Original Research Article

Comparison of predictive validity of Alvarado score and Lintula score in acute appendicitis in adults

Chandrabose K.[1], Nair V.[2]

[1]Dr. Karpagavel Chandrabose, Assistant Professor, [2]Dr.Velayudhan Nair, Assistant Professor; both authors are attached to Department of General Surgery, Dr. SMCSI Medical College, Karakonam, Trivandrum, Kerala, India.

Address for Correspondence: Dr. Karpagavel Chandrabose, Assistant Professor, Department of General Surgery, Dr. SMCSI Medical College, Karakonam, Trivandrum, Kerala E-mail: drkarpagavel@gmail.com

Abstract

Background: Acute appendicitis is still one of the most common emergency encountered in surgical practice at all levels of health care. In resource poor settings, where diagnostic facilities for definitive diagnosis are not available objective clinical scoring systems play an important role in diagnosis and therapeutic decision making. **Materials and Methods:** To compare the predictive validity of Alvarado score and Lintula score in acute appendicitis in adults. The study was a prospective observational study conducted in the department of general surgery Dr. SMCSI Medical College, Karakonam. Trivandrum, between February to December 2016. A total of 130 subjects aged ≥1 year with symptoms suggestive of acute appendicitis were included. Alvarado and Lintula scores were calculated for all subjects and were compared with histopathology findings. An Alvarado score of ≥7, Lintula score of ≥21 was considered as screening positive. **Results:** Alvarado score had a sensitivity of 63.15 % (52.31% to 74.00%), specificity of 81.48 % (71.12% to 91.84%). Positive predictive value & Negative predictive value was 82.75% (72.03% to 92.47%) and 61.11% (49.85% to 72.37%) respectively. Diagnostic accuracy was 70.26% (62.95% to 78.58%). Lintula score had a sensitivity of 72.36 % (62.31% to 82.42%), specificity was 88.88 % (80.50% to 97.27%). Positive predictive value & Negative predictive value was 90.16% (82.69% to 97.63%) and 69.56% (58.70% to 80.42%) respectively. Diagnostic accuracy was 79% (95%CI 72.25% to 86.20%). **Conclusions:** Lintula score is more accurate than Alvarado score in the diagnosis of acute appendicitis.

Keywords: Acute appendicitis, Alvarado score, Lintula score

Introduction

Globally Acute appendicitis is the most common surgical emergency which causes acute abdominal pain and it may affect about 7% of people during their lifespan [1,2]. When compared with Western countries, the incidence of acute appendicitis is lower in Asian and African countries because of higher intake of dietary fiber [1]. Diagnosis of acute appendicitis remains as a challenging task, because of overlapping symptoms of appendicitis with a number of other conditions, especially at an early stage of presentation [3, 4]. Delay in diagnosis and management of appendicitis may increase the morbidity and mortality rates. Clinical diagnosis is accurate in 80% of cases and acts better than gold standard histopathology but still, there are records of negative appendectomy ranging from 15- 30% and perforated appendectomy ranges are 10 to 30% [5-7]. Radiological imaging techniques are the good alternatives, with accurate diagnostic results but they have some disadvantages like excessive cost, less availability, lack of radiologists etc. To fill this gap numerous diagnostic and clinical scores have been developed which are helpful to increase the accuracy of diagnosis in acute appendicitis [8-10].

Alvarado or MANTRELS scoring system was published in 1986, which was based on the mnemonic for remembering the combination of 8 signs and symptoms [8]. Lintula has developed a scoring system namely Lintula score for use in children but it was subsequently been validated in adults [11]. Different results of these scoring systems have been reported in the literature. Some studies showed that the scoring systems reduced the negative appendectomy rate by 50% [8], while some others reported that the diagnostic accuracy of the scores was low [9, 11].

Although in existing literature very few studies have compared the diagnostic accuracy of Alvarado and

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Lintula scores in the diagnosis of acute appendicitis, when seen in Indian scenario there are fewer studies are focused in this context [12-14]. The current study is aimed to assess the predictive validity of Alvarado score and Lintula score in acute appendicitis in adults.

Aims and objectives

To assess the predictive validity of Alvarado score and Lintula score in acute appendicitis in adults.

Materials and Methods

Study setting: The study was conducted in Dr. SMCSI Medical College, Karakonam, Trivandrum, in the department of general surgery.

Study design: The study was a Cross-sectional study.

Study period: The study was conducted between February 2016 to December 2016.

Sample size: This study has included 130 acute appendicitis patients.

Inclusion criteria

- Subjects with Acute appendicitis were included in the study.
- Aged above 1 year

Exclusion criteria

Patients with the following conditions were excluded from the study

- Infants
- Patients with acute abdominal pain because of some other pathologies.
- Patients with past history of surgery and those with acute abdominal trauma.

