

Lintula Score versus Alvarado Score in Diagnosis of Acute Appendicitis

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Abstract: Background: Acute appendicitis is the commonest cause of abdominal surgical procedure with a prevalence of nearly 1 in 7 people. It is related to occasional mortality and high morbidity; this is due to the failure of diagnosing the condition earlier. Some studies demonstrate that there is no difference in the overall diagnostic accuracy of the Lintula system compared to the Alvarado system for the diagnosis of acute appendicitis. **Aim of study:** To compare the sensitivity, specificity and accuracy of two commonly applied scoring systems (Alvarado and Lintula) for diagnosis of acute appendicitis. **Methods:** A prospective study was conducted in the Department of General Surgery at Baghdad Teaching Hospital during the period of one year from 1st of July 2019 till 1st of July 2020. It included 100 patients attended the outpatient clinic or the emergency department with signs and symptoms suggestive of acute appendicitis (lower abdominal and/or right iliac fossa pain). Scoring was done to diagnose appendicitis by two scoring systems using the data for each patient, and these scoring systems were Alvarado and Lintula. The final diagnosis of pathology was done by histopathology postoperatively. **Results:** In this study, 82% of patients were underwent appendectomy and 47.6% of the operated cases were diagnosed as catarrhal appendicitis. Alvarado score was suggestive for acute appendicitis (positive) in 59% of study patients while Lintula score was suggestive in 64% of cases. Means of Alvarado and Lintula scores were significantly increased with severity ($P= 0.001$) to reach the highest level in patients diagnosed with severe appendicitis than other findings. Alvarado scoring system was 70.3% sensitive, 73.1% specific, and 71% accurate. Lintula score was 67.6% sensitive, 46.2% specific and 62% accurate. **Conclusion:** Lintula and Alvarado scores are comparable in the sensitivity, specificity, and accuracy for the diagnosis of acute appendicitis. Lintula score is considered simple, non-invasive way to be used.

Keywords: Diabetic, Spectrum, Orthopaedic unit.

INTRODUCTION

Acute appendicitis is still defined as the most frequent emergency abdominal condition encountered in general surgical practice, and it is one of the most common causes of lower quadrant abdominal pain. The condition has a diverse clinical presentation which overlaps with other intra-abdominal conditions. Appendicitis could carry a significant morbidity and even mortality in certain circumstances, mainly due to late presentation and diagnostic delay. (Andersson, R. *et al.*, 2004) Although the diagnosis of AA is largely a clinical one, still no single symptom, sign, or investigation can accurately predict the diagnosis of appendicitis because the clinical presentations are quite variable and the classical history of central or peri-umbilical pain with loss of appetite migrating to right iliac fossa with nausea, infrequent vomiting, and low-grade fever is present only in 50% or even a smaller number of cases. (Jones, K. *et al.*, 2004) In fact, despite diagnostic and therapeutic advancement in medicine, appendicitis remains a clinical emergency and is one of the more common causes of acute abdominal pain. (Sandy Craig BEB, 2019)

Acute appendicitis is the commonest cause of abdominal surgical procedure with a prevalence of nearly 1 in 7 people. It's estimated that about 6% of the population will have AA in their lifetime. It is related to occasional mortality and high

morbidity; this is due to the failure of diagnosing the condition earlier. (AbdulKarim, N. H. *et al.*, 2020)

Clinical studies have aimed to find out the most cost-efficient, noninvasive, and practical diagnostic procedures. To this end several scoring systems have been proposed for accurate diagnosis of AA. (Özsoy, Z. *et al.*, 2017)

Alvarado score (AS)

Alvarado score is the first and most widely known scoring method, the accuracy of which has been clinically approved. (Andersson, M. *et al.*, 2008) In 1986, Alvarado constructed a 10-point clinical scoring system, also known by the acronym MANTRELS, for the diagnosis of acute appendicitis as based on symptoms, signs and diagnostic tests in patients presenting with suspected acute appendicitis. (Alvarado, A. J, 1986)

Components of Alvarado score can summarize to acronym MANTRELS, including: (Özsoy, Z. *et al.*, 2017)

- Migration of pain.
- Anorexia.
- Nausea and/or vomiting.
- Right lower quadrant tenderness.
- Rebound tenderness.

- Elevation of temperature $\geq 37.3^{\circ}\text{C}$.
- Leukocytosis $\geq 10 \times 10^3/\text{mm}^3$, and polymorphonuclear neutrophilia $\geq 75\%$.

