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Accuracy of Surgeon's Clinical Acumen in Diagnosing Severity of Appendicitis in Adults

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ABSTRACT

Objective: To identify the accuracy of surgical clinical acumen in diagnosing severity of appendicitis in adults. **Study Design:** Observational study (Prospective). **Settings:** This study was conducted at University of Lahore Teaching Hospital, Lahore (UOLTH); a tertiary Care Hospital, Lahore Pakistan. **Duration:** November 2021 to April 2022. **Methods:** After ERB approval (ERC 58/21/09), data collection proforma was administered to general surgeons at UOLTH, who were asked to anticipate the severity of appendicitis preoperatively depending on history, clinical examination, ultrasound findings and laboratory tests reports. Area under the curve (AUC) and the optimal cut-point values for clinical variables were identified by drawing Receiver operating characteristic (ROC) curves for identifying non- complicated appendicitis. Preoperative diagnoses were compared to operative findings using chi-square test. Data was analyzed using SPSS version 24 was used for data analysis and p-value of < 0.05 was accepted as statistically significant. **Results:** Surgeon's prediction showed an accuracy of 85.9% with 89.3% positive predictive value and 78% negative predictive value and an error rate of 9.67%. Abdominal ultrasound demonstrated high sensitivity (95.8%) but lower specificity (29.1%) for appendicitis. Clinical variables, such as anorexia, nausea, and elevated temperature, exhibited a substantial diagnostic competence to distinguish complicated and non-complicated appendicitis. **Conclusion:** Surgeon's prognostication in appendicitis is more accurate than clinical or imaging alone, yet errors persist. Caution in patient selection for conservative management is vital, aided by integrating clinical judgment with imaging

Keywords: *Surgeon's prediction, Appendicitis, Non-Operative Management, Diagnostic accuracy.*

INTRODUCTION

Sudden abdominal pain makes about 7% to 10% of cases presenting to surgical emergency[1] and acute appendicitis is responsible for most of the cases presenting with abdominal pain.[2] Identifying acute appendicitis remains onerous, as it is a clinical diagnosis with various clinical presentations; relying on history, clinical examination and laboratory investigations. A number of scoring systems are also used to assist in diagnosis.[3]

So far surgical treatment for acute appendicitis is gold standard, however; with the advancements in diagnostic radiology (CT scan specially), there has been an increasing trend of Non-operative management (NOM) of simple acute appendicitis.[4,5] In addition to preserving a vital component of intestinal immunity (appendix), NOM of simple appendicitis can deflect any post-operative complications and cost of surgical interventions. However, firstly CT scan is not available at every hospital and is costly, secondly there are hazards of radiation exposure and burdening the radiology department.

Regardless of advancements in technology, acute appendicitis can be diagnosed by considering detailed history and thorough clinical examination.[6] Clinical scoring systems such as Alvarado, Eskelinen, Ohmann, Raja Isteri Pengiran Anak Saleha (RIPASA), and Tzanakis scores are also useful in diagnosing acute appendicitis.[7] Low scores can predict less chances of acute appendicitis.[8]

The accurately diagnosed patients of simple appendicitis can be managed conservatively (non-operatively).[9] However, it is evident from the research that inappropriate patient (complex appendicitis) selection for NOM may lead to failure of treatment and recurrence of symptoms within 1 year.[4] Therefore, clinical judgment of the severity of the condition is essential as one aims for non-operative management of simple acute appendicitis.

Currently, there is no approved guideline available for labelling patients of simple appendicitis who can be managed non-operatively. The data from this study may help in development of such guidelines.

METHODS

This prospective study was conducted at University of Lahore Teaching Hospital, Lahore (UOLTH); a tertiary Care Hospital from November 2021 to April 2022.

After taking ERB approval (ERC 58/21/09), data collection proforma was administered to 7 general surgeons (Total number of surgeons we have at our institute) at UOLTH with experience varying from 5 to 30 years of practice. A convenience sample of the patients with ages of 18 to 35 years, having sign and symptoms of acute appendicitis comprised the inclusion criteria. Patients already presenting with complications of appendicitis such as mass formation and perforation as well as patients booked for interval appendectomy were excluded.

