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Accuracy and impact of CT imaging during the management of acute abdomen: A prospective study

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Abstract

Background: Acute abdomen is a common surgical emergency requiring timely and accurate diagnosis. CT imaging has become a cornerstone in the diagnostic workup, but its influence on operative decision-making remains under continuous evaluation.

Methods: This was a prospective observational study conducted at Lotus Hospital, Erode, over 15 months. It included 50 patients who presented with an acute abdomen and underwent surgery. All patients had undergone CT imaging before surgery, and CT findings were compared with intraoperative findings. Discrepancies were analyzed, and statistical significance was assessed using chi-square tests.

Results: CT findings were consistent with intraoperative findings in 56% of cases, with discrepancies in severity noted in 24% and differing diagnoses in 20%. Appendicitis and its complications accounted for 52% of all CT diagnoses. Most discrepancies involved underestimation of appendicular perforation or missed alternative diagnoses, such as bezoars or small bowel strictures.

Conclusion: CT abdomen is a valuable tool in diagnosing acute abdomen and aids surgical decision-making. However, clinical judgment remains paramount, as imaging may not detect all pathologies or severity levels. Future studies with larger sample sizes are needed to further validate our observations.

Keywords: Acute abdomen; Computed tomography; Surgical decision-making; Appendicitis; Diagnostic accuracy.

Introduction

Acute abdomen, characterized by sudden and severe abdominal pain, is a frequent emergency department presentation requiring prompt diagnosis and management. It encompasses a spectrum of conditions ranging from appendicitis to intestinal perforation, obstruction, and ischemia [1,2]. While clinical history and examination are foundational to diagnosis, imaging plays a crucial adjunctive role. Ultrasonography is often the initial modality; however, Contrast-Enhanced Computed Tomography (CECT) has gained prominence due to its superior sensitivity and specificity, particularly in complex or equivocal presentations [3]. Despite its diagnostic value, concerns remain regarding radiation exposure, cost, and the potential for false negatives. This study was conducted to evaluate the effectiveness of CT imaging in diagnosing acute abdomen and to assess its impact on intraoperative decision-making.

Study method

Study design and setting: This was a single hospital-based prospective observational study conducted in the Department of General Surgery at Lotus Hospital, Erode, from May 2022 to July 2023.

Study population and sampling: A total of 50 consecutive patients who presented to the emergency surgical ward with an acute abdomen requiring operative intervention were enrolled using purposive sampling. Inclusion and exclusion criteria were strictly adhered to.

Inclusion criteria: Patients aged >15 years.

Patients with an acute abdomen (including blunt abdominal trauma) who require surgical intervention.

Exclusion criteria:

Pregnancy

Patients with renal or ureteric calculi.

Patients under 15 years of age.

Patients who were managed conservatively without surgery.

Sample size calculation:

The sample size was calculated based on previous literature with a 90.5% estimated accuracy rate for CT diagnosis (p = 0.905), using the formula:

N = \frac{4pq}{L^2}

Where:

p = 90.5% (estimated proportion based on earlier studies)

q = 1−p = 9.5%

L = 9% (allowable error)

N = Sample size = 42.5

Adding 10% for non-response, the final sample size was rounded to 50.

Data collection process: After initial clinical assessment and routine laboratory tests (CBC, LFT, RFT, serum amylase/lipase, electrolytes), patients with suspected surgical abdomen underwent imaging. The imaging workup included: X-ray Abdomen (erect): To assess for pneumoperitoneum, obstruction. Ultrasonography (USG): When appropriate (e.g., suspected cholecystitis, gynecologic causes). CT Abdomen-Plain and contrast: All eligible patients underwent plain and contrast-enhanced CT abdomen using iopamidol (100 ml, 300 mg/ml) as and when needed

CT Imaging Protocol:

Equipment: Helical CT scanner

Scan range: Diaphragm to pubic symphysis

Parameters: 10 mm collimation, 1.5 pitch, 10 mm reconstruction

Contrast: IV contrast if required

Reporting: All CT scans were interpreted by a single experienced radiologist blinded to surgical outcomes.

