

Diagnostic Utility of Total Leucocyte Count and Ultrasonography in Diagnosis of Acute Appendicitis: A Prospective Observational Study

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Abstract

Background: The diagnosis of acute appendicitis is primarily based on a detailed clinical history and thorough physical examination. The total leukocyte count (TLC) is one of the most frequently used inflammatory marker. Ultrasonography (USG) is a rapid, non-invasive, inexpensive, and readily available imaging modality that does not require patient preparation or contrast administration.

Material and Methods: This study was conducted in the Postgraduate Department of General Surgery, Government Medical College, and Srinagar over a period of one year (September 2022-September 2023). It was prospective observational study. 117 patients included in the study.

Results: Male to female ratio in our study was 2.2:1, 81 were male and 36 were females respectively. Leucocytosis was seen in a total of 82(70%) patients which included 45(38.46%) uncomplicated appendicitis and 37(31.6%) complicated appendicitis. Similarly, normal leucocyte count was seen in 35(29.9%) patients out of which 25(21.36%) had uncomplicated appendicitis and 10(8.8%) had complicated appendicitis. Thus leucocytosis had a sensitivity of 70.08%. Of the 117 patients, 95(81.1%) had positive ultrasound findings of acute appendicitis with 52(44.44%) having uncomplicated and 43(36.7%) having complicated appendicitis. 22 (18.80%) patients had a negative ultrasound out of which 18(15.38%) had uncomplicated and 4(3.41%) had complicated appendicitis. Ultrasonography showed a sensitivity of 81.1%.

Conclusion: The combined interpretation of clinical findings, laboratory parameters, and ultrasonographic features provides the highest diagnostic accuracy, reduces the likelihood of unnecessary negative appendectomies, and facilitates timely surgical intervention in patients with acute appendicitis.

Keywords: Total Leukocyte Count, USG, Acute Appendicitis.

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Introduction

Acute appendicitis is one of the most common causes of acute abdominal pain across all age groups and remains one of the leading indications for emergency abdominal surgery worldwide. The incidence is highest during the second decade of life, although the condition may occur at any age. It is relatively uncommon at the extremes of age. [1]

The diagnosis of acute appendicitis is primarily based on a detailed clinical history and thorough physical examination. In the classical presentation, patients experience initially poorly localized periumbilical pain that subsequently migrates to the right lower quadrant. This is often accompanied by nausea, vomiting, anorexia, and localized tenderness. However, this typical clinical pattern is observed in only 50–60% of patients, making diagnosis challenging in individuals with atypical presentations. [2,3] Several laboratory and imaging

modalities have been evaluated to improve diagnostic accuracy. Among laboratory investigations, the total leukocyte count (TLC) is one of the most frequently used inflammatory markers. Although an elevated TLC alone is not diagnostic, it provides valuable supportive evidence when interpreted alongside clinical findings and imaging studies.

Ultrasonography (USG) is a rapid, non-invasive, inexpensive, and readily available imaging modality that does not require patient preparation or contrast administration. According to the criteria described by Birnbaum and Wilson, the sonographic diagnosis of acute appendicitis is based on visualization of a non-compressible, blind-ending, aperistaltic tubular structure measuring ≥ 7 mm in diameter in the right iliac fossa or the presence of a characteristic target sign.

[4,5] In experienced hands, ultrasonography has demonstrated sensitivities ranging from 75% to 90%, specificities from 86% to 100%, overall diagnostic accuracies of 87% to 96%, positive predictive values of 91% to 94%, and negative predictive values of 89% to 97% for the diagnosis of acute appendicitis. 6,7]

The present study was undertaken to evaluate the diagnostic utility of total leukocyte count and ultrasonography in patients with clinically suspected acute appendicitis.

Material and Methods

This study was conducted in the Postgraduate Department of General Surgery, Government Medical College, and Srinagar over a period of one year (September 2022-septembet 2023). It was prospective observational study.

117 patients included in the study.

Inclusion Criteria: The study included all patients aged 14 years and above who underwent emergency appendectomy for clinically suspected acute appendicitis, including both uncomplicated and complicated cases.