Ethical Considerations: The study was approved by the intuitional human ethics committee. Informed written consent was obtained from all study participants.

Confidentiality of the study participants was maintained throughout the study.

Study Procedure: Selected data were elicited from the patients and recorded in structured proforma. The data was collected on Socio-demographic parameters like age, gender. The history, clinical examination results, basic laboratory data (white blood cell; WBC) and were recorded on the previously prepared data sheets at the time of admission. Alvarado and Lintula scores described previously in the literature were calculated separately for each patient. An Alvarado score of 7 or greater [8], a Lintula score of 21 or greater [11] are indicative of appendicitis.

Statistical Analysis: Descriptive analysis of all the explanatory and outcome variables was done using frequency and proportion for categorical variables. The categorical variables were compared across the groups by chi-square test.

The utility of Alvarado or Lintula scores in predicting the diagnosis of acute appendicitis was assessed 95% CI, sensitivity, specificity, false positive, false negative rates and predictive values for Alvarado and Lintula scores and presented appropriately. IBM SPSS statistical software, version 21 was used for data analysis.

Results

Table-1: Distribution of Age and Gender in study population (N= 130).

Parameter	Frequency	Percentage
I. Age Groups		
1-9	10	7.7%
10-19	49	37.7%
20-29	36	27.7%
30-39	18	13.8%
40-49	10	7.7%
50 & Above	7	5.4%
II. Gender		
Male	75	57.6%
Female	55	42.3%

Among the study participants distribution of age has shown that majority of the participants were between 10 to 19 years (37.7%) and only 7.7% were in between 1 to 9 years.

The proportion of subjects in 20 to 29 years, 30 to 39 years and 40 to 49 years were 27.7%, 13.8 %, and 7.7% respectively. Only 5.4% were at 50 and above. Females constituted only 42.3% of the study population compared to 57.6% males. (Table-1)

Table-2: Descriptive statistics of clinical parameter in study group (N=130).

Clinical parameter	Percent in acute appendicitis
Right iliac fossa pain	100%
Nausea/ vomiting	61.8%
Anorexia	80%
Rif tenderness	100%
Rebound tenderness	46%
Fever	46%
Leukocytosis	61.8%

In the study group, all of the participants have the complaint of Right iliac fossa pain and if tenderness. Nausea/Vomiting was observed in 61.8% of people. The proportions of Anorexia rebound tenderness and fever were 80%, 46% and 46% respectively. Leukocytosis was seen in 61.8% of study population. (Table-2)

Table-3: Association between Alvarado Score and Acute appendicitis (N=130).

Alvarado Score	Acute Appendicitis	
	Positive	Negative
7 and above	48 (63.15%)	10 (18.51%)
Below 7	28 (36.84%)	44 (81.48%)

Parameter	Value	95% Confidence Interval	
		Lower	Upper
Sensitivity	63.15%	52.31%	74.00%
Specificity	81.48%	71.12%	91.84%
False positive rate	18.51%	8.16%	28.87%
False negative rate	36.84%	25.99%	47.68%
Positive predictive value	82.75%	73.03%	92.47%
Negative predictive value	61.11%	49.85%	72.37%
Diagnostic accuracy	70.76%	62.95%	78.58%

Among adults who had 7 or more Alvarado score, 63.15 % had acute appendicitis positive, whereas this proportion was only 36.84 % among adults with Alvarado score <7. (Table-3)

Alvarado score had a sensitivity of 63.15 % (95% CI was 52.31% to 74.00%) in predicting the diagnosis of Acute appendicitis. Specificity was 81.48 % (95% CI was 71.12% to 91.84%), the False positive rate was 18.51% (95% CI was 8.16% to 28.87%) and the False negative rate was 36.84% (95% CI was 25.99% to 46.68%).

Positive predictive value & Negative predictive value was 82.75% (95%CI 72.03% to 92.47%) and 61.11% (95% CI 49.85% to 72.37%) respectively. Diagnostic accuracy was 70.26% (95%CI 62.95% to 78.58%). (Table 3)

Table-4: Association between Lintula score and Acute appendicitis (N=130).

