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Validation of Lintula score among patients with acute appendicitis in a tertiary care centre of South Gujarat, India

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ABSTRACT

Introduction

In addition to advanced imaging techniques, scoring systems have been developed to facilitate and diagnose acute appendicitis. Scoring systems include variables elicited from previous patients, each of which is given a numerical value. The sum of these values is used to predict the likelihood of appendicitis and prevent delays in diagnosis. The Lintula scoring system is based on physical examination alone, with no laboratory testing. The objective of this study was to validate the Lintula score among patients with suspected appendicitis.

Methods

A prospective observational study was carried out over a period of two years. A numerical value was recorded against each of the variables of the Lintula score, and the sum score of each patient was calculated, though the diagnosis and the decision to operate or not were based on clinical examination. The results of the operation were correlated with the Lintula scoring system to evaluate its usefulness in diagnosis. Outcome measures were calculated, including diagnostic accuracy, sensitivity and specificity.

Results

A summed Lintula score of ≤15 was seen in 11 patients; a score of 16–20 was seen in 8 patients, and a score of ≥21 was seen in 31 patients. True Positive (TP) Lintula score (≥21, with positive appendicectomy) was seen in 30 patients, and False Negative (FN) Lintula score (< 21, with positive appendicectomy) was seen in nine patients. The diagnostic accuracy using the Lintula score was therefore 80%.

Conclusion

The diagnostic accuracy and sensitivity of the Lintula score in this study was found to be slightly lower than expected based on past use of the test. Despite its lower diagnostic accuracy, however, the Lintula score has the advantage that it can be used at remote healthcare centres where laboratory facilities are not available.

Keywords: Acute Appendicitis, Lintula Score, Diagnostic Accuracy

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INTRODUCTION

Acute appendicitis is one of the most common causes of right iliac fossa pain and emergency abdominal surgery.[1,2] In India, where this study was undertaken, it is generally diagnosed by a clinician based on the patient's presenting history, clinical evaluation and laboratory tests. The manifestation of acute appendicitis can, however, simulate other acute abdominal conditions. In spite of careful clinical, laboratory and ultrasound examination, the removal rate of non-diseased appendices (appendectomy) is high (10-34%), as is the missed diagnosis of inflamed appendices (20–40%), which can lead to appendiceal perforation ('burst appendix'),[3] complications and death.

In recent years, alongside advanced imaging techniques, scoring systems have been developed to facilitate and diagnose acute appendicitis. Clinical scoring systems estimate the probability of appendicitis in a patient based on a series of variables elicited from previous patients. Each variable is given a numerical value. The sum of these values is used to predict the likelihood of the patient having appendicitis and is thus used to diagnose the condition. A delayed diagnosis, or a misdiagnosis of appendicitis, can result in severe complications such as perforation, abscess formation, sepsis and intra-abdominal adhesions.

A benefit of diagnoses by such diagnoses is that they can distinguish complicated from uncomplicated appendicitis in the preoperative stage and thus help to define appropriate treatment.[3,4] Scoring systems for appendicitis include those developed by Alvarado,[5] the Appendicitis Inflammatory Score,[6] Fenyo-Lindberg,[7] Lintula,[8] Ohmann,[9] RIPASA[10] and Tzanakis scoring systems.[11] Many of these scores utilize laboratory tests, some of which may be difficult to conduct and assess quickly, especially in developing countries with limited resources. Even when laboratory equipment is present in such regions, it can frequently break down.

Among the different scoring systems, only the Lintula scoring system is based on physical examination alone, with no laboratory tests included in the score.[8] The Lintula score can, therefore, be used to diagnose acute appendicitis in rural hospitals where other diagnostic tools such as ultrasound, computed tomography (CT) scan and serum C-reactive protein level (CRP) assessment is not possible.

Scoring systems do not always perform well when tested in new populations, however, so we decided to validate the Lintula score among patients suspected of having appendicitis in a tertiary hospital in Surat, South Gujarat, India.

METHODS AND MATERIALS

We conducted a prospective observational study over a period of two years, from April 2016 to March 2018, at the Department of Surgery Civil Hospital and Government Medical College, Surat. Before starting the study, approval was granted by the local Scientific Review Committee and Institutional Ethics Committee for Human Research.