A score of 5 or 6 is compatible with the diagnosis of acute appendicitis. A score of 7 or 8 indicates a probable appendicitis, and a score of 9 or 10 indicates a very probable acute appendicitis. (Douglas, C. D. et al., 2000)

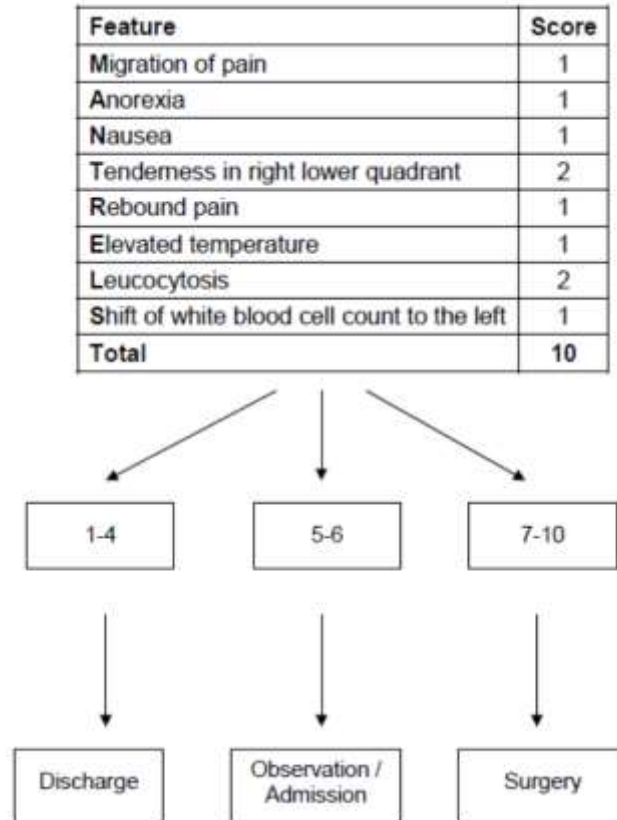


Fig.1: Alvarado score components

The original Alvarado score describes a possible total of 10 points, but those medical facilities that are unable to perform a differential white blood cell count, are using a Modified Alvarado Score with a total of 9 points which could be not as accurate as the original score. (Bundy, D. G. et al., 2007) The Alvarado score enables risk stratification in patients presenting with abdominal pain, linking the probability of appendicitis to recommendations regarding discharge, observation or surgical intervention. (Terasawa, T. et al., 2004)

The Lintula score

Lintula scoring system has the inherent advantage in that it does not require laboratory parameters. This then means that it can be deployed for use in situations where laboratory facilities may be difficult to access. Lintula scoring tools were developed in an attempt to assist clinicians in distinguishing AA from other causes of abdominal pain, with the aim of reducing the negative appendectomy rate. (Lintula, H. et al., 2009) Acute abdominal pain patients with a total score of ≤ 15

on the Lintula scales have a lower probability of AA and thus do not require hospitalization. Patients with scores of ≥ 21 , have a higher probability of AA requiring emergency appendectomy. Patients with Lintula scores between 16 and 20 are suspected cases for AA; close inpatient follow-up is recommended for this group. (Lintula, H. et al., 2010)

The Lintula score includes nine variables: gender, intensity of pain, relocation of pain, pain in the right lower abdominal quadrant, vomiting, body temperature, guarding, bowel sounds and rebound tenderness. It has a minimum of 0 points and a maximum of 32 points. The cut-off level to predict AA is ≥ 21 points, and the cut-off level for rule out AA is ≤ 15 points. Patients with scores ≥ 21 are recommended to undergo emergency appendectomy, and those with scores ≤ 15 points are amenable to discharge. Patients with the appendicitis score between 16 and 20 points are recommended to be observed. (Lintula, H. et al., 2009).

Table 1: Diagnostic criteria of Lintula score

Diagnostic Criteria	Response	Value
Gender	Male	2
	Female	0
Intensity of Pain	Severe	2
	Mild to moderate	0
Relocation of Pain	Yes	4
	No	0
Vomiting	Yes	2
	No	0
Pain in the RLQ	Yes	4
	No	0
Fever ≥ 37.5	Yes	3
	No	0
Guarding	Yes	4
	No	0
Bowel Sounds	Absent, tinkling, high-pitched	4
	Normal	0
Rebound Tenderness	Yes	7
	No	0
Total Score		32

Comparison between Lintula and Alvarado scoring system

The diagnosis of AA, remains a challenging endeavor even with the deployment of diagnostic adjuncts such as ultrasound and CT scan. In comparison between both scores, some studies demonstrate that there is no difference in the overall diagnostic accuracy of the Lintula system compared to the Alvarado system for the diagnosis of AA. The Lintula scoring system is a simple, non-invasive and cost-effective way of narrowing down the diagnosis of AA with potential utility in resource limited settings. (Ojuka, D. *et al.*, 2017)

PATIENT AND METHOD

A prospective study was conducted in the Department of General Surgery at Baghdad Teaching Hospital during the period of one year from 1st of July 2019 till 1st of July 2020.

