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Research Article

### DIAGNOSTIC ACCURACY OF COMPUTED TOMOGRAPHY FOR ACUTE APPENDICITIS KEEPING HISTOPATHOLOGY AS GOLD STANDARD

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**Abstract:**

**Introduction:** Appendix is a small pouch attached to the beginning of large intestine. Appendicitis, an inflammation of the appendix, is the most common acute surgical condition of the abdomen. Almost 10% of the general population develops acute appendicitis with maximal incidence in the second and third decades of life. **Objective:** To determine diagnostic accuracy of computed tomography in the diagnosis of acute appendicitis keeping histopathology as a gold standard.

**Materials and Methods:** This study was conducted in the Services Hospital Lahore during 2018-19, a total of 191 patients suspected of having acute appendicitis were included in the study in a consecutive manner and subjected to CT pre operatively and histopathology post operatively for the acute appendicitis.

**Results:** The mean age of the patients was 29.5 + 6.7 years. We had 53.4% males & 46.6% females. On CT we observed that the acute appendicitis was recorded in 58.1% of patients compared to 47.6% on histopathology. On applying the formulae for calculation, sensitivity of CT was found to be 89% and specificity 70%. The positive predictive value of the CT is 72.9% and negative predictive value is 87.5%.

**Conclusion:** CT is a highly sensitive and specific tool for the detection of acute appendicitis. As such, it is a useful radiological marker for diagnosis of acute appendicitis in adults and further studies are recommended to confirm its usefulness.

**Key Words:** Acute appendicitis, computed tomography, total leucocyte count, ultrasound, histopathology

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**INTRODUCTION:**

Appendix is a small pouch attached to the beginning of large intestine. [1] Appendicitis, an inflammation of the appendix, is the most common acute surgical condition of the abdomen. Almost 10% of the general population develops acute appendicitis with maximal incidence in the second and third decades of life.[2] Surgical removal of such inflamed appendix is the most commonly performed emergency operation in the world [3] and has long been considered the standard procedure of treatment of appendicitis [4]. Its peak incidence is between the ages of 10 and 30 years. [5] Differential diagnosis of appendicitis is often a clinical challenge because appendicitis can mimic several abdominal conditions. [6]

Traditionally, acute appendicitis has always been a clinical diagnosis based on patient history, physical examination, and laboratory testing [7]. A high percentage of negative appendectomies (20%) was considered reasonable, based on the premise that delay would inevitably lead to perforated appendicitis and thus increased morbidity and even mortality [8]. This classical practice is currently being abandoned by most surgeons, as negative appendectomies are no longer considered acceptable. They carry a substantial morbidity, increase hospital costs and may be avoided by using preoperative radiological imaging or diagnostic laparoscopy [9].

There has been a continuous search for complementary diagnostic methods to limit the number of “unnecessary” appendectomies without delaying the diagnostic and therapeutic process and without increasing perforation rates [10]. Preoperative imaging has gained wide acceptance due to the improved diagnostic accuracy, with computed tomography (CT) outperforming ultrasound (US) in most studies [11]. The diagnostic modalities, however, that are considered to be the most accurate for making the diagnosis appendicitis, such as CT and laparoscopy, also have negative repercussions. Computed tomography exposes the patient to considerable ionizing radiation, and laparoscopy is an invasive procedure performed under general anesthesia and thus carries a risk of morbidity [12].

Thus, use of imaging modalities such as ultrasonography (US) and computerized tomography (CT) has helped to decrease the rates of perforation, morbidity and mortality, in addition to shortening the length of hospital stay [10]. Although both US and CT are tomographic modalities, CT is not limited by its tomographic technique, as it is capable of delineating a wide, sequential field of view, unlike US which is

constrained by its field of view and sections which are only as sequential as intervening structures and patient cooperation will allow [13]. The sensitivity of CT for acute appendicitis was 91%; specificity was 69% and accuracy of 76% while PPV and NPV were 58%, 94% respectively in a study [14].

**Objectives:**

To determine diagnostic accuracy of computed tomography in the diagnosis of acute appendicitis keeping histopathology as a gold standard.

**MATERIALS AND METHODS:**

This Cross sectional validation study was conducted in Services Hospital Lahore during 2018-19. The Sample size was 191 using the following parameters. The data was collected through non probability consecutive sampling.

**Inclusion criteria:**

1. All patients presenting with clinical features suspicious of acute appendicitis as specified in the operational definition
2. Age group 18-45 years and either gender.

**Exclusion criteria:**

1. Patients with history of surgical intervention in the abdomen in the last one month.
2. Patients with symptoms of Urinary Tract infection (dysuria, Urgency, frequency) with positive Urine R/E findings &/ or renal/ uretric calculi on ultrasound
3. Patients with Renal insufficiency (serum urea of >50mg/dl and creatinine of >1.1mg/dl)

**Data collection procedure:**

The study was conducted after approval from hospitals ethical and research committee. All patients presenting to OPD with high suspicion of acute appendicitis was included in the study. The purpose and benefits of the study was explained to the patient, they was assured upon the purpose and benefits of the study, the risks involved and they was explained that the study is done purely for research and data publication and if agreed upon a written informed consent was obtained from the parents of the neonate.

