Al Ameen J Med Sci 2025;18(1):55-59 ● US National Library of Medicine enlisted journal ● ISSN 0974-1143

ORIGINAL ARTICLE CODEN: AAJMBG

Clinical symptoms of acute appendicitis correlating to its intraoperative anatomical position

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Received: 13th July 2024; ***Accepted:*** 20th December 2024; ***Published:*** 01st January 2025

Abstract: *Background:* Acute appendicitis is a common surgical emergency that can cause a variety of clinical symptoms, which are frequently impacted by the anatomical location of the inflamed appendix. The precise localisation of the appendix is critical for timely diagnosis and therapy. *Objectives:* The purpose of this study was to look at the relationship between clinical symptoms of acute appendicitis and the appendix's anatomical position during surgery. Furthermore, it assessed the diagnostic accuracy of clinical examination and ultrasound in determining the appendix's position. *Methods:* This prospective, observational study was carried out over a one-year period at a tertiary care centre in Navi Mumbai. Patients who presented with acute appendicitis were included. The clinical symptoms, ultrasound results, and intraoperative anatomical locations of the appendix were documented. A statistical analysis was conducted to determine the relationship between clinical symptoms, imaging findings, and appendix positions. *Results:* A total of 70 patients with acute appendicitis were included in the study. The most common anatomical position of the appendix was retrocecal (78.4%), followed by pelvic (19.6%) and pre-ileal (2%) positions. Clinical examination showed high sensitivity (100%) but lower specificity (63.64%) for detecting retrocecal appendicitis and lower sensitivity (63.64%) but perfect specificity (100%) for pelvic appendicitis. Ultrasonography demonstrated high sensitivity (100%) for retrocecal appendicitis but low sensitivity (27.3%) for pelvic appendicitis. *Conclusions:* The clinical appearance of acute appendicitis varies according to the anatomical position of the appendix. Clinical examination and ultrasonography have limits in precisely establishing the position of the appendix, highlighting the importance of an integrated strategy that combines clinical, radiological, and operational findings for exact diagnosis and management.

Keywords: Acute Appendicitis, Anatomical Position, Clinical Symptoms, Ultrasonography, Retrocecal, Pelvic.

Introduction

Acute appendicitis is one of the most common surgical emergencies globally, with a lifetime risk of 8.6% in men and 6.7% in women [1]. It is caused by inflammation of the vermiform appendix, which is a thin pouch that protrudes from the cecum. While appendicitis is a common illness, its clinical appearance can vary greatly, making diagnosis difficult and sometimes delaying treatment. Acute appendicitis typically manifests as low-grade fever, anorexia, nausea, vomiting, and periumbilical pain that moves to the right lower quadrant [2]. Nonetheless, a considerable percentage of individuals display atypical symptoms, which may be caused by a number of variables, including the appendix's anatomical location.

The appendix is a highly dynamic structure, and its position varies greatly between individuals. The retrocecal region is the most commonly used location, followed by the pelvic, subcecal, preileal, and post-ileal regions [3]. The anatomical position of the appendix can have a considerable impact on clinical presentation, as the pattern of pain referral and localised symptoms varies depending on the underlying disease process and its anatomical interaction with surrounding tissues [4]. For a timely diagnosis and effective surgical treatment, the inflamed appendix must be precisely located. Increased morbidity and mortality as well as complications like perforation and peritonitis might result from a delayed or inaccurate diagnosis [5]. Acute appendicitis is diagnosed

and localised with the use of a variety of diagnostic modalities, including as clinical examination, laboratory testing, and imaging methods like computed tomography and ultrasound.

The clinical assessment of individuals with suspected appendicitis is still difficult, even with advancements in diagnostic methods, especially when the presentation is unusual [6]. Clinicians can gain important insights and help with the early detection and proper treatment of this common surgical problem by knowing how the anatomical position of the appendix and its clinical symptoms relate to one another. The purpose of this study is to look at the relationship between the intraoperative anatomical position of the appendix and the clinical symptoms of acute appendicitis. This study aims to increase the clinical care of patients with acute appendicitis and improve diagnosis accuracy by investigating the relationship between the location of the appendix and the presenting symptoms.

Aims and Objectives:

- To correlate the clinical symptoms with the anatomical position of the appendix with the descriptive value of ultrasonographic findings, its varied clinical presentation, and intraoperative findings in acute appendicitis.
- To determine the frequency distribution of different appendix positions in patients undergoing surgery for acute appendicitis.

Material and Methods

Study Design: This research was a prospective, observational, hospital-based study.

Study Duration: The research spanned one year following institutional ethical approval, from June 2022 to July 2023

Sample Size: All patients meeting the inclusion criteria were enrolled in the study.

Inclusion Criteria:

- All cases presenting with appendicitis.
- Patients consenting to surgery.
- Patients operated with open or laparoscopic methods

Exclusion Criteria:

- Patients refusing to participate.
- Appendicular abscess, appendicular mass.
- Patients below 15 years of age.
- Pregnant patients.
- Patients unfit for surgical procedures.

