Section: Radiodiagnosis

Original Research Article

COMPUTED TOMOGRAPHY IN THE ASSESSMENT OF ACUTE ABDOMEN: A PROSPECTIVE ANALYSIS

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ABSTRACT

Background: Acute abdominal pain is one of the most common presentations in emergency departments and poses a significant diagnostic challenge due to its wide spectrum of underlying causes. Rapid and accurate diagnosis is essential to guide appropriate management and reduce morbidity and mortality. Computed tomography (CT) has emerged as a key imaging modality in the evaluation of acute abdomen, offering high diagnostic accuracy and influencing clinical decision-making.

Materials and Methods: This prospective observational study was conducted in a tertiary care emergency department .A total of 642 adult patients presenting with acute abdominal pain were included. All patients underwent standardized clinical evaluation followed by CT imaging. Diagnostic performance metrics including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated. The impact of CT on management decisions and clinical outcomes was analyzed.

Results: CT demonstrated high diagnostic accuracy across all major conditions, with sensitivity ranging from 87.3% to 96.9% and specificity from 94.6% to 98.2%. Emergency surgical interventions decreased from 45.0% to 33.6%, while conservative management increased from 30.4% to 50.8%. Mean hospital stay was reduced from 4.5 ± 3.4 days to 3.3 ± 2.6 days, and time to diagnosis decreased from 5.3 ± 3.0 hours to 2.7 ± 1.3 hours ($p<0.001$). Complication rates and unnecessary surgeries were significantly lower in the CT-guided group, with improved patient satisfaction and reduced healthcare costs.

Conclusion: CT is a highly reliable and clinically impactful imaging modality in the evaluation of acute abdominal conditions. Its use significantly improves diagnostic accuracy, optimizes management strategies, reduces unnecessary interventions, and enhances patient outcomes.

Keywords: Acute abdomen; Computed tomography; Diagnostic accuracy; Emergency imaging; Clinical decision-making; Multidetector CT.

INTRODUCTION

Acute abdominal pain is one of the most frequent reasons for emergency department visits and accounts for a significant proportion of hospital admissions worldwide. The clinical presentation is often variable and nonspecific, encompassing a wide range of conditions from self-limiting disorders to life-threatening surgical emergencies. Early and accurate diagnosis is therefore essential to guide timely management and improve patient outcomes.[1] Traditionally, diagnosis has relied on clinical evaluation supported by laboratory investigations and conventional imaging modalities such as plain radiography and ultrasonography. However, these approaches often lack sufficient sensitivity and specificity, particularly in complex or atypical presentations, leading to diagnostic uncertainty and potential delays in treatment.[2]

Computed tomography (CT) has emerged as a highly valuable imaging modality in the evaluation of acute abdominal pain due to its ability to provide detailed cross-sectional imaging and high diagnostic accuracy. CT allows precise identification of underlying pathology, assessment of disease severity, and detection of complications, thereby playing a crucial role in clinical decision-making.[3]

Several studies have demonstrated that CT imaging significantly reduces negative surgical explorations, improves diagnostic confidence, and enhances patient outcomes in acute abdominal conditions. Its role is particularly well established in conditions such as appendicitis, bowel obstruction, and gastrointestinal perforation, where early diagnosis is critical.[4]

Despite its advantages, concerns regarding radiation exposure and cost remain important considerations. However, advancements in CT technology and dose optimization techniques have significantly reduced radiation risks while maintaining diagnostic quality, supporting its routine use in emergency settings.[5]

Recent evidence suggests that the integration of CT into clinical protocols not only improves diagnostic accuracy but also contributes to more efficient resource utilization, reduced hospital stay, and better overall patient care.[6] In this context, the present study was undertaken to evaluate the diagnostic performance and clinical impact of CT in patients presenting with acute abdominal pain.

Aim

To evaluate the diagnostic accuracy and clinical impact of computed tomography in patients presenting with acute abdominal pain.

Objectives

1. To determine the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of CT in diagnosing major acute abdominal conditions.
2. To assess the impact of CT findings on clinical management decisions.
3. To evaluate the effect of CT-guided management on clinical outcomes including length of hospital stay, time to diagnosis, complications, and readmission rates.
4. To analyze the role of CT in reducing unnecessary surgical interventions and healthcare costs.

MATERIALS AND METHODS

Study Design and Setting: This prospective observational study was conducted in the emergency department of Radiodiagnosis at NRI Academy of Medical Sciences, Chinakakani, from March 2025 to February 2026. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Study Population: Adult patients (≥18 years) presenting with acute abdominal pain were consecutively enrolled. Acute abdominal pain was defined as pain of less than 7 days duration requiring emergency evaluation.