Lintula score	Acute Appendicitis	
	Positive	Negative
21 and above	55 (72.36%)	6 (11.11%)
Below 21	21 (27.63%)	48 (88.88%)

Parameter	Value	95% Confidence Interval	
		Lower	Upper
Sensitivity	72.36%	62.31%	82.42%
Specificity	88.88%	80.50%	97.27%
False positive rate	11.11%	2.728%	19.49%
False negative rate	27.63%	17.57%	37.68%
Positive predictive value	90.16%	82.69%	97.63%
Negative predictive value	69.56%	58.70%	80.42%
Diagnostic accuracy	79%	72.25%	86.20%

Among adults who had 21 or more Lintula score, 72.36 % had acute appendicitis positive, whereas this proportion was only 27.63% among adults with Lintula score <21. Lintula score had a sensitivity of 72.36 % (95% CI was 62.31% to 82.42%) in predicting the diagnosis of Acute appendicitis. Specificity was 88.88 % (95% CI was 80.50% to 97.27%), False positive rate was 11.11% (95% CI was 2.72 % to 19.49%) and False negative rate was 27.63% (95% CI was 17.57% to 37.68%). Positive predictive value & Negative predictive value was 90.16% (95%CI 82.69% to 97.63%) and 69.56% (95% CI 58.70% to 80.42%) respectively. Diagnostic accuracy was 79% (95%CI 72.25% to 86.20%). (Table-4)

Discussion

Although there was an advancement in diagnosis and treatment techniques, still appendicitis is a challenging surgical emergency with significant morbidity and mortality. The delay in the diagnosis and the treatment of the condition can lead to complications.

Radiologic imaging techniques have diagnostic accuracy, with few limitations like increasing the cost of additional radiation risk. To overcome all this limitations research is going on and a group of authors has developed scoring systems based on clinical findings and routine laboratory studies [5-9, 15]. In this context, we aimed to assess the validity of Alvarado and Lintula scoring systems that are previously defined.

In the current study, people having 7 or more Alvarado score had 63.15% positive acute appendicitis cases where as in below 7 Alvarado score cases the proportion of positive appendicitis were 36.84% only.

Alvarado score had a sensitivity of 63.15%, specificity was 81.48%, the false positive rate was 18.51% and the false negative rate was 36.84%. The positive predictive value & negative predictive values were 82.75% and 61.11%. Findings of the current study are similar to that reported by Limpawattanisiri et al[16], Memon ZA [17] and Shah et al [18].

In the study of Limpawattanisiri et al reported, that the sensitivity of the Alvarado score as 87.41 %, specificity of 74.39 %, PPV of 83.7 % and concludes that Alvarado scoring system is reliable for diagnosis of acute appendicitis [16]. Diagnostic accuracy of Alvarado system in the current study is 70.76% and similarly, in the study of Memon ZA [17], Diagnostic accuracy was 89.8%.

In our study 21 or more Lintula score participants had 73.36% positive acute appendicitis and <21 Lintula score persons had 27.63% positive acute appendicitis. Lintula scoring system had a sensitivity of 72.36%, specificity was 88.88%, the false positive rate was 11.11% and the false negative rate was 27.63%. The positive predictive value & negative predictive values were 90.16% and 69.56%. The diagnostic accuracy was 79 %. Similarly, Lintula et al[15] have reported in this study 87% sensitivity of the score and 98% specificity. And supporting the predictive validity of Lintula score in acute appendicitis. Similar findings were found in the study of Yoldas et al [19].

Similar to our study, few other studies by Konan et al[14] have studied 41 patients above 65 years of age with acute appendicitis and equal number of age and gender matched controls admitted with other complaints. As per this study,

both scores were observed to operate well in distinguishing between abdominal pain due to appendicitis and non-specific abdominal pain. The Alvarado score was a better predictor compared to the Lintula score. The authors have observed improved performance of the scores by minor modifications by excluding Two parameters (absent, tingling or high-pitched bowel sounds and nausea). Study findings of Konan et al[14] were 77% sensitivity and 100% specificity for Alvarado score 7 or more. For Lintula score at 12 points cutoff had PPV, NPV was 87.2%, 87.8%.

Senan et al [13] in their study have attempted to compare the predictive validity of Alvarado and Lintula scores in acute appendicitis along with two other scoring systems. As per area under the ROC curve, all the scores were reported to have very poor predictive value in diagnosing acute appendicitis. There was also the poor level of agreement between the scoring systems as shown by low Kappa statistic. The authors reported sensitivity and specificity of the four scoring systems were not sufficient enough in diagnosing acute appendicitis and recommended clinical judgment to a better alternative in absence of appropriate imaging facilities.

Wilasrusmee C et al. [12] in their recent systematic review have evaluated various scoring systems in predicting appendicitis. This review has included 44 studies published between 1974 to 2012, in which some of the studies have developed or modified existing diagnostic scoring systems and some studies have used existing validated models. Most frequently validated scores were Alvarado, modified Alvarado, Fenyo, and Eskelinen scoring systems.

