categories.2 patients in category I underwent surgery. One patient was found to have acute inflamed appendix and another showed normal appendix intra-operatively. In category II, 10 patients underwent surgery on re-evaluation, out of which 3 patients were found to have acute inflamed appendix, 2 patients had perforated appendix and 2 patients had normal appendix. Meckels diverticulitis, ovarian cyst and enlarged mesenteric lymph nodes were found in one patient each. All 53 patients of category III underwent surgery. Intraoperatively 21 patients had acute inflamed appendix, 22 patients had perforated appendix, 09 had gangrenous

appendix. Ectopic pregnancy was found in 1 patient.

Normal appendix was found in 2 patients.

Table 4: Management plan of patients in all categories.

Catagory of nations	Final plan of manager	ment	- Total	Chi-square P value	
Category of patient	Changed	Unchanged	Total		
I	2 (16.67%)	13 (14.77%)	15 (15.00%)		
II	10 (83.33%)	20 (22.73%)	30 (30.00%)	n <0.0005	
III	0 (0.00%)	55 (62.50%)	55 (55.00%)	p<0.0005	
Total	12 (100.00%)	88 (100.00%)	100 (100.00%)		

Table 5: Age and gender wise distribution of operated patients.

A go distribution	Sex	Total	
Age distribution	M	F	Total
10-20	8 (20.51%)	4 (14.29%)	12 (17.91%)
21-30	15 (38.46%)	16 (57.14%)	31 (46.27%)
31-40	9 (23.08%)	4 (14.29%)	13 (19.40%)
41-50	3 (7.69%)	3 (10.71%)	6 (8.96%)
51-60	4 (10.26%)	1 (3.57%)	5 (7.46%)
Total	39 (100.00%)	28 (100.00%)	67 (100.00%)

Table 6: Intraoperative findings in operated patients of each category.

	Intraoperative findings								
Category of patient	Acute inflammed appendix	Perforated appendix	Gangrene appendix	Normal appendix	Meckels diverticulitis	Ectopic pregnancy	Ovarian Cyst	Enlarged mesenteric lymph nodes	
т	1	0	0	1	0	0	0	0	
1	(4.00%)	(0.00%)	(0.00%)	(20.00%)	(0.00%)	(0.00%)	(0.00%)	(0.00%)	
II	3	2	0	2	1	0	1	1	
Ш	(12.00%)	(8.33%)	(0.00%)	(40.00%)	(100.00%)	(0.00%)	(100.00%)	(100.00%)	
III	21	22	9	2	0 (0 000/)	1	0	0	
1111	(84.00%)	(91.67%)	(100.00%)	(40.00%)	0 (0.00%)	(100.00%)	(0.00%)	(0.00%)	
Total	25	24	9	5	1	1	1	1	
Total	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	(100.00%)	

Table 7: The histopathological findings in all categories of operated patients.

Cotogowy	Histopathological findings							
Category of patient	Acute appendicitis	Acute suppurative and perforated appendicitis	Acute gangrenous appendicitis	Normal appendix	Total			
I	1 (4.00%)	0 (0.00%)	0 (0.00%)	1 (11.11%)	2 (2.99%)			
II	3 (12.00%)	2 (8.33%)	0 (0.00%)	5 (55.56%)	10 (14.93%)			
III	21 (84.00%)	22 (91.67%)	9 (100.00%)	3 (33.33%)	55 (82.09%)			
Total	25 (100.00%)	24 (100.00%)	9 (100.00%)	9 (100.00%)	67 (100.00%)			

Table 7 presents the histopathological findings of operated patients of categories I-III. 2 patients from category I underwent surgery. One patient was found to have acute appendicitis and other showed normal appendix on histopathological examination. In category II, 10 patients underwent surgery on re-evaluation, out of which 3 patients were found to have acute appendicitis, 2

patients had perforated and suppurative appendicitis and 5 patients had normal appendix. Out of 53 patients of category III, on histopathological examination 21 patients had acute appendicitis, 22 patients had perforated and suppurative appendicitis, 09 had gangrenous appendicitis. Normal appendix was found in 9 patients.