Exclusion criteria included pregnancy, known contraindications to iodinated contrast media, hemodynamic instability requiring immediate surgical intervention, and inability to provide informed consent.

Clinical Evaluation: All patients underwent standardized clinical assessment including detailed history, physical examination, and laboratory investigations. Clinical parameters included pain characteristics, associated symptoms, and physical findings. Laboratory investigations comprised complete blood count, renal and liver function tests, and inflammatory markers.

CT Imaging Protocol: All patients underwent multidetector computed tomography (CT) of the abdomen using standardized protocols. Imaging included a non-contrast phase followed by contrast-enhanced scans using intravenous iodinated contrast (100–120 mL at 3–4 mL/sec). Oral contrast was administered selectively.

Images were acquired with 1–2 mm slice thickness and reconstructed in axial, coronal, and sagittal planes.

Image Interpretation: CT images were interpreted by experienced radiologists using structured reporting formats. Diagnoses were categorized into major acute abdominal conditions including appendicitis, bowel obstruction, gastrointestinal perforation, pancreatitis, cholecystitis, diverticulitis, ischemic bowel, and abscess formation.

Radiological findings and diagnostic confidence were recorded, and urgent findings were immediately communicated to the treating team.

Reference Standard: Final diagnosis was established using a composite reference standard including surgical findings, histopathological examination, and clinical follow-up. Patients were followed for a minimum of 30 days.

Operative findings served as the reference standard in surgical cases, while clinical course and response to treatment were used for non-surgical cases.

Data Collection: Data collected included demographic characteristics, clinical findings, CT results, final diagnosis, management decisions, and clinical outcomes. Variables related to healthcare utilization such as hospital stay, readmission, and interventions were recorded.

Outcome Measures: The primary outcome was diagnostic performance of CT, assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy.

Secondary outcomes included impact on management decisions, surgical intervention rates, length of hospital stay, time to diagnosis, complication rates, readmission rates, patient satisfaction, and healthcare costs.

Statistical Analysis: Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Diagnostic performance metrics were calculated using standard definitions.

Comparisons between CT-guided and traditional management were performed using appropriate statistical tests. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 642 patients presenting with acute abdominal conditions were evaluated. Computed tomography (CT) demonstrated high diagnostic accuracy across a range of pathologies and significantly influenced clinical decision-making and patient outcomes.

Diagnostic Performance of CT: CT showed excellent diagnostic performance across all major acute abdominal conditions [Table 1]. Sensitivity ranged from 87.3% in ischemic bowel to 96.9% in appendicitis, while specificity remained consistently high, exceeding 94% for all conditions and reaching up to 98.2% for abscess detection. Negative predictive value (NPV) was particularly high across conditions (95.8%–97.9%), indicating strong reliability of CT in excluding disease.

Accuracy of CT remained above 93% for all evaluated conditions, with the highest accuracy observed in appendicitis (97.3%) and abscess formation (97.5%). Even in relatively challenging conditions such as ischemic bowel, CT maintained high specificity (97.8%) and overall accuracy (95.7%).

These findings confirm that CT is a robust diagnostic modality with consistently high performance across diverse acute abdominal pathologies.

Table 1: Diagnostic Performance of CT for Major Acute Abdominal Conditions

Condition	Cases (n)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Appendicitis	190	96.9	97.5	95.8	97.9	97.3
Bowel Obstruction	140	94.8	95.9	92.1	97.1	95.6
GI Perforation	87	92.6	96.3	87.8	97.5	95.4
Pancreatitis	76	91.3	96.8	93.2	95.9	95.2
Cholecystitis	65	88.1	94.6	83.7	95.8	93.2
Diverticulitis	58	90.5	95.3	86.2	96.6	94.3
Ischemic Bowel	34	87.3	97.8	92.4	96.3	95.7
Abscess Formation	42	94.3	98.2	96.4	97.6	97.5

Impact of CT on Clinical Management: CT significantly altered clinical management strategies [Table 2]. The proportion of patients undergoing emergency surgery decreased from 45.0% to 33.6%, representing a 25.3% relative reduction. In contrast, conservative management increased markedly from 30.4% to 50.8% (67.1% increase), indicating improved diagnostic confidence.

The need for additional investigations decreased by 31.5%, while specialist consultations reduced by 19.6%. Hospital admissions also showed a modest reduction from 63.7% to 55.3%. Importantly, discharge rates from the emergency department nearly doubled, increasing from 14.6% to 27.3%.