Methodology: Clinical signs, symptoms, and laboratory testing were used to assess each patient and determine the position of the appendix. The results were documented on a standardised proforma. All patients had ultrasound to confirm the diagnosis, rule out other conditions, and record the location of the appendix. A thorough medical history was obtained at admission, including the patient's principal complaints, the length of time they had been experiencing symptoms, their severity, their onset, progression, sequencing, and any changes in their symptom patterns, including unusual presentations. A comprehensive abdominal examination was performed on each patient, which included taking a local temperature, feeling for guarding or rigidity, locating the site of maximal tenderness, looking for rebound tenderness or mass formation, and analysing particular signs like Rovsing's, Psoas, Obturator, and Baldwin's.

Additionally, a rectal examination was performed to look for tumours or pain in the pelvis. General or spinal anaesthesia was used for all procedures. The location of the appendix was carefully recorded, and its position was determined prior to modifying other structures. Only cases that were confirmed to be appendicitis were included in the study when the specimen was sent for histological analysis following the appendectomy. Third-generation cephalosporins were given to patients while they were in the hospital, and surgical incisions were performed according to conventional procedures. The accuracy of radiological investigations and clinical symptoms was assessed by evaluating operational findings.

Statistical Analysis: Microsoft Excel and Epi-Info software were used for data analysis after the data was entered into a pre-made proforma. Quantitative variables were

displayed as means with standard deviations, whilst categorical variables were represented as frequencies and percentages. ANOVA was utilised to compare means (quantitative variables), whereas chi-square tests were employed to assess the significance of categorical variables. The threshold for statistical significance was $p < 0.05$.

Results

The study aimed to correlate the clinical symptoms of acute appendicitis with the anatomical position of the appendix and operative findings. A total of 70 patients were included in the study over a period of 12 months in tertiary care center.

Table-1: Demographic Characteristics and Symptom Duration

Characteristic		Frequency	Percentage
Age in years	16-25 years	27	38.5%
	26-35 years	21	30%
	36-45 years	15	21.4%
	>45 years	7	10%
Gender	Females	36	51.4%
	Males	34	48.5%
Duration of symptoms	<48 hours	32	45.7%
	>48 hours	38	54.2%

Table 1 provides a demographic overview of the study participants, illustrating the age and gender distribution as well as the duration of symptoms before presentation. The majority of patients fall within the 16-25 years age group (38.5%), indicating a higher prevalence of acute appendicitis among younger adults. There is a relatively balanced gender distribution, with females slightly outnumbering males (51.4% vs. 48.5%). Regarding symptom onset, the participants were nearly divided between those presenting within 48 hours (45.7%) and those presenting after 48 hours (54.2%), suggesting that symptoms of appendicitis prompt medical attention within two days in just over half of the cases.

Table-2: ALVARDO scores

Score	Frequency	Percentage
Score 7	16	22.8%
Score8	34	48.5%
Score 9	20	28.5%

Table 2 shows the distribution of ALVARADO scores of the patients, a clinical scoring system used to assess likelihood of appendicitis. Majority of patients had a score of 8 (48.5%), followed by scores of 9 and 7 (28.5% and 22.8%, respectively). This distribution underscores the ALVARADO score in predicting appendicitis, with higher scores correlating with a greater probability of the condition.

Table-3: Clinical presentations

Symptom	Frequency	Percentage
RIF Pain	70	100%
RIF tenderness	65	92.8%
Vomiting	57	81.4%
Anorexia	41	58.6%
Fever	35	50%
Raised TLC	34	48.6%
Psoas sign	19	27.1%
Guarding	12	17.4%
Baldwin sign	12	17.4%
Obturator Sign	4	5.7%
Urinary symptoms	9	12.9%

Table 3 outlines the different symptoms presented by the participants. All participants experienced right iliac fossa (RIF) pain, with a significant majority also exhibiting RIF tenderness (92.8%). Other common symptoms included vomiting (81.4%), anorexia (58.6%), and fever (50%). The prevalence of raised total leukocyte count (TLC) in nearly half of the patients (48.6%) and other specific signs like Psoas sign (27.1%) provide insight into the typical clinical presentations of appendicitis, aiding in diagnostic evaluations.

Table-4: Ultrasound and Intraoperative Position of the Appendix

Position	USG	Intraoperative
Retrocecal	66 (94.3%)	55 (78.6%)
Pelvic	4 (5.7%)	14 (20%)
Pre-ileal	0	1 (2%)

Table 4 compares the anatomical position of the appendix as seen in an ultrasound (USG) and confirmed during surgery. Discrepancies

are noted in the detection of retrocecal appendices (94.3% by USG vs. 78.6% intraoperatively) and pelvic appendices (5.7% by USG vs.20% intraoperatively). This is suggestive of limitations in the accuracy of Ultrasonography in identifying the pelvic position of the appendix.

