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Original Article

Radiology Section

Role of Multi-slice Computed Tomography in Evaluation of Non-traumatic Causes of Acute Abdominal Pain in Adult Patients with Negative/Inconclusive Sonogram: A Prospective Observational Study

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ABSTRACT

Introduction: Acute non-traumatic abdominal pain is a frequent emergency presentation, associated with a wide range of possible differential diagnoses. While Ultrasonography (USG) is widely available and radiation-free, its diagnostic accuracy is limited by the patient's habitus and bowel gas. Multi-slice Computed Tomography (MSCT) offers a comprehensive evaluation but comes with a higher cost and increased radiation exposure.

Aim: To assess the diagnostic accuracy of MSCT in adult patients with acute non-traumatic abdominal pain negative or inconclusive for USG.

Materials and Methods: The present prospective observational study was conducted in the Department of Radiodiagnosis at Teerthanker Mahaveer Medical College and Research Centre, Moradabad, Uttar Pradesh, India over a period of one year from June 2024 to July 2025. In this study, 81 adult patients who were referred for CT after an inconclusive/negative USG report underwent contrast-enhanced MSCT using a 128-slice scanner. CT findings were compared with surgical and histopathological outcomes when available, and with clinical follow up in conservatively managed cases. The sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV), as well as the diagnostic accuracy of MSCT in cases of non-traumatic acute abdominal pain were calculated.

Results: The mean age was 41.3±15.8 years, out of which 47 (58%) patients were male. MSCT diagnosed 16 (25.9%) cases of pancreatitis, 7 (16%) cases of appendicitis, and 5 (13.6%) cases of ureteric calculi among the most common pathologies. Among the 47 patients who got operated, CT findings were concordant with intraoperative results in 37 (90.2%) patients and with histopathology in all 41 patients (100%). MSCT provided new or alternative diagnosis in 66 out of 81 (81%) cases, significantly altering the management plans.

Conclusion: The prompt use of MSCT in cases of an acute abdomen with equivocal USG findings significantly improves diagnostic accuracy and ensures appropriate management, outweighing its higher cost and radiation risks.

Keywords: Acute abdomen, Multidetector CT, Ultrasonography

INTRODUCTION

The term "acute abdomen" refers to a condition characterised by severe abdominal pain that is sudden in onset and progressively worsens over hours. Upon examination, the abdomen is tender and rigid, necessitating prompt intervention. A 5 to 10% of consultations in the emergency room are for non-traumatic abdominal pathology, making it one of the most common reasons for such visits [1-3]. It has many causes, ranging from benign and self-limiting conditions to serious illnesses, with acute appendicitis, ruptured Abdominal Aneurysm (AA), intestinal perforation, and Acute Mesenteric Ischaemia (AMI) being some of the primary causes that require urgent treatment [4]. Physical examination, clinical history, and laboratory findings are seldom sufficient for establishing a definitive diagnosis; therefore, imaging plays a crucial role in supporting the diagnostic process [5].

USG is a valuable tool for assessing acute appendicitis (which is one of the commonest aetiologies of acute abdomen), gallbladder and biliary tract pathologies in all patients, especially in children and pregnant women. Patients with torsion in the ovary or testes, ectopic pregnancy, and epididymo-orchitis also necessitate the use of USG for their diagnosis. Due to its low cost, wider availability, and lack of ionising radiation, USG is being increasingly utilised to screen patients or to assess a constellation of symptoms in the majority of patients. However, USG can occasionally produce equivocal results, particularly in cases of excessive intra-abdominal fat or significant bowel gases [6,7].

MSCT plays a vital role in diagnosis due to its ability to provide a detailed analysis of the gut, mesentery, omentum, peritoneum, retroperitoneum, vasculature, solid organs, abdominal musculature, and bones. Moreover, it provides greater precision, accuracy, and clarity [8]. Currently, clinicians may opt for CT as the first-line modality or perform USG initially, proceeding to CT if the USG findings are inconclusive [9]. Even though MSCT provides notable advantages over plain-film radiography and USG in many cases, it comes with its own set of drawbacks, such as a high radiation dose, substantial cost, and limited availability [10,11]. However, MSCT is unaffected by the presence of bowel gases and intra-abdominal fat. Thus, it has emerged as the premier modality for evaluating the gut, peritoneum, mesenteries, retroperitoneum and omentum [9,12]. The shorter acquisition time and excellent multiplanar imaging (MPR) capability in the present day CT scanners are among the other key advantages of MSCT over Magnetic Resonance Imaging (MRI) [13,14].

Hence, the present study was undertaken to evaluate the accuracy of MSCT in the diagnosis of acute non-traumatic abdomen in adult patients with inconclusive/negative USG.