There was no statistically significant difference in antibiotic usage ($p > 0.05$), suggesting that CT primarily influenced decision-making related to procedural interventions rather than medical therapy. Pain management-only strategies increased significantly, reflecting improved exclusion of serious pathology.

Table 2: Impact of CT Findings on Clinical Management Decisions

Management Category	Without CT (n=642)	With CT (n=642)	Change (%)	P-value
Emergency Surgery	289 (45.0%)	216 (33.6%)	-25.3%	<0.001
Conservative Management	195 (30.4%)	326 (50.8%)	+67.1%	<0.001
Additional Investigations	149 (23.2%)	102 (15.9%)	-31.5%	<0.001
Specialist Consultation	226 (35.2%)	182 (28.3%)	-19.6%	<0.01
Hospital Admission	409 (63.7%)	355 (55.3%)	-13.2%	<0.05
Discharge from ED	94 (14.6%)	175 (27.3%)	+87.0%	<0.001
Antibiotic Therapy	305 (47.5%)	271 (42.2%)	-11.2%	>0.05
Pain Management Only	103 (16.0%)	149 (23.2%)	+45.0%	<0.01

Clinical Outcomes and Healthcare Utilization: CT-guided management was associated with significantly improved clinical outcomes (Table 3). Mean length of hospital stay was reduced from 4.5 ± 3.4 days to 3.3 ± 2.6 days ($p < 0.001$). Time to diagnosis was also significantly shorter (2.7 ± 1.3 hours vs 5.3 ± 3.0 hours).

Rates of delayed diagnosis decreased substantially from 7.5% to 2.1%, while unnecessary surgeries were reduced from 12.0% to 5.0%. Complication rates also showed a significant reduction (10.9% to 6.5%).

Patient satisfaction scores were higher in the CT-guided group (8.2 ± 1.2 vs 7.0 ± 1.7), reflecting improved patient experience. Additionally, healthcare costs per case were significantly lower in the CT group ($4,120 ± 2,040 vs $5,620 ± 3,280).

These findings demonstrate that CT not only improves diagnostic accuracy but also contributes to better clinical outcomes, reduced healthcare burden, and enhanced patient satisfaction.

Table 3: Clinical Outcomes and Healthcare Utilization Metrics

Outcome Parameter	CT-Guided Management	Traditional Management	P-value
Mean Length of Stay (days)	3.3 ± 2.6	4.5 ± 3.4	<0.001
30-day Readmission Rate (%)	4.5	8.6	<0.01
Delayed Diagnosis Rate (%)	2.1	7.5	<0.001

Unnecessary Surgery Rate (%)	5.0	12.0	<0.001
Complication Rate (%)	6.5	10.9	<0.01
Patient Satisfaction Score (1–10)	8.2 ± 1.2	7.0 ± 1.7	<0.001
Time to Diagnosis (hours)	2.7 ± 1.3	5.3 ± 3.0	<0.001
Healthcare Costs per Case ($)	4,120 ± 2,040	5,620 ± 3,280	<0.001

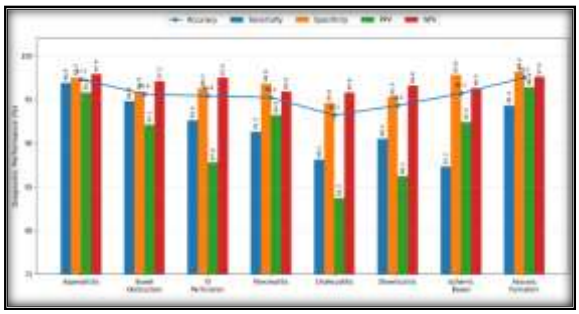

Figure 1: Diagnostic performance of CT across major acute abdominal conditions.

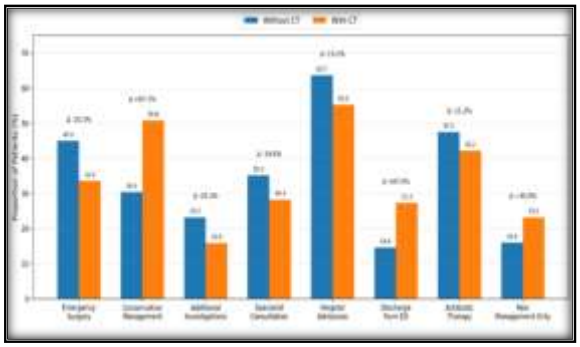

Figure 2: Impact of CT findings on clinical management decisions.