Variables like age, temperature, duration of the disease and total leucocyte count were documented by the surgeon while taking history, physical examination and analyzing lab results. To aid steady and secure correspondence between team members and sonologists, Appy-Score system was used.[10] Appy-Score division was: 1 = Non-inflamed appendix clearly visualized; 2 = Non-inflamed appendix partially visualized; 3 = Appendix not visualized, 4 = equivocal, 5a = No appendicular perforation and 5b = Appendicular perforation.

The surgeons took detailed history, performed thorough clinical examination and analyzed the ultrasound findings and laboratory test reports. The operative surgeon was requested to complete the first five questions pre-operatively, which included the absence, presence and spread of peritonitis, the overall look of the patient, the complexity of appendicitis (The non-complicated appendicitis was described as simply inflamed appendix and complicated appendicitis as ischemic/necrotic appendix or appendicular perforation), and how sure the surgeon was about his/her diagnosis. Post operatively, the surgeon completed the survey by recording his/her per-operative findings of the condition of the appendix.

The data collection form used for the study is shown is Table 1.

Table 1: Data collection proforma provided to surgeons

Accuracy of surgeons' Clinical acumen to predict severity of appendicitis

Record Number ____

Age of the patient-----	**Gender of the patient----**
No. of days of symptoms----	**Highest temperature----**

Alvarado's score:

Migratory pain	1
Anorexia	1
Nausea	1
Tenderness	2
Rebound tenderness	1
Elevated temperature	1
Leukocytosis	2
Shift to left	1
Total	

Ultrasound findings* (circle):	1 2 3 4 5
General appearance of the patient (Circle):	well appearing Ill looking
Does the patient has peritonitis? (circle):	yes No
If yes, (circle):	Focal Diffuse
In your opinion, what type of appendicitis the patient has? (circle)	Simple Complex
How sure are you about your diagnosis? (circle)	Absolutely sure, Somewhat sure, Equivocal Doubtful, Very doubtful

** 1 = Non-inflamed appendix clearly visualized; 2 = Non-inflamed appendix partially visualized; 3 = Appendix not visualized, 4 = equivocal, 5a = No appendicular perforation and 5b = Appendicular perforation*

Per-Operative Findings:

SPSS (version 24, IBMSPSS) was employed to perform statistical analysis. Clinical variables, continuous variables and demographic data of participants were descriptively analyzed. Generation of Receiver operating

characteristic (ROC) curve and calculation of the maximum value of the Youden's J statistic for each point on the ROC curve for discrete variables were performed, distinguishing non-complicated from complicated appendicitis. The values of sensitivity and specificity as well as accuracy and positive and negative predictive values were determined for all the clinical variables individually and their combinations and surgeon's diagnosis for preoperative versus operative findings of appendicitis. Preoperative and intraoperative findings were compared via chi-square test and p-value of < 0.05 was accepted as statistically significant.

