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The relevance of Alvarado score and ultrasonography in predicting and avoiding negative appendectomy in acute appendicitis: A prospective study

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Abstract
Aim: To evaluate the role of Alvarado score and ultrasound in diagnosing and preventing negative laparotomies in acute appendicitis.
Methodology: A prospective study was conducted on 100 consecutive patients who underwent appendicectomy in the department of general surgery at …….during the period of 1.5 years. Depending on individual presentation of signs and symptoms, a score was calculated for each case of suspected appendicitis from 10 values (based on the Alvarado scoring system).
All patients were clinically examined after taking a detailed history using a structured questionnaire. Then, they underwent blood examination, ultrasound abdomen, followed by surgery. The histopathological examination (HPE) of the specimen was obtained. Finally, the histopathology reports were correlated with the findings of ALVARADO Score and USG abdomen.
Results: In our study of 100 patients, 62(62%) were male, and 38 (38%) were female. 46 (46%) patients were between 20-29 years of age followed by 14-20 years of age (32%). 100 (100%) of patients were admitted with pain in the abdomen. 78 (78%) complained of nausea or vomiting at admission, 66 (66%) had fever on admission and 82 (82%) of patients had anorexia at the time of admission. All patients (100%) had tenderness in the right iliac fossa. A shift to the left was seen in 80 (80%) of patients.
Conclusion: According to our study the use of Alvarado Scoring System with USG is more effective and accurate than USG performing alone.

Keywords: Laparotomies, appendicits, Alvarado score, ultrasonography (USG)

Introduction
Acute appendicitis is the most common surgical abdominal emergency with a life time prevalence of one in seven [1]. Appendicular abscess occur in 2-6% and appendicular perforation in 25.8% of untreated patients [2].
Performing an appendectomy on clinical suspicion alone will lead to 15-30% of negative appendectomies [3, 4]. Negative appendectomy rates are reported to be between 13% and 34% in most series [5]. The accuracy of clinical examination ranges from 71-97%, depending on the examiner's experience [6]. However, a missed case of appendicitis can have dire consequences, so surgeons usually operate with a 20% negative appendicectomy rate [7]. A study of more than 75,000 patients from 1999 to 2000 revealed a negative appendectomy rate of 6% in men and 13.4% in women [8]. Negative appendicectomy was associated with significant morbidity and mortality at times. As the need to increase the diagnostic accuracy of appendicitis arose, different tools were used. The Alvarado score was described in 1986 and has been validated in adult surgical practice. This scoring system can reduce the negative appendectomy rate to 5% [9]. It was later modified by Kalan M *et al.* [10]. In order to improve the diagnostic accuracy, a number of diagnostic modalities have been proposed, including clinical scoring systems, ultrasonography, CT scans, MRI and laparoscopy [11, 12]. Graded compression ultrasonography is an accurate procedure that leads to the prompt diagnosis and early treatment of many cases of appendicitis [13].

Materials and Methods
A prospective study was conducted on 100 consecutive patients who underwent appendicectomy in the department of general surgery at ……during the period of 1.5 years.

Inclusion criteria
- Patients above 14 years of age
- Provisional diagnosis of acute appendicitis
- Willing for surgery
- Who gave consent

Exclusion criteria
- Patients below 14 years of age
- Patient with pain abdomen along with distention of abdomen
- Pregnant females
- Patient not willing for surgery

Methodology

Depending on individual presentation of signs and symptoms, a score was calculated for each case of suspected appendicitis from 10 values (based on the Alvarado scoring system). Patients were classified into three groups based on end score:
- Those patients with scores of >/= 7-9 underwent appendicectomy.
- Those patients with scores of 5-7 who were thought on clinical grounds to require appendicectomy, it was performed.
- Those patients with a score of <5 were observed initially, reassessed and later underwent surgery.

All patients were clinically examined after taking a detailed history using a structured questionnaire. Then, they underwent blood examination, ultrasound abdomen, followed by surgery. The histopathological examination (HPE) of the specimen was obtained. Finally, the histopathology reports were correlated with the findings of ALVARADO Score and USG abdomen [4].

Results

In our study of 100 patients, 62(62%) were male, and 38 (38%) were female. 46 (46%) patients were between 20-29 years of age followed by 14-20 years of age (32%).

Table 1: Demographic details of patients

Variables		Number	%
Age (in years)	14-20	32	32
	20-29	46	46
	30-39	14	14
	>39	8	8
Gender	Male	62	62
	Female	38	38

100 (100%) of patients were admitted with pain in the abdomen. 78 (78%) complained of nausea or vomiting at admission, 66 (66%) had fever on admission and 82 (82%) of patients had anorexia at the time of admission. All patients (100%) had tenderness in the right iliac fossa. A shift to the left was seen in 80 (80%) of patients.

Table 2: Sign and symptoms of patients

Sign and symptoms	Number	%
Pain in abdomen	100	100
Tenderness	100	100
Nausea or Vomiting	78	78
Fever	66	66
Shift to left	80	80
Anorexia	82	82

56 (56%) of patients in our study had conclusive evidence of appendicitis on ultrasound. Alvarado score calculated for the 100 patients showed that 88 (88%) had a score >=7. Histopathology revealed that 90 (90%) patients had appendicitis.

Table 3: Predictive power of conclusive in USG in predicting appendicitis

USG Abdomen	Appendicits	Normal	Total
Conclusive	50	6	56
Inconclusive	40	4	44
Total	90	10	100

Table 4: Predictive power of ALVARADO Score>=7 in predicting appendicitis

Alvarado score	Appendicits	Normal	Total
>=7	82	6	88
<7	8	4	12
Total	90	10	100

Discussion

Ultrasound abdomen findings are operator dependent, and an experienced sonographer can give far better positive findings than an experienced one. The inability of the sonologist to achieve adequate compression of the right lower quadrant could be due to obesity of the patient, presence of severe pain or abdominal guarding, in case of excessive bowel gas, and an uncooperative patient can all affect the accuracy of the ultrasound. The anatomical location of the appendix, like in retrocecal position it is not easily visible due to the bowel being placed anteriorly.

As in a previous study by Hale *et al*., a similar picture was noted in the case of the gender predisposition, with males affecting 65% compared to females 35% [14]. The predominant clinical feature was pain abdomen seen in all the patients followed by nausea and vomiting in 82% of the subject. This was later followed by anorexia in 80% of patients, then fever in 70% of subjects. These results are consistent with the studies done by Hardin *et al*. and Wagner JM *et al*. [15, 16].

The ALVARADO score is a scoring system that was developed to facilitate the diagnosis of acute appendicitis. In 2011, a compilation by Ohleda *et al*. [17] showed that when the predictive value of the Alvarado score was taken as 5, the sensitivity was 99% and the specificity was 43%; when predictive value was taken as 7, the sensitivity was 82% and the specificity was 81%. ALVARADO score was found to be more than or equal to 7 in 70(88.8%) cases. They were comparable to a study done by Limpawattanasiri *et al*. [18].

Although appendicitis is a common disease that requires emergency surgery, a timely and correct diagnosis can be difficult at times [19]. A patient suspected of appendicitis should be thoroughly evaluated for other causes of abdominal pain prior to surgery. The removal of a normal appendix exposes the patient to unnecessary risks related to surgery and anaesthesia and can have further implications in the patient's life.

Conclusion

According to our findings, combining the Alvarado Scoring System with USG is more effective and accurate than using USG alone. It is suggested that USG be performed on every patient with suspected appendicitis and that individuals with a USG-supported appendicitis diagnosis and an Alvarado score of 7 or above be operated on.

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