All patients having suspected acute appendicitis clinically with symptoms as defined in the operational definition and fulfilling the inclusion criteria was subjected to CT Scan examination which was performed at the department of Diagnostic Radiology, Khyber Teaching Hospital, Peshawar using a multi-slice CT scanner (SOMATON Sensation or Definition, Siemens Medical Solutions USA, Inc.,

Malvern, PA). 145 cc of Isovue-300 IV contrast at a rate of 2 cc/s just prior to the scan was given. Serial 3-mm axial images was obtained from the diaphragm through the perineum. Additional delayed images was obtained through the lower abdomen after the patient asked to lay on the right side for 10 min. Once done with CT, all the patients was subjected to appendectomy and biopsy was obtained. All surgeries was performed at the department of Surgery, Khyber Teaching Hospital using the same standard technique. All the biopsy investigations was done by the histopathologist at the department of Pathology, Khyber Medical College, Peshawar. All the radiological investigations was done by single expert radiologist having minimum experience of five years. All the above mentioned information was recorded on

a pre-designed proforma. Strictly exclusion criteria was followed to control confounders and bias in the study results.

#### Data analysis procedure:

The collected data was entered in SPSS version 20 and analyse through it, study variable was CT findings and Histopathology report. Frequency and percentage was calculated for categorical variables like gender. Mean  $\pm$  SD was calculated for continuous variables like age. Sensitivity, Specificity, positive predictive value (PPV), negative predictive value (NPV) was determined by taking Histopathology as gold standard from 2x2 table. All the results was presented in the form of tables and graphs.

**Histopathology acute appendicitis**

	+	-
+	a	b
-	c	d

#### CT

Acute Appendicitis

Sensitivity of CT =  $(a / a+c) \times 100$

Specificity of CT =  $(d / b + d) \times 100$

Positive predictive value (PPV) for CT =  $(a / a +b) \times 100$

Negative predictive value (NPV) for CT =  $(d / c +d) \times 100$

Accuracy of CT=  $(d + a) / \text{overall patients}$

a = True positive, b = False positive, c = False negative, d = True negative

#### RESULTS:

The study was conducted on 191 patients suspected of having acute appendicitis. The mean age of the sample was  $29.5 \pm 6.7$  years. The range of age in our study was 23 years with minimum age of 19 years and maximum age of 42 years. On grouping the sample in different age groups, we observed that 26.2% of patients were in the age group up to 25.00 years, 47.1% were in the age group 25.01 to 35.00 years and 26.7% of patients were in the age group 35.01 to 45.00 years (Table 1). While distributing the patients with regards

to gender, we observed that in our study 53.4% of the sample was male and 46.6% were female gender (Table 2). On CT, we observed that the acute appendicitis was recorded in 58.1% of patients. After surgery, acute appendicitis on histopathology was recorded in 47.6% of patients. On applying the formulae for calculation, sensitivity of CT was found to be 89% and specificity 70%. The positive predictive value of the CT is 72.9% and negative predictive value is 87.5% (Table 3).

**Table 1: AGE-WISE DISTRIBUTION OF SAMPLE (n=191)**

	n	Range	Minimum	Maximum	Mean	Std. Deviation
Age of the patient	191	23.00	19.00	42.00	29.5136	6.73198
Age Groups			Frequency		Percent	
	Up to 25.00 years		50		26.2	
	25.01 to 35.00 years		90		47.1	
	35.01 to 45.00 years		51		26.7	
	Total		191		100.0	

**Table 02: FREQUENCY OF ACUTE APPENDICITIS ON CT (n=191)**

Acute Appendicitis on CT	Frequency	Percent
Positive	111	58.1
Negative	80	41.9
Total	191	100.0

**Table 03: CT & HISTOPATHOLOGY 2 x2 TABLE (n = 191)**

		Acute Appendicitis on Histopathology		Total
		Positive	Negative	
Acute Appendicitis on CT	Positive	81 TP	30 FP	111
	Negative	10 FN	70 TN	80
Total		91	100	191

Sensitivity of CT:  $TP/TP + FN = 89\%$

Specificity of CT:  $TN/TN + FP = 70\%$

Positive Predictive Value CT:  $TP/TP + FP = 72.9\%$

Negative Predictive Value CT:  $TN/TN + FN = 87.5\%$

### DISCUSSION:

The clinical appreciation of a patient with suspected appendicitis remains challenging as it is complicated by nonsurgical diseases that mimic appendicitis [11]. The accuracy of the clinical diagnosis is approximately 80%, which corresponds to a negative appendectomy rate of around 20% [12]. This flaw in diagnostic accuracy has traditionally been accepted as it was considered most important to perform an early operation. Quality assurance focused on perforated appendicitis rather than negative appendectomy rates [13]. This practice has become less accepted for several reasons: the morbidity and costs associated with a negative appendectomy are substantial [14-17], and there is ample evidence that preoperative imaging can reduce the negative appendectomy rate [18], and lessen the use of hospital resources [19]. Even though some institutions have reported contradictory results [20], preoperative imaging for all patients with suspected appendicitis is gaining support [21]. Another reason for abandoning indiscriminate explorations for suspected appendicitis is new insights into the natural history of appendicitis. These challenge the belief that the perforated appendicitis rate is inversely related to the negative appendectomy rate and thus avoidable by urgent appendectomy [22]. Perforated appendicitis rates are not influenced by in-

hospital delay [23] and have not decreased with the increasing use of CT imaging [24]. Evidence suggesting that resolving appendicitis is common can clarify this phenomenon [25]. Quality assurance should therefore focus on the accuracy of the preoperative diagnosis, and not on the urgency with which it is made. Negative appendectomy rates and false negative diagnoses for patients who present with perforated appendicitis should be kept to an absolute minimum [26].

### CONCLUSION:

CT is an highly sensitive and specific tool for the detection of acute appendicitis. As such, it is a useful radiological marker for diagnosis of acute appendicitis in adults and further studies are recommended to confirm its usefulness.

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