RESULTS

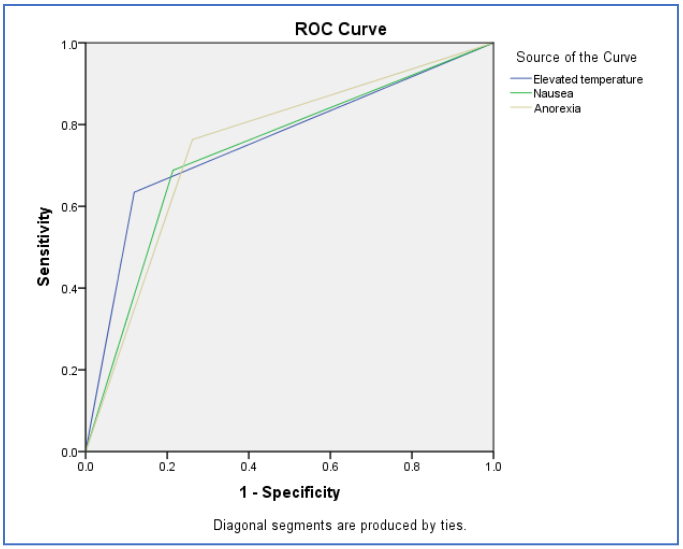
A total of 135 patients undergoing appendectomy for acute appendicitis were involved in the study. There were 55 (40.7%) male and 80 (59.3%) female patients with median age of 8 years (IQR 19-27 years). Of 135 patients 78(57.8%) had elevated leukocytes. Reference range for WBC considered was 4.5–11.5 × 103/µL. Fifty patients were afebrile (98.6oF). The rest of 85 patients had a median temperature of 101°F with an interquartile range (IQR) of 98°F to 100°F recorded before appendectomy. A greater number (51.1%, n = 69) of patients indicated 2 days of symptoms (IQR 1-3). Eight (5.9%) patients had an Appy-Score of 5b followed by 40(29.6%) having 5a, 27(20%) having 4, 26(19.3%) having 1 and 34(25.2%) having an Appy-Score of 3. Regarding the physical examination, 70 patients (51.9%) showed no signs of peritonitis, 57 patients (42.2%) exhibited focal peritonitis, and 8 patients (5.9%) displayed diffuse peritonitis. A total of 66 patients (48.9%) were characterized as appearing well and 69(51.1%) were ill looking.

Surgeons predicted that 93(68.9%) patients had simple appendicitis and 42(31.1%) had complex appendicitis. A total of 85.2% of predictions fell into the categories of either or "absolutely sure." (n = 66) or "somewhat sure" (n=49), 9.6% (n = 13) were "equivocal", 1.5% (n = 2) were "somewhat doubtful", and 3.7% (n = 5) were "very doubtful".

Intraoperative findings confirmed 94(69.6%) cases as simple appendicitis and 41(30.4%) cases as complex appendicitis. An error of 9.67% was found when out of 93 simple appendicitis expectations, 9 turned out to be complex appendicitis preoperatively. Similarly, out of 42 complex appendicitis 8 (19%) were found to be simple appendicitis preoperatively.

Receiver operating characteristic curves illustrated that Anorexia (AUC 0.751, p = 0.003), Nausea (AUC 0.737, p = 0.03), and Elevated temperature (AUC 0.758, p < 0.001) possess noteworthy diagnostic capability in distinguishing between simple appendicitis and complex appendicitis. (Fig. 1).

Figure 1: Receiver operating characteristic (ROC) and optimal cut-point values of diagnostic variables



Area Under the Curve	
Test Result Variable(s)	**Area**
Elevated temperature	.758
Nausea	.737
Anorexia	.751

The test result variable(s): Elevated temperature, Nausea, Anorexia has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

Sonography had higher sensitivity than clinical variables such as migratory pain, anorexia, nausea, elevated temperature, tenderness and laboratory tests (leukocytosis) but lower specificity than most of the clinical variables (Table 2).

Table 2: Comparison of capacity of clinical variables, sonography and surgical acumen for predicting simple appendicitis

Variables for Prediction	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
Ultrasound Findings	95.8%	29.1%	57.5%	87.5%	62.5%	<0.001
Migratory Pain	64.5%	28.5%	66.6%	26.6%	53.3%	0.430
Anorexia	24%	74%	41%	13%	25.0%	0.003
Nausea	31%	78%	47%	12%	28.1%	0.03
Tenderness	100%	98%	69%	100%	71.3%	0.13
Rebound tenderness	88%	95%	67%	15%	61.9%	0.198
Elevated Temperature	36%	88%	48%	8.0%	39.2%	<0.001
Leukocytosis	46%	33%	75%	36%	53.5%	0.160
Surgeons prediction	90.3%	76.1%	89.3%	78.0%	85.9%	<0.001

Tenderness and rebound tenderness had higher sensitivity for simple appendicitis among clinical variables. Range of accuracy for clinical variables appeared to be 25-71%, with tenderness having highest

accuracy. Surgeon's forecasting demonstrated an accuracy of 85.9% with 89.3% positive predictive value and 78% negative predictive value.