Data of correlation of Alvarado score with histopathology was analysed using Fischer-t-test was given in Table 8. 12 patients (17.91%) were operated with Alvarado score less than 7, out of which 6 patients (66.67%) did not show appendicitis and 6 patients (10.34%) showed appendicitis on histopathology. Out of 55 patients (82.09%) with score equal to or more than 7, 3 patients

(33.33%) did not show appendicitis on histopathology and 52 patients (89.66%) showed appendicitis on histopathology. Kappa value being 0.611 shows good strength of agreement. P value being <0.005 shows highly significant data. This shows that Alvarado score co-relates with histopathology (gold standard) in diagnosing acute appendicitis.

Table 8: Correlation of Alvarado score (gender wise) with histopathology.

Sex			Histopathological f	indings	■ Total	Vanna	P value
Sex	Sex		Non-appendicitis	Appendicitis	Total	Kappa	r value
	Alvarado Score	<7	3 (75.00%)	2 (5.71%)	5 (12.82%)		
M	Aivarado Score	≥7	1 (25.00%)	33 (94.29%)	34 (87.18%)	0.624	< 0.0005
	Total		4 (100.00%)	35 (100.00%)	39 (100.00%)		
	Alvarado Score	<7	3 (60.00%)	4 (17.39%)	7 (25.00%)		
F	Aivarado Score	≥7	2 (40.00%)	19 (82.61%)	21 (75.00%)	0.598	0.040
	Total		5 (100.00%)	23 (100.00%)	28 (100.00%)		
	Alvarado Score	<7	6 (66.67%)	6 (10.34%)	12 (17.91%)		< 0.0005
Total	Aivarado Score	≥7	3 (33.33%)	52 (89.66%)	55 (82.09%)	0.611	
	Total		9 (100.00%)	58 (100.00%)	67 (100.00%)	_	

Table 9: The co-relation of Alvarado score (category wise) with histopathology.

Catagory of nations	Histopathological findi	ings	Total	P value
Category of patient	Non-appendicitis	Appendicitis	Total	r value
I	1 (11.11%)	1 (1.72%)	2 (2.99%)	
II	5 (55.56%)	5 (8.62%)	10 (14.93%)	< 0.0005
III	3 (33.33%)	52 (89.66%)	55 (82.09%)	
Total	9 (100.00%)	58 (100.00%)	67 (100.00%)	

Table 10: The association of various components of Alvarado score with histopathology.

Components of Alvarado score		Histopathological findings		— Total	P value
Components of Aiv	arado score	Non-appendicitis	Appendicitis	Total	r value
Migratory RIF	Present	3 (33.33%)	35 (60.34%)	38 (56.72%)	0.004
pain	Absent	6 (66.67%)	23 (39.66%)	29 (43.28%)	0.004
Amonovio	Present	3 (33.33%)	40 (68.97%)	43 (64.18%)	0.060
Anorexia	Absent	6 (66.67%)	18 (31.03%)	24 (35.82%)	0.060
Nausea and	Present	7 (77.78%)	39 (67.24%)	46 (68.66%)	0.700
vomiting	Absent	2 (22.22%)	19 (32.76%)	21 (31.34%)	0.709
Tenderness RIF	Present	9 (100.00%)	54 (93.10%)	63 (94.03%)	1.000
Tenderness Kir	Absent	0 (0.00%)	4 (6.90%)	4 (5.97%)	1.000
Rebound	Present	6 (66.67%)	43 (74.14%)	49 (73.13%)	0.602
tenderness	Absent	3 (33.33%)	15 (25.86%)	18 (26.87%)	0.693
Elevated	Present	5 (55.56%)	24 (41.38%)	29 (43.28%)	0.495
temperature	Absent	4 (44.44%)	34 (58.62%)	38 (56.72%)	0.485
T 4	Present	4 (44.44%)	56 (96.55%)	60 (89.55%)	-0.0005
Leucocytosis	Absent	5 (55.56%)	2 (3.45%)	7 (10.45%)	<0.0005
Chift to left	Present	4 (44.44%)	51 (87.93%)	55 (82.09%)	
Shift to left	Absent	5 (55.56%)	7 (12.07%)	12 (17.91%)	0.007
Total		9 (100.00%)	58 (100.00%)	67 (100.00%)	

Correlation of Alvarado score of category wise with histopathology was presented in Table 9. Out of 67 operated patients, one patient of category I, 5 patients of category II and 58 patients of category III were found to have appendicitis. On application of chi–square test, the data comes to be highly significant with p value <0.005 representing that Alvarado score correlates with the histopathology.