All patients presenting to the Out Patient Department or Emergency Department with suspicion of acute appendicitis were included in the study. Patients with abdominal trauma, chronic abdominal pathology, intra-abdominal pathology requiring emergency laparotomy, previous appendicectomy were excluded from the study, as were patients undergoing elective appendectomy.

Fifty patients met the inclusion criteria. Written informed consent was taken from each participant before enrolling them in the study. Lintula score variables (see Table 1) were recorded and the sum score of each patient was calculated. Diagnosis and the decision to operate or not was taken on a separate clinical evaluation, but the results of the operation were correlated with the Lintula scoring system to evaluate the latter's usefulness in diagnosis.[8] Following this, intra-operative findings were used to validate (or not) the need for appendicectomy,

including swollen and thickened appendix, appendix adherent to the caecum or ileum, greater omentum adherent to right iliac fossa, appendicolith in lumen of appendix, perforated appendix and gangrenous appendix.

Table 1 The Litula Scoring System

PARAMETER	POINTS
Gender	male = 2 points, female = 0 points
Intensity of pain	severe = 2 points, mild or moderate = 0 points
Relocation of pain	yes = 4 points, no = 0 points
Pain in right lower abdominal quadrant	yes = 4 points, no = 0 points
Vomiting	yes = 2 points, no = 0 points
Body temperature	>37.5 C = 3 points, <37.5 C = 0 points
Guarding	yes = 4 points, no = 0 points
Bowel sounds	absent, tinkling, high pitched = 4 points, normal = 0 points
Rebound tenderness	yes = 7 points, no = 0 points
Total score	0 to 32

The Lintula score has a minimum of 0 points and maximum 32 points. The cut-off level to predict acute appendicitis is >=21 points and the cut-off level to rule out acute appendicitis is <=15 points. Patients with score >=21 are recommended to undergo emergency appendectomy and those with score <=15 points are usually discharged. Patients with a score between 16 and 20 points are recommended to be observed. Each parameter has defined scores; for example, severe pain imparts two points, while mild to moderate intensity pain scores 0 points. Lintula score parameters are shown in Table 1.

Patients were further investigated, where this was considered necessary, using Complete Blood Count, ultrasound, CT scan and other appropriate diagnostic techniques. After appendicectomy, each operation was categorized as positive or negative for required appendectomy and correlated with the Lintula scoring system to evaluate its usefulness in diagnosis.

The main outcome measure used was diagnostic accuracy (true cases of acute appendicitis and true cases of non-appendicitis as a proportion of all results). Other parameters compared were sensitivity (ability to diagnose acute appendicitis); specificity (the ability rule out a diagnosis of appendicitis); the positive predictive value (the proportion of patients with acute appendicitis who were correctly diagnosed); the negative predictive value (the proportion of patients without appendicitis who were correctly diagnosed); and the likelihood ratio.

RESULTS

The 50 patients with a clinical diagnosis of acute appendicitis, who were included in the study over a period of two years, included 37 men and 13 women. Patients under 18 years of age were included in a children group and others in an adult group. (Figure 1) The youngest participant was nine years old and the eldest was 65 years old.

All the patients presented with pain in the right iliac fossa with relocation of pain seen in 33 patients. Vomiting was present in 33 patients while fever (>37.5 C) was seen in only 3 patients. Guarding was seen only in 3 patients while rebound tenderness was seen in 33 patients. (Table 2)