It included 100 patients attended the outpatient clinic or the emergency department with signs and symptoms suggestive of acute appendicitis (lower abdominal and/or right iliac fossa pain).

Patients aged below eight years, those who had features of generalized peritonitis, those had previous intra-abdominal surgery, pregnant women, and those who refused to participate were excluded from this study.

Verbal permission was obtained from each patient prior to collecting data, and information was anonymous. Names were removed and replaced by

identification codes. All information kept confidential in a password secured laptop and data used exclusively for the research purposes.

A questionnaire was applied to all enrolled patients to collect the needed information as the following: (Sociodemographic information, past medical and surgical history, symptoms which included vomiting, anorexia, and pain with details of site, severity, and shifting. Examination was done including general and vital signs, temperature, abdominal examination and bowel sound. Work up with investigation results as complete blood count.

Scoring was done to diagnose appendicitis by two scoring systems using the data for each patient, and these scoring systems were:

Alvarado score

It uses mainly clinical findings and laboratory values to assess the presence of acute appendicitis. Alvarado constructed a 10-point clinical scoring system, also known by the acronym MANTRELS, for the diagnosis of acute appendicitis as based on symptoms, signs and diagnostic tests in patients presenting with suspected acute appendicitis. (Alvarado, A. J, 1986)

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- Right lower quadrant tenderness.

- Rebound tenderness.
- Elevation of temperature $\geq 37.3^{\circ}\text{C}$.
- Leukocytosis $\geq 10 \times 10^3/\text{mm}^3$, and polymorphonuclear neutrophilia $\geq 75\%$.

The two most important factors, tenderness in the right lower quadrant and leukocytosis, are assigned two points, and the six other factors are assigned one point each, for a possible total score of ten points. A score of 5 or 6 is compatible with the diagnosis of acute appendicitis. A score of 7 or 8 indicates a probable appendicitis, and a score of 9 or 10 indicates a very probable acute appendicitis. (Douglas, C. D. *et al.*, 2000)

Lintula score

Developed in an attempt to assist clinicians in distinguishing acute appendicitis from other causes of abdominal pain. The Lintula score includes nine variables: (Lintula, H. *et al.*, 2009)

- Gender (male, 2 points; female, zero points).
- Intensity of pain (severe, 2 points; mild or moderate, zero points).
- Relocation of pain (yes, 4 points; no, zero points).
- Pain in the right lower abdominal quadrant (yes, 4 points; no, zero points).
- Vomiting (yes, 2 points; no, zero points).
- Body temperature ($\geq 37.5^{\circ}\text{C}$, 3 points; $< 37.5^{\circ}\text{C}$, zero points).
- Guarding (yes, 4 points; no, zero points).
- Bowel sounds (absent, tinkling or high-pitched, 4 points; normal, zero points)
- Rebound tenderness (yes, 7 points; no, zero points).

The Lintula score has a minimum of 0 points and a maximum of 32 points.

The decision on patient management; by discharge, observation, further diagnostic studies or appendectomy was left to the discretion of the treating surgeon. The individual scores were then compared to the final diagnosis made by the

clinician and to the recommendations of each scoring system.

The final diagnosis of pathology was done by histopathology postoperatively. Appendectomy was performed through open surgery by removal of the infected appendix through a single large incision in the lower right area of the abdomen. Patients who were adjudged not to have appendicitis by the attending clinician were discharged home on analgesics and instructed to make a contact with us if any worsening or persistence of symptoms. Individuals who didn't make any contact were considered to have resolution of their symptoms after discharge and judged to have no acute appendicitis. Administrative approvals were granted from the Council of Arab Board of Medical Specialization and an approval from the Department of General Surgery at Baghdad Teaching Hospital was obtained.

The data analyzed using Statistical Package for Social Sciences (SPSS) version 25. The data presented as mean, standard deviation and ranges. Categorical data presented by frequencies and percentages. Chi square test was used to assess the association between provisional diagnosis and certain parameters of both scores. Receiver operating characteristic (ROC) curve analysis was used for prediction of Alvarado and Lintula scores as diagnostic of acute appendicitis. Pearson's correlation test (r) was used to assess correlation between Alvarado and Lintula scores. A level of p -value less than 0.05 was considered significant.

RESULTS

This study included 100 patients complained from lower abdominal and/or right iliac fossa pain suggestive of acute appendicitis.