The reviewers have reported only Eskelinen model to be derived based on multivariate regression methods and concluded that the research methods for scoring systems of appendicitis to be very inconsistent. Lintula Score was used by very few studies as per the review. The authors basing on this review have strongly recommended the need to develop more efficient scoring systems with better internal and external validity.

Conclusions

- Both Alvarado and Lintula scores have high sensitivity and specificity values in the diagnosis of acute appendicitis of adults.

- Diagnostic accuracy of Lintula score is slightly higher than Alvarado score and hence Lintula score is more accurate than Alvarado score in the diagnosis of acute appendicitis.

Recommendation

- Considering the inconsistency of reported validity and reliability of Alvarado and Lintula scoring systems, there is a strong need to conduct further large scale studies to strengthen the existing evidence on their utility
- Until strong evidence is available on the subjects, these scoring systems must be used with caution in making clinical decisions.

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References

1. Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. Am J Epidemiol. 1990;132(5):910-25.

2. Franz MG, Norman J, Fabri PJ. Increased morbidity of appendicitis with advancing age. The American surgeon. 1995;61(1):40-4.

3. Bundy DG, Byerley JS, Liles EA, Perrin EM, Katznelson J, Rice HE. Does this child have appendicitis? Jama. 2007;298(4):438-51.

4. Singh K, Gupta S, Pargal P. Application of Alvarado Scoring System in Diagnosis of Acute Appendicitis. 2008.

5. Raza M, Habib L. Negative appendicectomy rate in current surgical practice. Journal of Postgraduate Medical Institute (Peshawar-Pakistan). 2011;23(3).

6. Das M, Gautam D, Roy H, Mukherjee A, Gaurav R, Sen S. Unnecessary appendicectomy in suspected cases of acute appendicitis. Journal of the Indian Medical Association. 2009;107(6):354, 6-7.

7. Townsend Jr CM, Beauchamp RD, Evers BM, Mattox KL. Sabiston textbook of surgery: Elsevier Health Sciences; 2016.

8. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Annals of emergency medicine. 1986;15(5):557-64.

9. Ohmann C, Yang Q, Franke C. Diagnostic scores for acute appendicitis. Abdominal Pain Study Group. The European journal of surgery Acta chirurgica. 1995;161(4):273-81.

10. Lintula H, Kokki H, Pulkkinen J, Kettunen R, Gröhn O, Eskelinen M. Diagnostic score in acute appendicitis.

Validation of a diagnostic score (Lintula score) for adults with suspected appendicitis. Langenbeck's Archives of Surgery. 2010;395(5):495-500.

11. Lintula H, Pesonen E, Kokki H, Vanamo K, Eskelinen M. A diagnostic score for children with suspected appendicitis. Langenbecks Arch Surg. 2005;390(2):164-70,10.1007/s00423-005-0545-8.

12. Wilasrusmee C, Anothaisintawee T, Poprom N, McEvoy M, Attia J, Thakkinstian A. Diagnostic Scores for Appendicitis: A Systematic Review of Scores' Performance. British Journal of Medicine and Medical Research. 2014;4(2):711.

13. Sencan A, Aksoy N, Yıldız M, Okur Ö, Demircan Y, Karaca İ. The evaluation of the validity of Alvarado, Eskelinen, Lintula and Ohmann scoring systems in diagnosing acute appendicitis in children. Pediatric surgery international. 2014;30(3):317-21.

14. Konan A, Hayran M, Kilic YA, Karakoç D, Kaynaroglu V. Scoring systems in the diagnosis of acute appendicitis in the elderly. Ulus Travma Acil Cerrahi Derg. 2011;17(5):396-400.

15. Lintula H, Kokki H, Pulkkinen J, Kettunen R, Grohn O, Eskelinen M. Diagnostic score in acute appendicitis. Validation of a diagnostic score (Lintula score) for adults with suspected appendicitis. Langenbecks Arch Surg. 2010;395(5):495-500,10.1007/s00423-010-0627-0.

16. Limpawattanasiri C. Alvarado score for the acute appendicitis in a provincial hospital. J Med Assoc Thai. 2011;94(4):441-9.

17. Memon ZA, Irfan S, Fatima K, Iqbal MS, Sami W. Acute appendicitis: diagnostic accuracy of Alvarado scoring system. Asian Journal of Surgery. 2013;36 (4): 144-9.

18. Shah SWA, Khan CA, Malik SA, WaqasAjmel Munir Tarrar A, Buhatta IA. MODIFIED ALVARADO SCORE; ACCURACY IN DIAGNOSIS OF ACUTE APPENDICITIS IN ADULTS. Professional Medical Journal. 2010;17(4).

19. Yoldas O, Karaca T, Tez M. External validation of Lintula score in Turkish acute appendicitis patients. International Journal of Surgery. 2012;10(1):25-7.

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