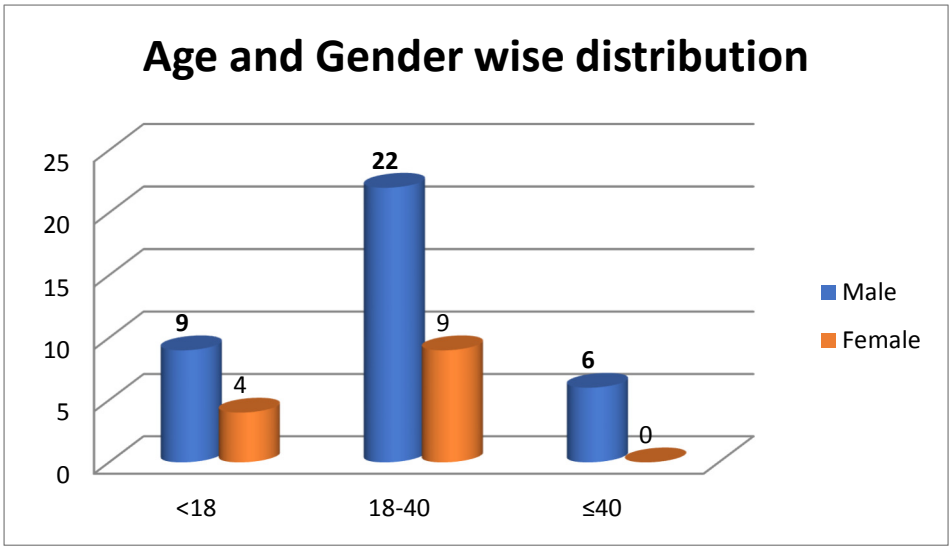

Fig 1 Age and Gender wise Distribution of all the Participants

Table 2 Distribution of Individual Parameters of Lintula Score

	Parameters		Total
Gender	**Male (2 point)**	**Female (0 point)**	
Adult	28	09	37
Children	09	04	13
Total	37	13	50
Intensity of Pain	Mild to moderate (0 point)	Severe (2 point)	
Adult	08	29	37
Children	03	10	13
Total	11	39	50
Pain in Right Iliac Fossa	Absent (0 Point)	Present (4 Point)	
Adult	00	37	37
Children	00	13	13
Total	00	50	50
Relocation of Pain	Absent (0 Point)	Present (4 Point)	
Adult	15	22	37
Children	02	11	13
Total	17	33	50
Vomiting	Absent (0 Point)	Present (2 Point)	
Adult	13	24	37
Children	04	09	13
Total	17	33	50
Temperature	Normal (0 Point)	Raised (3 Point)	
Adult	36	01	37
Children	12	01	13
Total	48	02	50
Guarding	Absent (0 Point)	Present (4 Point)	

Adult	35	02	37
Children	12	01	13
Total	47	03	50
Rebound Tenderness	Absent (0 Point)	Present (7 Point)	
Adult	11	26	37
Children	06	07	13
Total	17	33	50
Bowel Sound	Normal (0 Point)	Absent, High Pitch or Tinkling (4 Point)	
Adult	08	29	37
Children	03	10	13
Total	11	39	50

The patients were assessed using the Lintula score parameters, given a score for each parameter and a summed score for all parameters. The number of patients positive for each parameter is shown in Table 2. A total Lintula score of ≤15 was seen in 11 patients; 16 – 20 seen in 8 patients; and ≥21 in 31 patients (Table 3). Intraoperative exploration determined that 39 out of the 50 patients did require appendectomy (Table 4), while 11 (22%, 9 male and 2 female), as seen in Table 6 [13] did not.

Table 3 Distribution of all Participants According to Lintula Score

Lintula Score	Adult		Children		Total
	Male	Female	Male	Female	
≤ 15	07	01	02	01	11
16-20	02	03	03	00	08
≥21	19	05	04	03	31
Total	28	09	09	04	50

Table 4 Intraoperative Results After Exploration

Appendicectomy	Adult		Children		Total
	Male	Female	Male	Female	
Positive	21	08	07	03	39
Negative	07	01	02	01	11
Total	28	09	09	04	50

Table 5 Distribution of Lintula Intraoperative Results After Exploration

Lintula Score	Positive Appendicectomy	Negative Appendicectomy	Total
Positive (≥21)	30	01	30
Negative (≤15) or intermediate (16-20)	09	10	19
Total	39	11	50

Table 6 Comparison of Negative Appendicectomy Rate in Present Study with Other Studies

Negative Appendicectomy Rate	OC Osime et al	M Aslam et al	I Khan et al	Present Study
Male	0%	7%	12%	18%
Female	16%	20%	18%	4%
Total	16%	27%	30%	22%

The distribution of Lintula score in positive and negative appendicectomy shows that True Positive (TP) Lintula score (≥21 with positive appendicectomy), was seen in 30 out of the 31 patients assessed as in need by the Lintula score only. A False Negative (FN) Lintula Score (< 21 with positive appendicectomy), was seen in 9 out of 11 patients. True Negative (TN) Lintula score (<21, with negative appendicectomy), was seen in 10 out of 11 patients and False Positive (FP) Lintula Score (≥21, assessed as positive for appendicectomy that was not in fact) required was seen in 1 patient.