DISCUSSION

Traditionally appendectomy is considered as a gold standard for appendicitis, however certain trials and meta-analysis have declared a debate between a conservative approach with antibiotics versus surgical intervention in uncomplicated appendicitis.[11,12,13] Conservative management is only recommended for simple appendicitis. Acute appendicitis can manifest in several ways ranging from silent and self-resolving to lethal sepsis,[14] so selection of suitable patient for Non-operative management is the crucial decision. Our study highlighted that a prediction of a surgeon for a patient having a non-complicated appendicitis was more precise than depending on sonography outcomes, clinical signs, or other factors. Still an error of 9.67% was found.

There has been an improvement in the diagnostic accuracy as a consequence of growth in imaging technology. While CT has been declared as best imaging modality with higher accuracy for diagnosing acute appendicitis, it has a limitation of cost and exposure to radiations. The American College of radiology advocates sonography as the primary modality for suspected appendicitis while reserving CT for uncertain conditions.[15] Moreover, the establishment of Appy-Score has led to 93% sensitivity and specificity for diagnosing acute inflammation of appendix.[10] At our hospital, abdominal sonography is used as first line imaging modality to complement clinical diagnosis for patients of suspected appendicitis.

As sensitivity reflects the capability to detect non-complicated inflamed appendix, specificity gauges the potential to identify complicated cases and accuracy values the potential to discriminate between two, our study found that the sonography has a high sensitivity (95.8%) and low specificity (29.1%) for appendicitis which is similar to the data reported in a study performed in Tehran[16]. Comparatively, the surgeon's prediction had a sensitivity of 90.3% which is contrary to the research published which showed comparable sensitivity of ultrasound and surgeon's forecasting [17]. These findings may be influenced by the clinical acumen of surgeons as well as experience of the sonologists. In the current study, specificity and accuracy of surgeon's prediction was way more than that of sonography (Table 2). The published data report an array of results regarding comparison of specificity and accuracy of surgeon's prediction versus ultrasound. Some studies report higher specificity and accuracy of surgeon's prediction in children as well as adults.[18] However, there are studies reporting contrary results.[19]

A number of clinical trials and meta-analyses have tried to document non-surgical treatment of acute appendicitis in terms of safety, efficacy, hospital stay and treatment failure, with a denominator of careful selection of patients for non-operative management [20]. Our study stresses the importance of surgical acumen not only in identifying the diseased appendix but also differentiating its levels of severity. However, selection of patients for non-operative management exclusively by using clinical judgment should be attempted with discretion.

CONCLUSION

The study revealed that surgeon's prognostication of severity of appendicitis was more accurate than depending purely on Sonographic findings or clinical signs and symptoms, still; a small error rate was demonstrated in forecasting the correct diagnosis. Furthermore, the study also adds to our knowledge regarding the significance of surgical acumen in identifying the type and severity of appendicitis. Nevertheless, designing of a standardized guideline for selecting appendicitis patients who can be managed non-operatively mandates additional research and validation. Eventually, conservative management of simple appendicitis can deflect any post-operative complications and cost of surgical interventions with meticulous patient selection and pairing of clinical acumen and imaging.

LIMITATIONS

Different levels of experience of clinicians and sonologists might have influence the prediction of simple and complex appendicitis. This aspect of experience influencing clinical judgment was not studied in this research. However, we used Appy-score template to reduce this bias for sonologists.

Besides, current study was conducted in a single center and included a limited number of consultant surgeons.

SUGGESTIONS / RECOMMENDATIONS

The paper emphasizes the need for standardized guidelines for selecting appendicitis patients who can be managed non-operatively. Future research should focus on developing evidence-based guidelines that incorporate both clinical judgment and imaging findings to determine the suitability of NOM.

To further validate the findings of this study and generalize the results, multicenter studies involving a larger and more diverse patient population should be conducted. These studies could explore variations in diagnostic accuracy among different healthcare settings and geographical regions.

Future researches can also take into consideration the experience levels of surgeons as well as sonologists and use a larger sample of clinicians.

CONFLICT OF INTEREST / DISCLOSURE

We declare no conflict of interest.

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