Surgical intervention: The decision for surgery (laparoscopy or laparotomy) was made based on clinical judgment, supported by imaging findings. Operative findings were documented in detail and compared with CT findings postoperatively.

Outcome measures:

Primary: Concordance between CT and intraoperative findings.

Secondary: Type and severity of discrepancy, diagnostic accuracy, influence on surgical decision-making.

Statistical analysis

Data were entered and analyzed using SPSS version 21 (IBM Corp, Armonk, NY).

Descriptive Statistics: Continuous variables (e.g., age) were expressed as mean ± standard deviation.

Categorical variables (e.g., gender, CT diagnosis) were presented as frequencies and percentages.

Inferential statistics: The association between CT findings and intraoperative findings was analyzed using the Chi-square test.

Subgroup analysis was done to assess discrepancies based on age and gender.

A p-value <0.05 was considered statistically significant.

Results

Among the 50 patients, 34(68%) were male and 16(32%) females. The majority (46%) were aged 21-40 years.

Pain was present in all cases (100%), followed by vomiting (82%), fever (44%), abdominal distension (38%), constipation (24%), and diarrhea (22%).

The most common CT diagnosis, as shown in Figure 1, was appendicitis and its complications (52%), followed by bowel obstruction (12%), ischemia and perforation (14%), trauma-related findings (10%), and others (12%).

As shown in Table 1, Intraoperative findings showed appendicitis (52%), bowel perforation (28%), intussusception (8%), ischemia (6%), and miscellaneous findings (6%).

CT and surgical findings matched in 56% of cases; 24% showed underestimation of severity, and 20% had different diagnoses. No statistically significant correlation was found between age (p=0.390) or gender (p=0.248) and diagnostic discrepancy as shown in Table 2.

Table 3 delineates specific discrepancies observed between CT findings and intraoperative observations in individual cases. It outlines instances where certain diagnoses from CT scans did not align with the actual intraoperative findings. For example, cases of perforated appendicitis, bowel ischemia, intussusception, and others showed discrepancies between CT and intraoperative findings, specifying what was observed differently between the two methods.

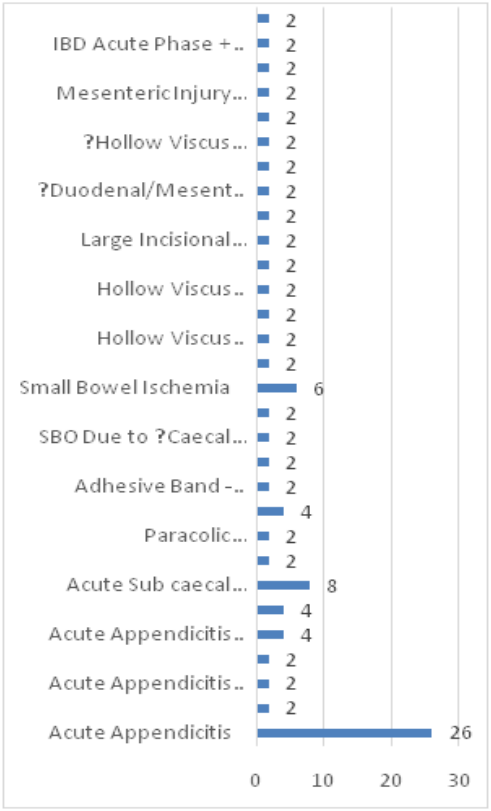

Figure 1: Magnetic resonance of cholangio pancreatography; intrahepatic bile

Table 1: Overall Intraoperative Findings.

S No	CT findings	Frequency	Percentage
1	Appendicitis and its complications	26	52
2	Perforation	14	28
3	Intussusception	4	8
4	Ischemia	3	6
5	Miscellaneous	3	6

Table 2: Comparison of CT and intraoperative findings among the study participants.