Age was ranging from 8 to 46 years with a mean of 21.8 years and a standard deviation (SD) of ± 6.72 years. The highest proportion of study patients was aged < 20 (58%).

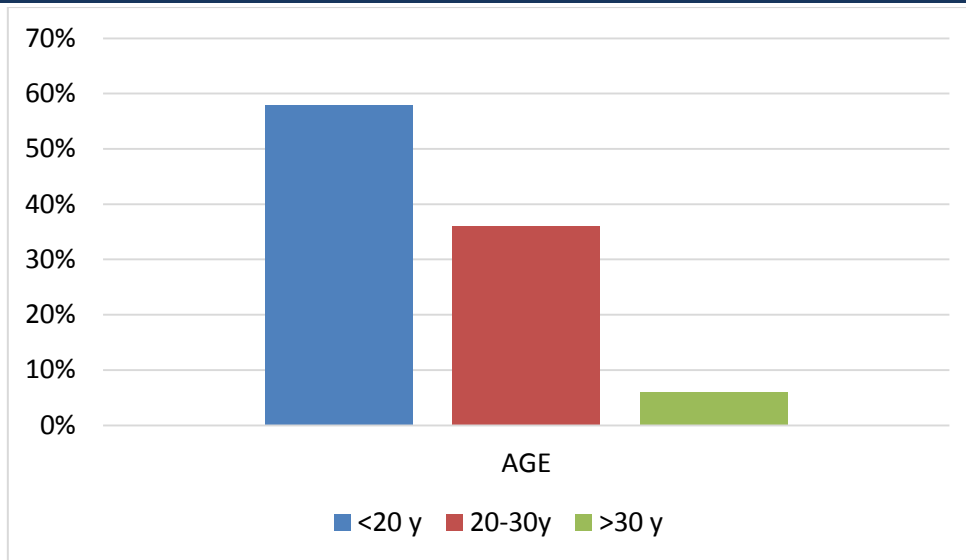


Fig.2: Age distribution in patients.

Regarding gender, proportion of females was slightly higher than males (56% versus 44%) with a male to female ratio of 1.27:1.

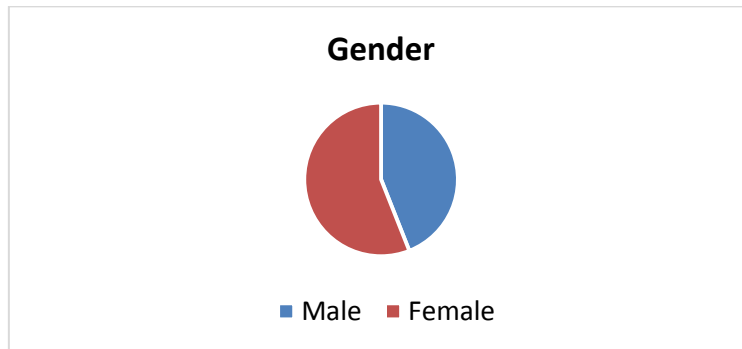


Fig.3: Gender distribution in patients.

The highest proportion of study patients were students (62%), 12% were hypertensive, 6% were diabetics, and the majority (92%) of patients' pain

was located at the right iliac fossa with duration of less than 48 hrs. in 72% of them.

Table 2: general characteristics of patients

Variable	No. (n=100)	Percent (%)
Occupation		
Student	62	62
Private worker	17	17
Housewife	21	21
Past Medical History		
Negative	82	82
Hypertension	12	12
Diabetes mellitus	6	6
Site of pain		
Right iliac fossa	92	92
Generalized abdominal pain	8	8
Duration of pain		
< 48 hrs.	72	72
> 48 hrs.	28	18

Signs and symptoms were demonstrated in the figure below, most of patients complained from right iliac fossa tenderness (93%), nausea and/or vomiting (87%) and anorexia (83%).

Rebound tenderness was detected in 87% of patients and leukocytosis was present in 71% of cases.