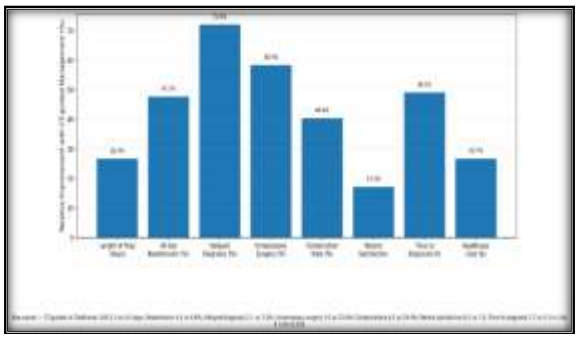

Figure 3: Relative improvement in clinical outcomes and healthcare utilization with CT-guided management.

DISCUSSION

The findings of the present study indicate that computed tomography (CT) provides consistently high diagnostic accuracy across a broad spectrum of acute abdominal conditions, with overall accuracy exceeding 93% for all evaluated entities. Sensitivity ranged from 87.3% in ischemic bowel to 96.9% in appendicitis, while specificity remained high across all conditions, reaching up to 98.2% in abscess formation. These observations reinforce the central role of CT in the diagnostic evaluation of acute abdomen and are in agreement with established imaging-based diagnostic strategies.[7,8]

The diagnostic performance of CT in appendicitis observed in the present study (sensitivity 96.9%, specificity 97.5%, accuracy 97.3%) is consistent with earlier studies demonstrating reduced negative appendectomy rates with increased CT utilization.[10,11] The high negative predictive value (97.9%) further supports its reliability in excluding appendicitis in clinically uncertain cases. In contrast to ultrasonography, which is often operator-dependent and may be limited in obese patients or those with atypical presentation, CT offers a more consistent and reproducible diagnostic approach, particularly in complex clinical scenarios.[20,23]

In bowel obstruction, CT demonstrated sensitivity of 94.8% and specificity of 95.9%, with a high negative predictive value of 97.1%, indicating its effectiveness in ruling out obstruction when imaging is negative. Beyond detection, CT also enables precise identification of the transition point, etiology, and associated complications such as ischemia or strangulation. This multidimensional diagnostic capability has been emphasized in previous studies and contributes significantly to surgical planning and risk stratification.[9,21]

The diagnostic accuracy for gastrointestinal perforation (sensitivity 92.6%, specificity 96.3%, accuracy 95.4%) confirms the reliability of CT in detecting even subtle radiological signs such as pneumoperitoneum and extraluminal contrast leakage. Early and accurate identification of perforation is critical in clinical practice, as delays in diagnosis are associated with increased morbidity and mortality. The findings of the present study further support the role of CT as the imaging modality of choice in suspected perforation.[22]

In ischemic bowel, although sensitivity was relatively lower (87.3%), specificity remained high (97.8%), reflecting the inherent challenges associated with detecting early ischemic changes. The subtle nature of early perfusion abnormalities often limits sensitivity; however, the high specificity observed indicates that CT remains reliable in confirming clinically suspected cases. Emerging imaging techniques such as dual-energy CT and perfusion imaging are expected to further improve early detection in the future.[13,21]

A key strength of the present study is the demonstration of the impact of CT on clinical management decisions. Emergency surgical interventions decreased from 45.0% to 33.6%, representing a relative reduction of 25.3%, while conservative management increased from 30.4% to 50.8%, reflecting a 67.1% increase. These findings indicate improved diagnostic confidence and more appropriate patient selection for surgical intervention. Similar trends have been reported in

earlier studies, where CT imaging contributed to a reduction in unnecessary surgeries and facilitated evidence-based clinical decision-making.[15,16]

Furthermore, the requirement for additional investigations decreased by 31.5%, and specialist consultations were reduced by 19.6%, demonstrating a more streamlined and efficient diagnostic pathway. Hospital admissions decreased from 63.7% to 55.3%, while discharge rates from the emergency department increased from 14.6% to 27.3%. These findings highlight the role of CT in improving triage efficiency and optimizing healthcare resource utilization.

CT-guided management was also associated with significant improvements in clinical outcomes. The mean length of hospital stay decreased from 4.5 ± 3.4 days to 3.3 ± 2.6 days, and time to diagnosis was reduced from 5.3 ± 3.0 hours to 2.7 ± 1.3 hours ($p<0.001$). In addition, delayed diagnosis rates decreased from 7.5% to 2.1%, and unnecessary surgical interventions were reduced from 12.0% to 5.0%. These findings are clinically significant and demonstrate the direct impact of timely and accurate imaging on patient outcomes.