S No	Findings matched	Frequency	Percentage
1	Same findings	28	56
2	Same findings but severity missed	12	24
3	Different findings	10	20

Table 3: Discrepancy in the CT and intraoperative findings among the study participants

S no	CT findings	Intraoperative findings
1	Perforated appendicitis	No perforation
2	Bowel ischemia	No bowel ischemia
3	Intussusception	Trichobezoar missed
4	Mesenteric injury	Perforation missed
5	Strictures	No IBD, phytobezoar missed
6	Acute cholecystitis with duplication cyst	No duplication cyst
7	Caecal growth	Crohn's stricture missed
8	Bowel ischemia	Band causing congestion missed
9	Meckel's diverticulum	Duplication cyst misdiagnosed
10	Gastric perforation	Actual site of perforation not diagnosed

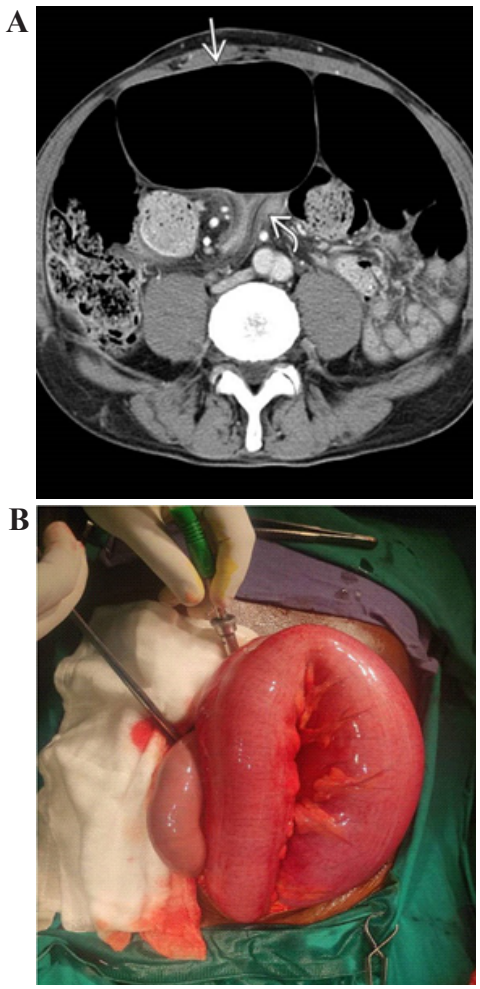

Figure 2: **(A)** CT abdomen image showing grossly dilated sigmoid colon (straight arrow) with twisted colon (curved arrow) denoting volvulus. **(B)** Intraoperative image of sigmoid volvulus.

Table 4: Discrepancy in the CT and intraoperative findings in terms of severity (N=12).

S No	Severity missed in	Frequency	Percentage
1	Appendicitis with perforation/Peritonitis	8	66.7
2	Appendicular mass	1	8.3
3	Transection of inferior epigastric artery	1	8.3
4	Ischemia of large/small bowel	1	8.3
5	Posterior wall perforation	1	8.3

Discussion

This prospective observational study was conducted to assess the diagnostic accuracy of contrast-enhanced Computed Tomography (CT) in evaluating patients with acute abdomen and its influence on operative decision-making. The study revealed that CT findings were consistent with intraoperative observations in 56% of cases, while discrepancies in either severity or diagnosis were noted in 44% of patients. These findings highlight both the strengths and limitations of CT imaging in acute surgical settings. CT abdomen emerged as a highly useful imaging modality, particularly in identifying conditions such as appendicitis, bowel obstruction, and hollow viscus perforation. Appendicitis and its complications were the most common CT findings (52%), consistent with existing literature that positions appendicitis as a leading cause of surgical abdomen globally [4]. CT imaging allowed identification of various subtypes, such as