Exclusion Criteria: The following patients were excluded from the study:

- Patients managed conservatively without surgical intervention.
- Patients younger than 14 years of age.
- Patients admitted for interval appendectomy.

Patients with other conditions associated with leukocytosis, such as gout, inflammatory bowel disease (IBD), steroid therapy, or other inflammatory disorders. Patients undergoing incidental appendectomy as part of another operative procedure. Only patients fulfilling the inclusion criteria and providing informed consent were enrolled in the study.

All enrolled patients underwent clinical evaluation, laboratory investigations, ultrasonography, operative assessment, and histopathological examination according to the study protocol.

Clinical diagnosis of acute appendicitis will be done based on detailed history, symptoms of pain, migration, nausea and vomiting, anorexia, fever and signs of peritoneal inflammation such as right iliac fossa tenderness, rebound tenderness and guarding. Once acute appendicitis is suspected, the

patient will be subjected to routine investigations as per the hospital protocol. Total leucocyte count and differential count will be done in all cases. The upper limit of the normal TLC will be taken as $10 \times 10^9/L$ and that of the Neutrophils as 75%. All the patients will be subjected to USG of abdomen and pelvis to aid the diagnosis and rule out other causes of pain abdomen. The diagnosis of appendicitis on ultrasound will be confirmed by criteria suggested by Birnbaum and Wilson. The presence of appendicular faecolith, probe tenderness, increased echogenicity of the periappendiceal fat, and free intraperitoneal fluid particularly in the right iliac fossa or pelvis will be additional criteria. The distinction between gangrenous and perforated appendix along with other signs of complication will be made by the operating surgeon on table and confirmed by HPE.

All the findings including history, clinical examination, laboratory investigation, ultrasound findings and intraoperative findings will be recorded. Histopathology report of the specimen will be noted. Histopathological examination of the specimen will be taken as the gold standard for the diagnosis of appendicitis. According to the results of histopathological examination of the removed appendix, patients will be divided into 3 groups, group (1) normal appendix (no pathological diagnosis), group (2) with uncomplicated appendicitis and group (3) with complicated appendicitis (perforated and gangrenous). The recorded data was compiled and entered in a spread sheet (Microsoft excel) and was exported to data editor of SPSS version 2.0.

Continuous variables was summarized in the form of means and standard deviations. Categorical variables were summarized as percentages. Graphically the data was presented by bar diagrams. Student independent t test was employed for comparing continuous variables. Chi square or Fisher test, was applied for comparing categorical variables.

Results

Male to female ratio in our study was 2.2:1, 81 were male and 36 were females respectively. Out of the 81 male patients 44(37.6%) had uncomplicated appendicitis and 37(31.6%) had complicated appendicitis. Amongst the 36 female patients 26(22.22%) had uncomplicated appendicitis and 10(8.5%) had complicated appendicitis (Table 1).

Table 1:

Gender	Count of Gender
M	81
F	36
Grand Total	117

Leucocytosis was seen in a total of 82(70%) patients which included 45(38.46%) uncomplicated appendicitis and 37(31.6%) complicated appendicitis. Similarly, normal leucocyte count was

seen in 35(29.9%) patients out of which 25(21.36%) had uncomplicated appendicitis and 10(8.8%) had complicated appendicitis. Thus leucocytosis had a sensitivity of 70.08% (Table 2)

Table 2: Leucocytosis vs Appendicitis

Leucocytosis	Uncomplicated Appendicitis	Complicated Appendicitis	Total
Yes	45	37	82
No	25	10	35
Total	70	47	117

Of the 117 patients, 95(81.1%) had positive ultrasound findings of acute appendicitis with 52(44.44%) having uncomplicated and 43(36.7%) having complicated appendicitis. 22 (18.80%)

patients had a negative ultrasound out of which 18(15.38%) had uncomplicated and 4(3.41%) had complicated appendicitis. Ultrasonography showed a sensitivity of 81.1% (Table 3)

Table 3: USG vs Appendicitis

Diagnostic of App.	Uncomplicated Appendicitis	Complicated Appendicitis	Total
Yes	52	43	95
No	18	4	22
Total	70	47	117

Discussion

This study was conducted to determine the role of investigations (TLC and USG) in the patients operated for suspected acute appendicitis. The study sample was formed by 117 subjects operated for appendicitis on the basis of suggestive clinical and/or paraclinical parameters.