Table-5: Correlation of Clinical Symptoms, USG, and Intraoperative Findings

Position	Clinical	USG	Intraoperative
Retrocecal	60 (85.7%)	66 (94.3%)	55 (78.6%)
Pelvic	10 (14.2%)	4 (5.7%)	14 (20%)
Pre-ileal	0	0	1 (2%)

Table 5 shows the correlation between clinical presentation, Ultrasonography findings, and intraoperative findings regarding the position of the appendix. The data reveal that USG is able to accurately predict the retrocecal position but underestimates the incidence of pelvic and pre-ileal positions compared to intraoperative findings. This brings out a potential area for improvement in preoperative investigative especially imaging techniques to improve predictions of varying anatomical positions.

Table-6: Diagnostic Accuracy of USG in Identifying Retrocecal and Pelvic Positions

	Retrocecal	Pelvic
Sensitivity	83.3% (71.5-91.7)	27.3% (6.0-61)
Specificity	63.6% (30.8-89.1)	100% (93.4-100)
Positive Predictive Value (PPV)	83.3% (71.5-91.7)	100% (39.8-100)
Negative Predictive Value (NPV)	63.6% (30.8-89.1)	84.8% (74-92)
Diagnostic Accuracy	84.3% (73.6-91.9)	84.3% (73.6-91.9)

Table 6 details the diagnostic performance of Ultrasound in identifying the position of the appendix, focusing on retrocecal and pelvic locations of the appendix. USG showed a sensitivity of 83.3% for identifying retrocecal appendix but low sensitivity (27.3%) for pelvic positioning of the appendix, though its specificity for the latter was perfect (100%). These values show the strengths and weaknesses of ultrasonography imaging in the diagnosing, emphasizing its reliability in confirming the retrocecal position of the appendix but indicating a need for caution in ruling out pelvic appendices based on Ultrasonography alone.

Discussion

Acute appendicitis is a frequent surgical emergency that can be difficult to diagnose because of its diverse clinical presentation. The physical examination results and symptom presentation can be greatly impacted by the anatomical location of the inflamed appendix, which makes the diagnosis even more challenging. In patients with acute appendicitis, the purpose of this study was to examine the relationship between the intraoperative anatomical position of the appendix, preoperative imaging results, and clinical symptoms.

According to the study's findings, the retrocecal position of the appendix was the most prevalent anatomical position, followed by the pelvic and pre-ileal positions. This distribution is in line with earlier research that found that the retrocecal position was the most common place because of the appendix and cecum's developmental processes [3, 7]. It is important to remember, nevertheless, that this study and others have shown that structural changes in the appendix's position can drastically change the clinical appearance [8].

It is still difficult to perform a clinical evaluation on people who may have appendicitis, especially if their presentation is unusual. Clinical examination demonstrated a high sensitivity for retrocecal appendicitis detection in this study, but a low sensitivity for pelvic appendicitis identification. These results are consistent with other research [9], highlighting the limits of using clinical evaluation alone to precisely determine the location of the appendix. Ultrasound was advocated by pioneers like Puylaert et al [10] and is now a useful non-invasive technique. In contrast to Patel KG et al [9], who reported higher sensitivity across a range of appendiceal placements, it has a lower sensitivity for pelvic appendicitis identification despite having a high sensitivity for retrocecal appendicitis detection. This is consistent with the findings of Kumar S et al

[11]. This variation highlights how important it is to carefully evaluate ultrasonography data, particularly in uncommon situations.

Many people believe that ultrasonography is a useful non-invasive method for diagnosing acute appendicitis [10]. Ultrasonography showed a good sensitivity for diagnosing retrocecal appendicitis in this study, but a low sensitivity for detecting pelvic appendicitis. These findings are in line with some research [12], emphasising the need for cautious interpretation, especially in atypical instances, and the variation in ultrasound's diagnostic performance across various contexts. The inconsistencies among intraoperative observations, ultrasound results, and clinical evaluation highlight how difficult it is to diagnose acute appendicitis and precisely locate the appendix. For an accurate diagnosis and suitable treatment, an integrated strategy integrating clinical, radiological, and surgical results is essential. It is critical to recognise the study's limitations, notably the small sample size and focus on a single medical facility, which may limit the findings' generalisability. Future research with bigger and more diverse sample populations from numerous institutions would give a more comprehensive assessment of the diagnostic utility of different approaches, as well as the impact of anatomical variances on clinical presentation.

Conclusion

In conclusion, the wide range of clinical manifestations and anatomical variances make it difficult to diagnose acute appendicitis and pinpoint the precise location of the appendix. For a timely and correct diagnosis that can ultimately enhance patient outcomes and lower the risk of complications, an integrated strategy integrating clinical assessment, imaging tools, and operational findings is crucial.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

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Cite this article as: Singh C, Hamdule A, Kasbekar A and Kamble S. Clinical symptoms of acute appendicitis correlating to its intraoperative anatomical position. *Al Ameen J Med Sci* 2025; 18(1): 55-59.

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