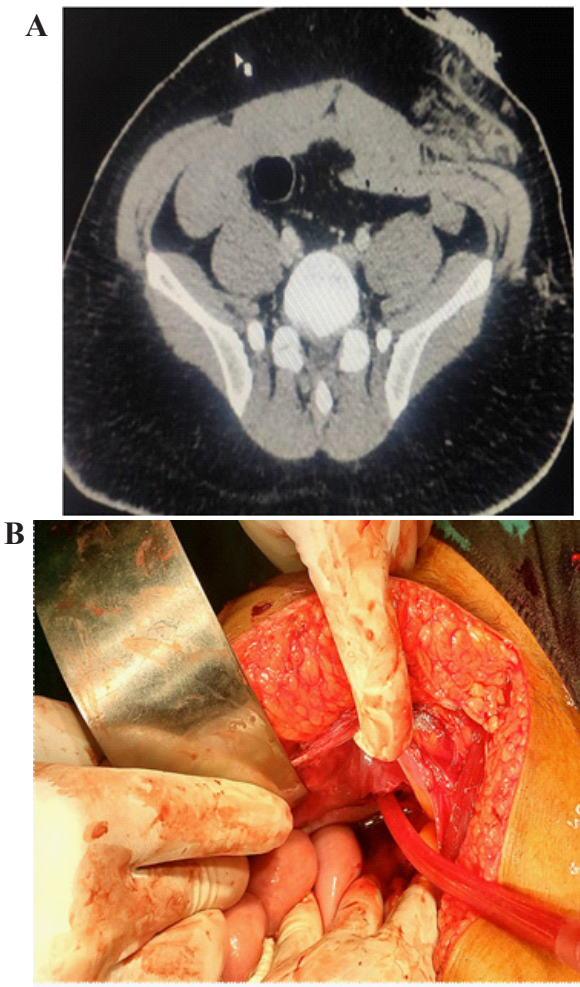

Figure 3: **(A)** CT Abdomen showing anterior abdominal wall hematoma in blunt trauma patient. **(B)** Intraoperative image showing active bleeding from inferior epigastric artery.

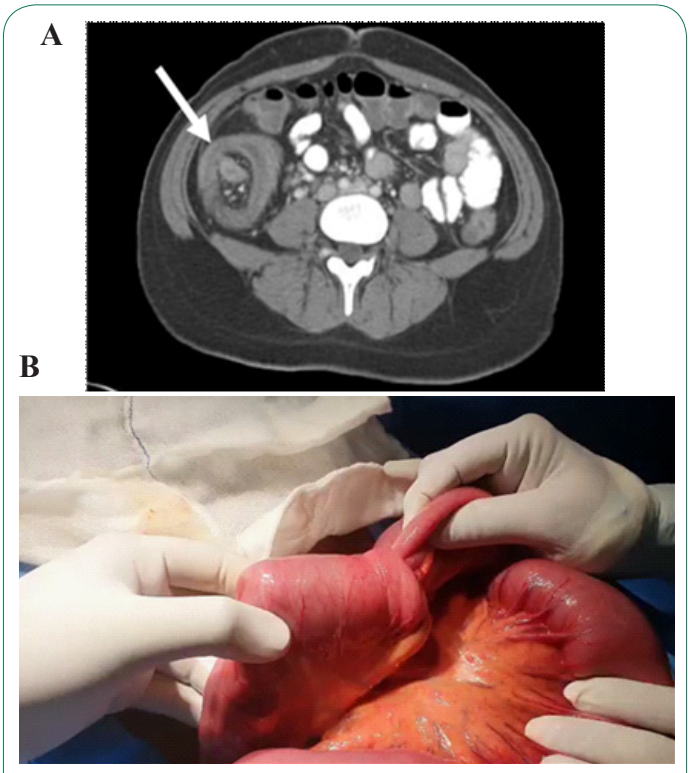

Figure 4: **(A)** CT abdomen axial view showing the target sign of intussusception (white arrow). **(B)** Intraoperative image of intussusception.

retrocaecal and subcaecal appendicitis, and in several cases, impending or actual perforation.

Our results align with the findings of Rosen et al. and Gardner et al [5]. who demonstrated that abdominal CT significantly improved diagnostic confidence and altered management decisions in over 60% of emergency department patients presenting with abdominal pain [6]. Gardner et al. specifically emphasized CT's utility in diagnosing bowel obstruction, diverticulitis, and vascular-related abdominal emergencies, which was mirrored in our cohort [2]. Similarly, studies by Yun et al. and Alshamari et al [7]. validated the high diagnostic accuracy of both standard and low-dose CT for acute appendicitis [8], reporting pooled sensitivities over 95%. These findings reinforce the importance of CT in rapidly triaging patients and preventing unnecessary laparotomies or hospital admissions [9].