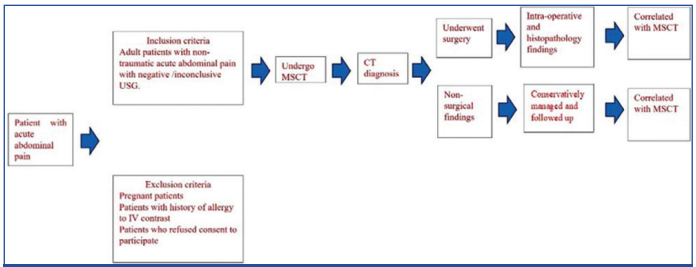
MATERIALS AND METHODS

The present prospective observational study was conducted after obtaining approval from the Institutional Ethics Committee (TMU/IEC, November 23, 1987) in the Department of Radiodiagnosis at Teerthanker Mahaveer Medical College and Research Centre, Moradabad, Uttar Pradesh, India, from June 2024 to July 2025.

Inclusion criteria: All adult patients who presented with non-traumatic acute abdominal pain and were referred to the Department of Radiodiagnosis for CT abdomen in view of negative/inconclusive ultrasound.

Exclusion criteria: Exclusion criteria included pregnancy, history of allergy to intravenous (i.v.) contrast, and refusal to provide consent for participation in the study.

The flowchart of patient recruitment in the present study is illustrated in [Table/Fig-1]. Consecutive sampling was used after applying the selection criteria. A total of 81 cases were enrolled in the present study.



[Table/Fig-1]: Flowchart showing patient recruitment.

Study Procedure

The patients' clinical histories were documented. All qualifying patients were appropriately counselled and informed in detail about the study's objectives and procedure. Privacy and confidentiality were upheld. Patients were enrolled in the study only after obtaining the written informed consent.

MSCT of the abdomen was performed using a 128-slice scanner, "Ingenuity CT, Philips Healthcare", from the level of the diaphragm to the symphysis pubis. Iodinated i.v. contrast was routinely used, except in patients with known medical renal disease or a history of anaphylaxis to medications. eGFR was assessed, and i.v. contrast was administered only when eGFR values came within the normal range. Oral contrast administration was done according to the provisional clinical diagnosis and was avoided in cases of high-grade bowel obstruction and acute gastrointestinal bleeding. A scanogram was obtained and pre and post i.v. contrast series of the abdomen and pelvis were obtained.

MSCT diagnoses were compared with intraoperative surgical findings and histopathological results, when available. In conservatively managed cases, clinical follow-up was conducted to assess recovery and associate outcomes with the initial CT findings.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software, version 24.0. For comparing the frequency, the Chi-square test was applied and a p-value less than 0.05 were considered to be significant. Subsequently, the sensitivity, specificity, PPV, and NPV, as well as the diagnostic accuracy of MSCT in cases of non-traumatic acute abdominal pain, were calculated. Additionally, the association of CT findings with clinical and surgical outcomes in these patients was evaluated.

RESULTS

The mean age of the study population was 41.33±15.75 years, with 47 (58%) male patients and 34 (42%) female patients. Twenty subjects out of 81 (24.69%) were aged 20-30 years; and 18 (22.22%) were aged 41-50 years. Among the rest, 6 (7.4%) subjects were aged <20 years, 15 (18.5%) were in 31-40 and 51-60 years age groups each and 7 (8.6%) were aged >60 years. In 24 (29.6%) of the patients, pain was localised to the epigastrium, 23 (28.3%) had pain in the right iliac fossa, and 18 (22.2%) had pain in the umbilical region. Only 2 (2.4%) patients had right hypochondriac pain, 9 (11.1%) had left iliac fossa pain, and 7 (8.6%) had diffuse abdominal pain.

Based on CT findings, 21 (25.9%) cases were diagnosed with pancreatitis, 13 (16%) with appendicitis, and 11 (13.6%) with a ureteric calculus [Table/Fig-2]. A total of 41 cases (50.6%) were managed surgically, and the remaining 40 cases (49.4%) were treated conservatively.

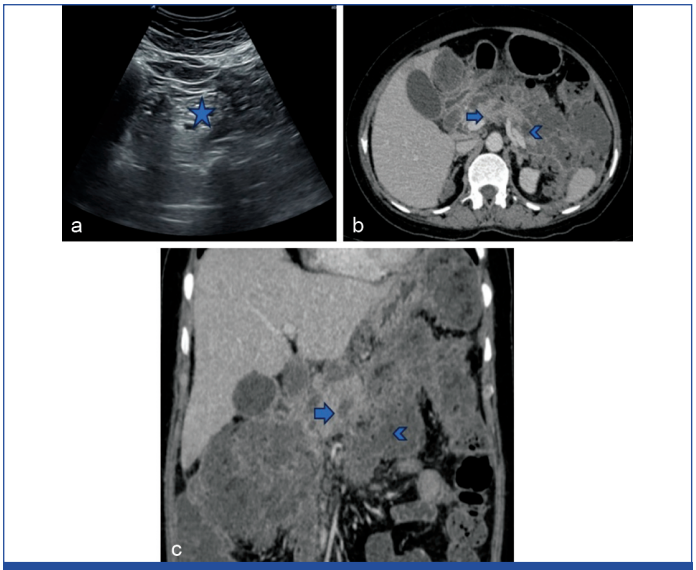
Findings	Frequency (n=81)	Percentage (%)
Mesenteric ischaemia	6	7.4
Pancreatitis	21	25.9
Appendicitis	13	16.0
GB perforation	3	3.7
Cholecystitis	2	2.5
SMA stenosis	4	4.9
Ureteric calculus	11	13.6
Intestinal obstruction	5	6.1
Intestinal perforation	6	7.4
Diverticulitis	6	7.4
Epiploic appendagitis	2	2.5
Intussusception	2	2.5