Table 10 presents the association of various components of Alvarado score with histopathology. On analyzing data migratory RIF pain, leukocytosis and shift to left are strongly associated with histopathological proven cases of appendicitis with p value being 0.004, <0.0005 and <0.007 respectively.

Mean Alvarado score associated with acute appendicitis, acute suppurative and perforated appendicitis and acute gangrenous appendicitis are 7.12, 8.08 and 8.89 respectively. Normal appendix is associated with Alvarado score of 6. P value was 0.001 showing that

higher the Alvarado score, higher is the severity of appendicitis on histopathology (Figure 1).

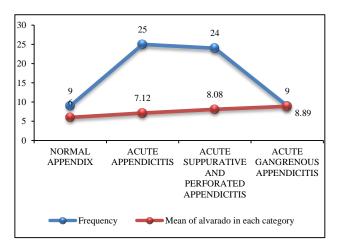


Figure 1: Pattern of Alvarado Score with increase in histopathological severity.

Table 11: Sex wise distribution of different parameters.

Sex	Sensitivity	Specificity	Positive likelihood ratio	Negative likelihood ratio		Negative predictive value
Male	94.29%	95.24%	19.8	0.06	97.06%	90.91%
Female	82.61%	90.48%	8.67	0.19	90.48%	82.61%
Overall	89.66%	92.86%	12.55	0.11	94.55%	86.67%

Table 11 shows sensitivity and specificity of Alvarado score to be 89.66% and 92.86% respectively. PPV and NPV of Alvarado score is 94.55% and 86.67% respectively.

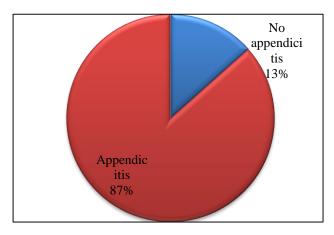


Figure 2: Pie chart showing negative appendectomy rate.

Out of 67 patients operated, 58 patients showed appendicitis on histopathology. In 9 patients, there were

no features of appendicitis. So, negative appendectomy rate was13.43% (Figure 2).

DISCUSSION

Our study included 100 consecutive patients out of which 86 patients were below the age of 40 years with maximum number of patients in the age group of 21-30 years. The mean age was 25 years. There were 56 males and 44 females. Previous studies have also shown the peak incidence of appendicitis occurring between the age group of 10 and 30 years. ¹¹ In a study done by Arain et al on 100 patients of suspected acute appendicitis, there were 55 males and 45 females, almost similar to the results of our series. ¹² Similar distribution of males and females were shown in study by Memon et al. ¹³

The reported frequency of various symptoms such as migratory RIF, anorexia, nausea and vomiting in our study was 48%, 63% and 63% respectively. Signs such as tenderness in RIF, rebound tenderness and elevated temperature were present in 92%, 69% and 36% of the patients respectively. On laboratory analysis, leukocytosis was present in 72% with shift to left present in 66% patients of patients. Similar distribution of symptoms, signs and laboratory parameters were seen in

study done by Reddy et al on 100 patients of acute appendicitis.¹⁴

In our series, 15 patients were present in category-I, 30 category-II and 55 in category-III. In a similar study conducted by Dey et al in 155 patients 22 (14.1%) patients were placed within the 1-4 score range, 70 (45.1%) were categorized as within 5-6 and 63 (40.6%) fitted in to the last score range of 7-10. 15

Out of 67 patients operated, 25 patients (37.31%) had acute inflamed appendix, 24 patients (35.82%) had perforated appendix. Gangrenous appendix was seen in 9 patients (13.43%). Meckel's diverticulitis, ectopic pregnancy, ovarian cyst and enlarged mesenteric lymph nodes were seen in 1 patients each. Normal appendix was seen in 5 patients (7.46%). The incidence of appendiceal perforation has been reported to be 17 to 40% in the literature. Gangrenous appendix was found in 11.8% of patients in prospective study done by Singh et al. 16