1) *Sensitivity of Lintula Score = TP/(TP+FN) = 30/(30+9) = 77%*
2) *Specificity of Lintula Score = TN/(TN+FP) = 10/(10+1) = 91%*
3) *Positive Predictive Value = TP/(TP+FP) = 30/(30+1) = 96%*
4) *Negative Predictive Value = TN/(TN+FN) = 10/(10+9) = 53%*
5) *Diagnostic Accuracy = (TP + TN)/Total = (30+10)/50 = 80%*

DISCUSSION

Despite the advancement in diagnostic techniques, diagnosis of acute appendicitis remains a challenge. Initial management of patients with suspected appendicitis is based on the condition's history, physical signs and, in some cases where available, basic laboratory tests reflecting the inflammatory response.

It is common practice to perform ultrasonography or computed tomography in patients with suspected appendicitis. However, imaging does not always perform well and the indiscriminate use of CT scans may lead to the detection of low-grade appendicitis that would have resolved spontaneously.[12] At the other extreme, morbidity and mortality rates associated with appendicitis greatly increase when perforation occurs. Wound infection rates may treble, intra-abdominal abscess formation increases 15-fold and mortality rate can be 50 times greater than in patients whose appendix has not perforated. Appendicular perforation can cause tubal infertility. Selecting patients for immediate surgery to prevent perforation is therefore paramount, as is making correct decisions on when patients can be observed at home.[13] Adding scoring systems to the tools available, such as clinical tests and imaging, is useful.

It is important to be aware that no single sign, symptom or diagnostic test is 100% accurate for appendix inflammation in all cases. The Lintula scoring system is based on clinical examinations that assess the site, intensity and relocation of pain, guarding and rebound tenderness, vomiting, body temperature and bowel sounds. In the present study, the diagnosis and decision to operate was made on this clinical basis.

The negative appendectomy rate in present study was 22%, of which 9 (18%) were in men and (4%) in women. Other studies have found different rates: Osime et al[14] have reported 16% negative rates in women; Jawaid et al in Lahore[15] found a negative appendectomy rate of 7% in men and 20% in women, while Khan[16] found a rate of 12% in men and 18% in women. In the present study, the negative appendectomy rate was higher in men than in women. However, nationally, among young male patients the negative appendectomy rate is relatively low (5-22%) while for women of childbearing age the figure may be

as high as 30-50%.[17] The reasons for this were beyond the scope of this study to determine.

The sensitivity and specificity of the Lintula scoring system in diagnosis of acute appendicitis were found to be 77% and 100% respectively. Another study, by Yoldas et al[17] determines the sensitivity and specificity of Lintula score to be 88% and 92%, which are similar to present study, which found the diagnostic accuracy of the Lintula score to be 80%; Lintula, in the original study demonstrated the diagnostic accuracy of the score to be 92%.[8] As seen in Table 7, due to high specificity the negative appendectomy rate is decreased when using the Lintula score and thus morbidity resulting from unnecessary surgery may be reduced. The negative predictive value of the score was, however, only 53%. This means a negative score should be interpreted cautiously and repeated clinical examination, with investigations as per necessary, may be more helpful in these cases.

Table 7 Comparison of Accuracy Score of Lintula Score Different Studies with Present Study

Outcome Measures (%)	Lintula et al.	Yoldas O et al.	Present Study
Sensitivity	100	88.11	76.92
Specificity	88	91.66	90.9
Positive predictive value	83	97.8	96
Negative predictive value	100	64.7	52.63
Accuracy	92	88.8	80
Negative appendicectomy rate	17	15.4	22

The variables of Lintula score depend solely on physical examination, so play a significant role in the diagnosis of patients with suspected acute appendicitis in rural hospitals where the availability of other diagnostic tools such as ultrasound, CT scans and CRP are scarce. Delays associated with slow laboratory investigations can be decreased and thus morbidity and mortality associated with complicated appendicitis can be prevented. The removal of a non-preforated appendix is bound to lower complications and morbidity due to delayed diagnosis in all cases of clinically suspected acute appendicitis. This might well improve the clinical outcome in adults with suspected appendicitis.

CONCLUSION

We found the diagnostic accuracy and sensitivity of the Lintula Score to be found slightly lower than expected, based on the original study. The main reason behind this might be that there is no laboratory parameter included in the Lintula score. Despite the lower diagnostic accuracy, however, we believe that the Lintula score can be used at remote medical centers where laboratory facilities are not available.

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