In our study, CT scans facilitated appropriate operative decisions in the majority of patients. Particularly in trauma cases, CT helped localize potential mesenteric injuries or assess for retroperitoneal hematomas. Moreover, CT provided key preoperative anatomical details that improved intraoperative preparedness. However, 24% of cases showed partial discrepancies where severity (e.g., perforation or peritonitis) was underestimated, potentially delaying or altering the surgical plan. This underlines the need for CT interpretation to be integrated with robust clinical assessment. Twenty percent of patients showed a complete mismatch between CT and operative findings. Most of these discrepancies were in cases with atypical or rare pathologies such as phytobezoars, Meckel's diverticulum, Crohn's disease, or posterior duodenal wall perforations. In some cases, radiologic misdiagnosis occurred due to overlapping features or limitations in soft tissue contrast. These discrepancies demonstrate that while CT is sensitive for detecting gross pathology, it can misinterpret subtleties or rare anatomical variants. Moreover, inflammatory adhesions or localized peritonitis may be difficult to delineate in early stages. Interestingly, the age group 21-40 years showed the highest rate of diagnostic accuracy, likely due to clearer radiologic presentation of common pathologies like appendicitis. Elderly patients (>60 years) showed a higher proportion of diagnostic mismatches, which could be attributed to atypical presentations and coexisting comorbidities. However, statistical analysis revealed no significant correlation between age/gender and CT-intraoperative mismatch ($p>0.05$), suggesting that discrepancies may depend more on pathology type and imaging limitations rather than demographic variables. This study confirms that CT abdomen not only expedites diagnosis but also reduces negative laparotomies and helps in planning the extent of surgery. Surgeons should, however, remain vigilant for CT underestimation, especially in cases suggestive of peritonitis, bowel ischemia, or unusual findings. A multidisciplinary approach involving radiologists, surgeons, and emergency physicians remains key to optimizing diagnostic accuracy and patient outcomes.

Limitations

Small sample size from a single center. Inability to calculate specificity due to lack of non-surgical cases. Diagnostic accuracy may vary with radiologist expertise. The high concordance rate (56%) between CT and intraoperative findings in this study underscores its diagnostic reliability, especially for common surgical emergencies like appendicitis, bowel obstruction, and hollow viscus perforation. Additionally, the ability of CT to influence clinical decision-making positively impacts patient out-

comes by reducing diagnostic uncertainty, avoiding unnecessary laparotomies, and ensuring timely intervention. However, it is important to recognize that CT is not infallible. In a significant proportion of cases (44%), either the severity of the disease was underestimated or the diagnosis was inaccurate. These discrepancies, often involving rare or complex presentations such as Crohn's disease, Meckel's diverticulum, or mesenteric ischemia, highlight the importance of correlating imaging findings with a thorough clinical assessment.

Therefore, while CT abdomen has become an indispensable tool in emergency surgical care, it should be regarded as a complement, not a replacement, for clinical judgment. The surgeon's experience, bedside evaluation, and understanding of pathophysiology remain central to effective patient management. This study reinforces the significant role of contrast-enhanced CT imaging in the evaluation and management of the acute abdomen. CT scans not only improve diagnostic precision but also guide surgeons in preoperative planning by identifying the location, nature, and possible severity of intra-abdominal pathology. Future research with larger, multicentric cohorts and standardized imaging protocols is warranted to validate these findings and enhance diagnostic algorithms. Additionally, exploring the use of artificial intelligence in radiologic interpretation and assessing the impact of low-dose CT protocols could offer promising avenues for improving diagnostic efficiency while minimizing radiation exposure.

Conclusion

CT imaging is a cornerstone in the diagnostic pathway of the acute abdomen. When used judiciously alongside clinical expertise, it significantly contributes to timely and appropriate surgical intervention, ultimately improving patient care and outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee.

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