Complication rates were lower in the CT-guided group (6.5% vs 10.9%), and patient satisfaction scores were higher (8.2 ± 1.2 vs 7.0 ± 1.7). These improvements likely reflect a combination of accurate diagnosis, appropriate management, and avoidance of unnecessary interventions, ultimately leading to better patient experience and clinical outcomes.

Healthcare costs were also reduced in the CT-guided group ($4,120 ± 2,040 vs $5,620 ± 3,280), indicating that CT contributes not only to clinical effectiveness but also to cost-efficient patient care. This is particularly relevant in high-volume emergency settings where resource optimization is essential.

Radiation exposure remains an important consideration in CT imaging. However, with the implementation of dose optimization strategies and advancements in imaging technology, radiation exposure can be minimized without compromising diagnostic quality. In the present study, optimized imaging protocols ensured adequate image quality while maintaining patient safety.[12]

Recent guideline updates and contemporary evidence further support the findings of this study. The 2020 update of the World Society of Emergency Surgery (WSES) guidelines emphasizes the early use of CT imaging in suspected acute appendicitis to reduce diagnostic uncertainty and avoid unnecessary surgical intervention.[21] The high sensitivity (96.9%) and specificity (97.5%) observed in the present study are in close agreement with these recommendations.

Additionally, recent meta-analytical evidence has highlighted the importance of timely diagnosis in reducing complications associated with acute abdominal conditions. van Dijk et al. demonstrated that delays in diagnosis are associated with increased risk of adverse outcomes.[22] The significant reduction in time to diagnosis (from 5.3 ± 3.0 hours to 2.7 ± 1.3 hours) and delayed diagnosis rates (7.5% to 2.1%) observed in the present study further emphasize the clinical importance of early imaging.

Contemporary imaging literature has also reinforced the evolving role of CT as the cornerstone modality in acute abdomen evaluation. Modern multidetector CT techniques provide comprehensive anatomical and pathological assessment, enabling rapid diagnosis and improved clinical outcomes.[23] The consistently high diagnostic accuracy observed across multiple conditions in the present study reflects these advancements in imaging technology.

Furthermore, recent studies have emphasized the expanding role of CT beyond diagnosis, particularly in guiding management strategies and optimizing healthcare utilization. CT imaging has been shown to reduce unnecessary admissions, investigations, and surgical interventions, thereby improving overall healthcare efficiency.[24] These findings are consistent with the present study, where significant reductions in admissions, investigations, and surgical interventions were observed.

Despite these findings, certain limitations must be acknowledged. The single-center design may limit generalizability, and exclusion of hemodynamically unstable patients may introduce selection bias. However, these factors reflect routine clinical practice in emergency settings, where immediate intervention may take precedence over imaging. The use of composite reference standards, although necessary, may introduce variability in diagnostic confirmation.

Taken together, the findings of the present study indicate that CT plays a crucial role in the evaluation of acute abdominal conditions. It provides high diagnostic accuracy, significantly influences clinical decision-making, improves patient outcomes, and contributes to efficient utilization of healthcare resources.

CONCLUSION

The present study demonstrates that computed tomography is a highly effective diagnostic tool in the evaluation of acute abdominal conditions, providing consistently high accuracy across a wide range of pathologies. With sensitivity ranging from 87.3% to 96.9% and specificity exceeding 94% for all conditions, CT enables reliable diagnosis and exclusion of disease.

CT significantly influences clinical decision-making, as evidenced by a reduction in emergency surgical interventions from 45.0% to 33.6% and a substantial increase in conservative management from 30.4% to 50.8%. The reduction in additional investigations and hospital admissions, along with increased emergency department discharges, reflects improved efficiency in patient triage and resource utilization.

Furthermore, CT-guided management is associated with improved clinical outcomes, including reduced hospital stay (3.3 vs 4.5 days), shorter time to

diagnosis (2.7 vs 5.3 hours), lower complication rates (6.5% vs 10.9%), and decreased unnecessary surgeries (5.0% vs 12.0%). Enhanced patient satisfaction and reduced healthcare costs further support its clinical and economic benefits.

Overall, CT has become an indispensable tool in emergency medicine, enabling rapid, accurate diagnosis and optimal patient management. Its integration into standard diagnostic protocols is essential to improve patient outcomes and healthcare efficiency.

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