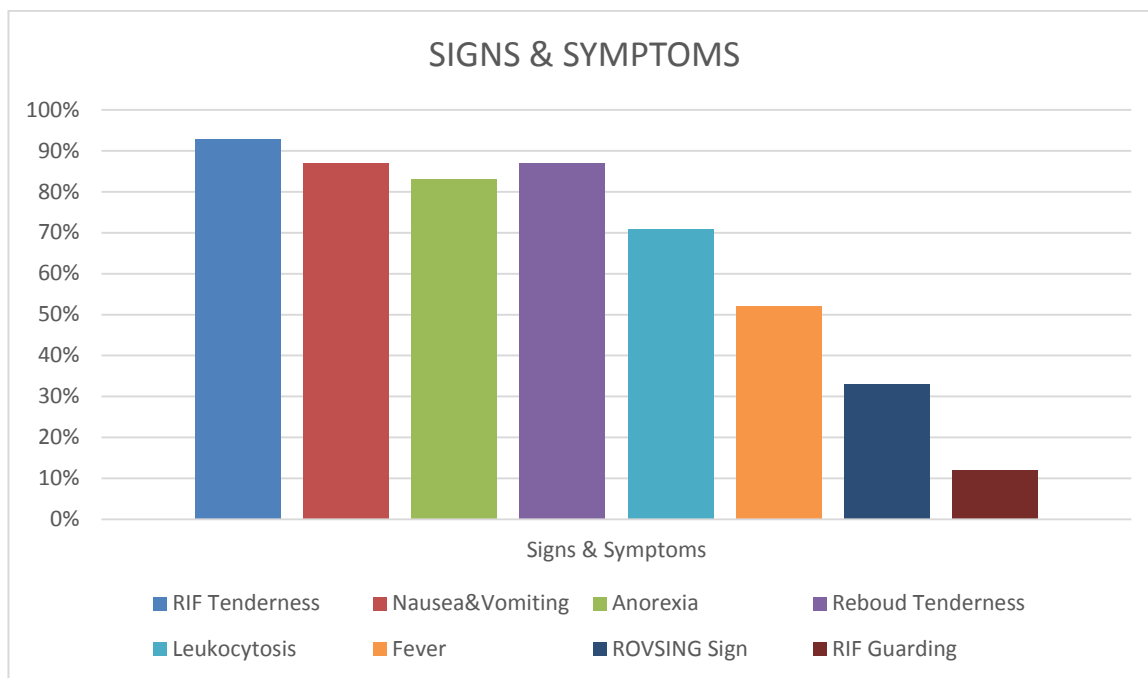


Fig.4: signs and symptoms

We noticed that 82% of patients were underwent appendectomy.

The final diagnosis of the 82 patients who underwent appendectomy. It was obvious that 47.6% of the operated cases were diagnosed as catarrhal appendicitis.

Table 3: Histopathological findings regarding those who underwent appendectomy

Histopathological findings	No. (n= 82)	Percentage (%)
Catarrhal appendicitis	39	47.6
Severe appendicitis	21	25.6
Perforated appendix	12	14.6
Normal appendix	8	9.8

We noticed that Alvarado score was positive in 59% of study patients while Lintula score was positive in 64% of cases.

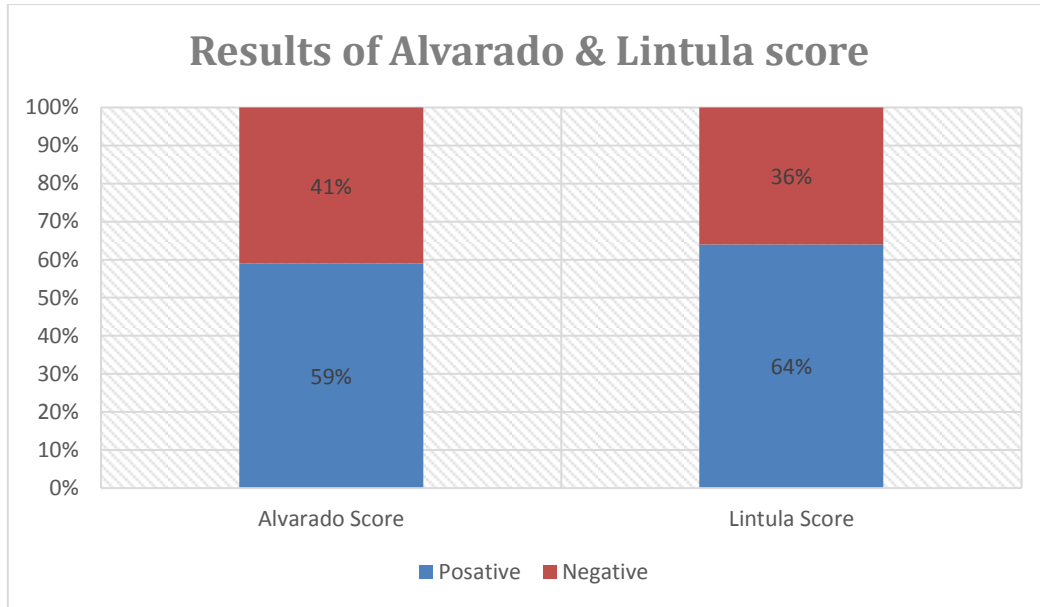


Fig.5: Results of Alvarado and Lintula scores

The comparison in ALVRADO and RIPASA Scores by diagnosis is shown in the table below. Means of Alvarado and Lintula scores were

significantly increased with severity (P= 0.001) to reach the highest level in patients diagnosed with severe appendicitis than other findings.