A similar study was conducted by Fatima SR et al. [8] and Ali S et al. [9], where they concluded that these investigations should be interpreted in light of clinical findings.

The majority of patients with acute appendicitis have an elevated total leukocyte count of more than ten thousand⁶¹. In complicated cases, such as gangrene or perforation, it may be raised up to 18,000/mm³, [10]. It was observed in this study that the leucocyte count was increased in 82 patients out of total of 117 patients giving a sensitivity of 70.08%. Higher mean values were observed in gangrenous and perforated appendices. Al-Gaithy ZK et al. found the sensitivity of leucocyte count to be 76.8% [11]. Lau WY et al. found the sensitivity of total leucocyte count to be 81.4% [12]. Similarly Fatima SR et al. found sensitivity of total leucocyte count to be 83.10% [13]. Most of the studies reveal that >60% of the patients with acute appendicitis have a TLC of over 10 x 10⁹/L [14,15]. Since the white cell count is raised in 25-70% of patients with other causes of acute right iliac fossa pain, the investigation is rendered almost useless by its low specificity and has little diagnostic value [16].

Ultrasound is frequently used as the initial imaging modality for the diagnosis of acute appendicitis, especially in pregnant women, children, and the elderly. However, making an accurate diagnosis in

obese patients can prove to be difficult [16]. Modern advancements have made it possible to detect the appendix in up to 97% of cases and the associated inflammatory changes of acute appendicitis, making it a highly sensitive tool. The accuracy of ultrasound in detecting acute appendicitis also depends on the expertise of the radiologist¹⁷. In our study, 95 out of 117 patients that tested positive on ultrasonography, turned out to be true-positive as confirmed on the histopathological report. The sensitivity of ultrasonography was 81.19%. Similar results were obtained by S Ali et al. [9]. Most of the American and European studies give high sensitivities of 85-90% and specificities of 94-100% [17]. Less accurate results in another study¹⁸ and low values obtained in the present study could be due to the fact that the probe used was 5MHz in contrast to 7.5MHz used by them. Poorer results were also seen for any collection which was seen in 34 patients at laparotomy but were picked by ultrasonography in only 21 cases. Similarly ultrasonography showed faecolith inside appendix in 16 patients but at laparotomy 18 patients had evidence of faecoliths.

The present study revealed that 43 of the total of 47 gangrenous/perforated appendices were picked up by USG, though the sonologist did not make the diagnosis of perforated or gangrenous appendicitis. Takeda et al. [18] observed a sensitivity of 100% in such cases.

Combining the previous three investigations to USG by the 'or' rule raises the sensitivity to >85%. In contrast, sensitivity decreased markedly when all the 4 suggestive investigations were used together. These results are consistent with studies conducted previously and favor performing routine TLC,

neutrophil count, and ultrasonography in patients clinically suspected of having acute appendicitis.

The limitations of our study were that it was a single-center study and cannot be termed as truly representative of the entire population so the results cannot be generalized to the whole population.

Also, different radiologists performed ultrasonography on patients, depending on availability and working shifts, which could have lead to a wide variation in diagnostic accuracy.

Conclusion

The findings of the present study demonstrate that total leukocyte count (TLC) and ultrasonography (USG) are valuable adjuncts in the diagnosis of acute appendicitis. However, neither investigation should be used as an independent diagnostic tool.

An elevated total leukocyte count supports the diagnosis of acute appendicitis, whereas a normal leukocyte count does not exclude the disease. Similarly, ultrasonography is a safe, non-invasive, cost-effective, and readily available imaging modality with good diagnostic sensitivity, although its accuracy remains dependent on operator expertise. Clinical evaluation continues to be the cornerstone of diagnosis.

The combined interpretation of clinical findings, laboratory parameters, and ultrasonographic features provides the highest diagnostic accuracy, reduces the likelihood of unnecessary negative appendectomies, and facilitates timely surgical intervention in patients with acute appendicitis.

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