Median Alvarado score was 7,8,9 in acute appendicitis, acute suppurative and perforated appendicitis and gangrenous appendicitis respectively. Thus, Alvarado score showed a good co-relationship with the histopathological results, "higher the score, greater the incidence of histopathological proven acute appendicitis" p value = 0.001. Our results are comparable to various other studies. In a study done by Reddy et al on 100 consecutive patients of suspected acute appendicitis, out of 83 operated subjects, 75 were found to have acute appendicitis by histopathological examination. ¹⁴

In this study, migratory RIF pain (p=0.004) was the only symptom that was significantly associated with the histopathological diagnosis of appendicitis. Migratory right iliac fossa pain was also found to be significantly associated with appendicitis in a study performed by Korner et al. ¹⁷ Similar result was found in a study done by Graffeo. ¹⁸

Among the signs components of Alvarado score, no component was significantly associated with appendicitis. This could be attributed to the position of appendix with retrocaecal being the most common position and sometimes due to the pelvic position in which classical signs of appendicitis are absent.¹⁹

Among the laboratory analysis, both leukocytosis (p<0.005) and shift to left (p=0.007) were significantly associated with the histopathological diagnosis of appendicitis. Our results are in accordance with the studies of Wang et al and Merhi et al. 20,21

The sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, positive predictive value and negative predictive value in our study was 89.6%, 92.8%, 12.5, 0.11, 94.5% and 86.6% respectively. Overall values were comparatively more in males as compared to females (94.29%, 95.24%, 97.06%, 90.91% in males v/s 82.61%, 90.48%, 90.48%, 82.61% in females).

This concludes that the results of Alvarado score are poor in females as compared to males that are in accordance with the findings of Khan et al.²² These observations can be explained by the fact that various gynaecological conditions can mimic the presentation of acute appendicitis. Ovarian cysts, leiomyoma, malignant ovarian disease, pelvic adhesions and salpingitis have been reportedly misdiagnosed as acute appendicitis in women.²²

Our results of sensitivity, specificity, positive predictive value and negative predictive value were comparable to the results shown by Khan et al and Cham et al.^{22,23} Tamana et al studied 164 patients of suspected appendicitis. The overall sensitivity, specificity, positive predictive value and negative predictive value were 59.5%, 85.1%, 71.9% and 76.82%.²⁴

In our study, negative appendectomy rate was 13.4% as compared to the findings of Khan et al (15.6%) and Ohmann et al (14.3%). 22.25 Many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid complications, accepting the negative appendectomy rate of about 15-20%. 25 Literature shows that if negative appendectomy rate is less than 10-15%, then the surgeon is operating on too few patients thus increasing the risk of complications. 22

Therefore, the Alvarado scoring system should be used clinically for resolving the most potential management option in patients with different scores and clinical findings.

CONCLUSION

The Alvarado score can be used efficiently in diagnosing acute appendicitis to reduce the incidence of negative appendectomies. The use of this scoring system is economical and can be applied easily even by junior surgeons with less number of diagnostic facilities presented to them. Overall statistical characteristics of Alvarado score are better in males as compared to females. Other diagnostic procedures like USG may be done to improve the diagnostic accuracy in females of reproductive age.

Recommendations

- Alvarado score can be combined with radiological investigations in the evaluation of women in whom there is a high degree of suspicion of gynaecologic diseases to reduce the negative appendectomy rate
- In the equivocal clinical presentation of appendicitis, as defined by Alvarado score of 4-6, adjunctive radiological imaging is recommended to confirm the diagnosis in the emergency settings
- If clinical presentation suggests acute appendicitis by an Alvarado score of 7 or higher, operative management is recommended

- In the setting of emergency diagnosis, application of Alvarado scoring system may reduce unnecessary scans, reduce delay in diagnosis
- Alvarado score can be used in emergency setting to reduce the negative appendectomy rate.

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Ethical approval: The study was approved by the

institutional ethics committee

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