Table 4: Comparison in ALVRADO and Lintula Scores by diagnosis

Score	Diagnosis				p-Value
	Catarrhal Mean ± SD	Severe Mean ± SD	Perforated Mean ± SD	Normal Mean ± SD	
Alvarado	6.42 ± 1.1	8.33 ± 1.2	8.02 ± 1.1	5.91 ± 0.9	0.001
Lintula	19.21 ± 2.8	22.12 ± 3.1	21.02 ± 3.2	16.72 ± 3.4	0.001

Sensitivity, specificity and accuracy

The table below shows the sensitivity (SN), specificity (SP), Positive predictive value (PPV), negative predictive value (NPV), and accuracy of

Alvarado score. Alvarado score was 70.3% sensitive, 73.1% specific, and 71% accurate.

PPV was 88.1% and NPV was 46.3%.

Table 5: Sensitivity and specificity of Alvarado score

Alvarado score	Diagnosis		Total
	Appendicitis	Normal	
Positive	52	7	59
Negative	22	19	41
Total	74	26	100

The next table shows the sensitivity (SN), specificity (SP), Positive predictive value (PPV), negative predictive value (NPV), and accuracy of

Lintula score. Lintula score was 67.6% sensitive, 46.2% specific, and 62% accurate.

PPV was 78.1% and NPV was 33.3%.

Table 6: Sensitivity and specificity of Lintula score

Lintula score	Diagnosis		Total
	Appendicitis	Normal	
Positive	50	14	64
Negative	24	12	36
Total	74	26	100

DISCUSSION

In spite of being the most common cause of acute abdomen, acute appendicitis remains a challenging

diagnosis because it is basically a clinical diagnosis which has many clinical pictures. (Awayshih, M. M. A. et al., 2019) It is the most

common reason for surgical intervention among patients admitted to the emergency department with abdominal pain. Approximately one-third of acute appendicitis cases present with atypical clinical symptoms. (Karaman, K. *et al.*, 2018) The diagnosis of acute appendicitis is mainly clinical based on history, clinical examination and sometimes aided by laboratory investigations (as white blood cells count or CRP level). The definitive diagnosis is achieved at surgery and after histopathologic examination of the resected appendix. Delay in diagnosis and management may result in significant morbidity. The negative appendectomy rate in this series was 20% which is congruent with the rates reported in the literature of 8 to 33%. (Awayshih, M. M. A. *et al.*, 2019)

In recent years, multiple scoring systems have been developed based on anamnesis scores, clinical symptoms and findings, and inflammatory parameters, to assist in diagnosis of acute appendicitis. The Alvarado score is the first of these systems. It is based on symptoms, and clinical and laboratory results. These scoring systems aim to reduce negative appendectomies and mortality/morbidity rates by preventing complications. (Karimi, E. *et al.*, 2017) The Lintula scoring system was originally developed for the pediatric age group, but has since been validated for use in the adult age group. (Lintula, H. *et al.*, 2010) It has been developed in an attempt to assist clinicians in recognizing which children presenting with abdominal pain are at greatest risk of having appendicitis. These clinical scores are based on elements of history and physical exam, with the vast majority of scores incorporating basic laboratory investigations including the White Blood Cell (WBC) and Neutrophil counts (NC). (Khanafar, I. *et al.*, 2016)

This study enrolled 100 patients complained from lower abdominal and/or right iliac fossa pain suggestive of acute appendicitis.

Alvarado scores

In the current study, Alvarado score was positive in 59% of study patients. Means of Alvarado score was significantly increased with severity ($P=0.001$) to reach the highest level in patients diagnosed with severe appendicitis, this goes with the study of Jang, S.O. *et al.*, study in 2008, who report a positive appendectomy rate of 90.9% in patient with Alvarado score 7 and above. (Jang, S. O. *et al.*, 2008) Also, it has been found in Laith, *et al.*, study in 2015, that patient with Alvarado score 5 have a positive appendectomy of 37.5% and 55%

in patient who have Alvarado score 6 and 92.07% in patients with Alvarado score 7 and above which indicate that the positive appendectomies and its severity increases as the score increase. (Hindosh, L. N. *et al.*, 2015) In fact, severity of appendicitis can be determined clinically, by detailed history and adequate physical examination and by many laboratory

investigations (WBC, fever, peritoneal signs), and because score is dependent mainly on such variable, so as the disease worsen, these variables elevated which in turn make the score of the important determinants of the disease severity.

In this study, Alvarado score was 70.3% sensitive, 73.1% specific, and 71% accurate. PPV was 88.1% and NPV was 46.3%. These variables were compared with other studies, as in Korkut, *et al.*, study in 2020, which was more specific and less sensitive, as the AUC, sensitivity, specificity, PPV and NPV of Alvarado score was 0.938, 60.9%, 89.9%, 97.56 and 24.24 respectively. (Korkut, M. *et al.*, 2017) Another different result observed in Subraman, *et al.*, in 2017, in which reported the sensitivity and specificity of Alvarado score to be 68% and 86.96%, respectively. (Subramani, B. *et al.*, 2017) Whereas, a study conducted by Elhosseiny and colleagues in 2018 found these values to be 65.2% and 100%, respectively. (Elhosseiny, M. M. *et al.*, 2017) On the other hand, Frountzas and others in their study in 2018, noticed that the sensitivity of Alvarado score was 69% (95% CI, 67%-71%) and the specificity was 77% (95% CI, 74%-80%). Moreover, the AUC was 0.7944. (Frountzas, M. *et al.*, 2018)

The differences observed in above studies were attributed to many factors, among them, the sample size was the most important, additionally, patient education, delayed presentation to the medical care system, unreliability of the history and presentation, high progression rate of the inflammatory process, immunologic factors, and finally the primary care doctor. The principal cause being, delay before admission to the hospital. (Körner, H. *et al.*, 1997)

On the other hand, Alvarado scoring system is a simple system that can be used easily in the clinic or emergency department. Alvarado score was selected to aid in the decision-making process because of its simple design and application. Also, it has been reported that a scoring system, such as the present one, has the same diagnostic accuracy as computer aided techniques. (Alvarado, A, 1986)

Lintula score

In the current study, Lintula score was positive in 64% of cases. Means of Lintula scores were significantly high with severity ($P= 0.001$) to reach the highest level in patients diagnosed with severe appendicitis. This relation can be observed in a study done by Ojuka, *et al.*, study in 201, as they found that 60% of patients with Lintula score > 21 will have a histopathological diagnosis of acute appendicitis, meaning as the score increased in the form of increase severity, the diagnosis approved. (Ojuka, D. *et al.*, 2017) The Lintula scoring system is a simple, non- invasive and cost-effective way of narrowing down the diagnosis of acute appendicitis with potential utility in resource limited settings. (Ojuka D. *et al.*, 2017)

In the current study, Lintula score was 67.6% sensitive, 46.2% specific, and 62% accurate. PPV was 78.1% and NPV was 33.3%. When compared to other studies, Ojuka and colleagues in 2017, reported that sensitivity of the Lintula scoring systems were 60.8%, while the specificity was 60%, PPV was 79.5% and NPV was 37.5%, they concluded that Lintula system compares well with the Alvarado system for diagnosis of acute appendicitis and can therefore be employed in situations where laboratory facilities may be limited. (Ojuka, D. *et al.*, 2017)

A more specific findings observed in Konan, *et al.*, series in 2011, in which the PPV for a score of 21 in Lintula score was 100%, with an accuracy of 78%. The cut-off limit of 15 had a PPV of 88.5% and a NPV of 77.8%. Finally found the optimal cut-off point to be 12 points, with a PPV of 87.2% and a NPV of 87.8%. (Konan, A. *et al.*, 2011) On the other hand, Khanafer and colleagues in their study in 2016, observed at cut-off point of Lintula score 16, sensitivity, specificity and PPV were 59.3%, 80.1% and 57.1% respectively, which were more specific despite a lower score value. (Khanafer I. *et al.*, 2016)

Different results observed in above studies, and these differences related to the different numbers of the participants in each study, accuracy of the diagnosis of acute appendicitis which is depend on the surgeon's experience of the diagnosis and physical findings of repeated clinical examinations, severity of the disease and duration of the symptoms.

The importance of Lintula scoring system appear in that has the inherent advantage in that it does not require laboratory parameters. This then means

that it can be deployed for use in situations where laboratory facilities may be difficult to access. The diagnosis of acute appendicitis, whose gold standard remains histopathology, remains a challenging endeavor even with the deployment of diagnostic adjuncts as ultrasound and CT scan. (Ojuka, D. *et al.*, 2017)

Decision of appendectomy

In the present study, 82% of patients were underwent appendectomy. It was obvious that 47.6% of the operated cases were diagnosed as catarrhal appendicitis and 9.8% had normal appendix, while 25.6% had sever appendicitis. By comparison to other studies, Singh, *et al.*, study in 2018, observed that rate of negative appendectomy was higher compared to the current results (16%), while 82% of them had inflamed appendix (Singh, A. *et al.*, 2018), also, Awayshih, *et al.*, study in 2019, found that purulent appendicitis was the commonest findings in 37%, while catarrhal appendicitis was observed in only 9% of cases enrolled.

Another different result observed in Chong, *et al.*, study in 2010, in which diagnosis of acute appendicitis was the predominant diagnosis as formed 83.7% of cases, in contrast to only 16.3% rate of negative appendectomy. (Chong, C. F. *et al.*, 2010) Finally, in Nanjundaiah, *et al.*, study in 2014, researchers reported that a true acute appendicitis was diagnosed in 89.3% of cases and 2% of them was a perforated appendicitis, versus only 10.6% of cases had a negative appendectomy. (Nanjundaiah, M. *et al.*, 2014) The differences in the rates observed in above studies may be explained by a variety of factors: as different sample size in each study, surgeon experience in diagnosis decision, the other assistant tools of diagnosis as U/S or CT, presence of other co-morbid conditions obscure the diagnosis, as renal diseases or gynecological problems and a different Male to Female ratio in each study, the female cases always have more negative appendectomy than males and this could be due to gynecological conditions mimicking appendicitis. In fact, diagnosis of acute appendicitis is mainly clinical. Early and accurate diagnosis of a cute appendicitis is essential to decrease the morbidity and mortality associated with delayed diagnosis.

Also, negative appendectomy is not without risks. Different diagnostic aids have appeared like laparoscopy and ultrasonography with good results but they have limitations. (Singh, A. *et al.*, 2018)

Signs and symptoms

In this study, most of patients had right iliac fossa tenderness (93%); nausea and/or vomiting (87%); and anorexia (83%). Rebound tenderness was detected in 87% and leukocytosis in 71% of cases. A comparable result reported by Korkut, *et al.*, study in 2020, as found that of 74 patients diagnosed with acute appendicitis, pain in the right iliac fossa was the commonest presentation (86.5%), nausea and vomiting found in 35.1%, and rebound tenderness existed in 59.5% of cases enrolled. (Korkut, M. *et al.*, 2020) A similarity also observed in a study conducted by Singh and colleagues in 2018, as noticed that Right iliac fossa pain was most common symptom (92%) observed among cases and tenderness to right iliac fossa was most common sign (84%) cases. (Singh, A. *et al.*, 2018)

In fact, despite advances in the diagnosis and surgical treatment, diagnosing appendicitis still remains difficult. Acute appendicitis is one of the few surgical diagnosis that is made clinically and decision to undergo surgery is often given without certainty of the definitive diagnosis. The delay in the diagnosis increases morbidity and mortality, whereas false positive diagnosis of appendicitis leads to unnecessary surgery. (Partrick, D. A. *et al.*, 2003)

General characteristics

The age participants in this study were ranging from 8 to 46 years with a mean and a standard deviation (SD) of age was 21.8 ± 6.72 years. The highest proportion of study patients was aged < 20 (58%). Regarding gender, female predominance observed (56% versus 44%) with a male to female ratio of 1.27:1. By comparison to other studies, a different result observed in Korkut, *et al.*, study in 2020 which included a total of 74 patients with a preliminary acute appendicitis diagnosis. A male predominance observed in that constituted 56.8% of study patients versus 43.2% females. The median age was 33 years (range between 18-63) years.²⁵ Furthermore, another different result reported by Awayshih, *et al.*, study in 2019, in which 100 consecutive patients with clinical picture of acute appendicitis were conducted. Among these patients 44 were female (44%) and 56 were male (56%). The male to female ratio was 1:1.2. Mean of age and standard deviation was 22.9 ± 12.5 years (range 5-61 years), with median age of 19 years.

Finally, Singh, *et al.*, study of 200 patients in 2018 observed a different result, as female

predominance observed (122 males (61%) and 78 females (39%)) patients with M:F ratio of 1.56:1, the highest number of patients (49.5%) were observed in the age group of 15 to 24. The mean age of patients in our study was 27.55 years (males 27.45 years and female 27.70 years). (Singh, A. *et al.*, 2018) Differences observed in the above-mentioned study, can related to different sample size enrolled, different gender participated, as it associated with a variety of differential diagnosis, factors determined the attendance of patients to health care, as educational and socioeconomic status.

CONCLUSION

Lintula and Alvarado scores are comparable in the sensitivity, specificity, and accuracy for the diagnosis of acute appendicitis. Lintula score is considered simple, non-invasive way to be used.

RECOMMENDATIONS

We recommend to do larger studies with larger sample size and longer duration to confirm the current results and to compare the sensitivity, specificity, and accuracy according to age and gender.

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