[Table/Fig-2]: Radiological findings of cases.
GB: Gall bladder; SMA: Superior mesenteric artery

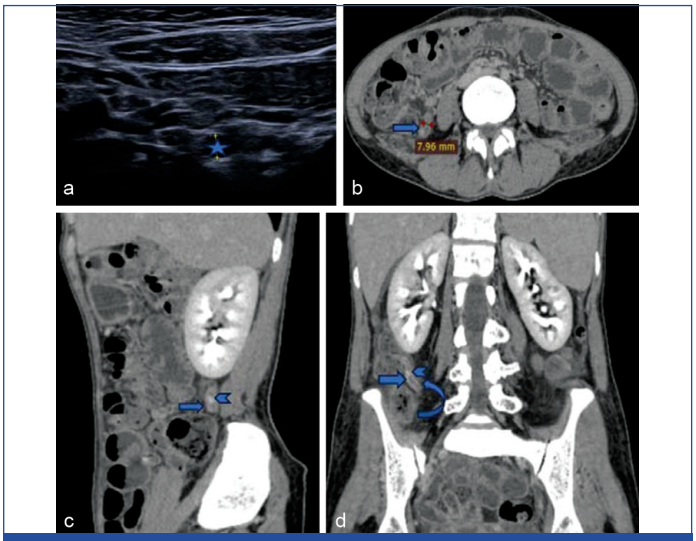
Intraoperative findings were consistent with imaging findings in 37 out of 41 (90.24%) cases. Histopathological findings were consistent with intraoperative findings in all 41 (100%) cases [Table/Fig-3]. Inconclusive/non-specific USG findings in five cases of acute pancreatitis were confirmed on MSCT. There were 16 cases with normal/negative USG where MSCT findings suggested a diagnosis of acute pancreatitis. [Table/Fig-4]. Similarly, six cases with inconclusive/non-specific USG findings were confirmed to have of acute appendicitis on MSCT. Additionally, in seven cases where USG appeared normal, MSCT findings indicated acute appendicitis [Table/Fig-5]. Three cases with inconclusive USG findings of intestinal obstruction were confirmed on CT. Additionally, in two cases where USG appeared normal, CT findings suggested intestinal obstruction. Five cases of intestinal perforation with inconclusive USG findings were confirmed on CT. In one case where USG appeared normal, CT findings suggested intestinal perforation as a diagnosis. Six cases with inconclusive/non-specific USG findings were diagnosed as having a mid or distal ureteric calculus on MSCT. Three cases of Gall Bladder (GB) perforation with inconclusive/non-specific findings on USG were confirmed on MSCT. In all cases of mesenteric ischaemia (n=6) [Table/Fig-6], SMA stenosis (n=4), diverticulitis (n=6), epiploic appendagitis (n=2) [Table/Fig-7], and intussusception (n=2), where USG was negative, MSCT suggested an alternative diagnosis. A significant association (p<0.05) was observed between positive CT findings and inconclusive USG findings [Table/Fig-8].

Intraoperative findings	Frequency (n=41)	Percentage (%)
Consistent with imaging findings	37	90.24
Inconsistent with imaging findings	4	9.76
Consistent with histological findings	41	100
Inconsistent with histological findings	0	0

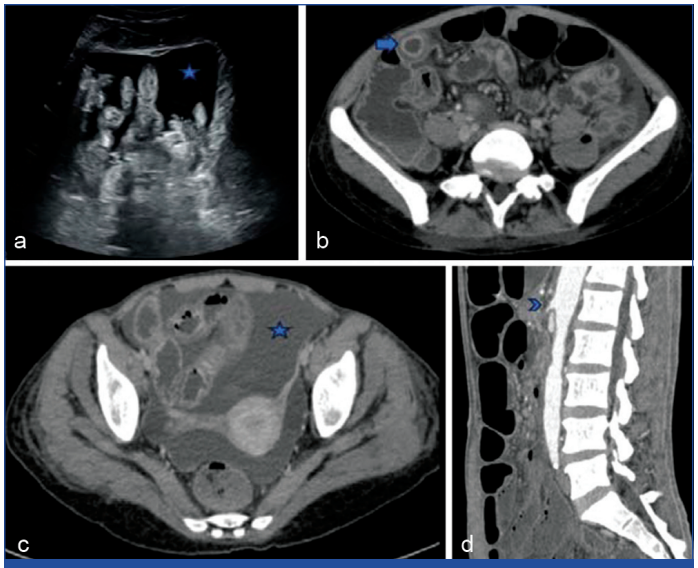
[Table/Fig-3]: Distribution of study subjects according to intraoperative and histological findings.



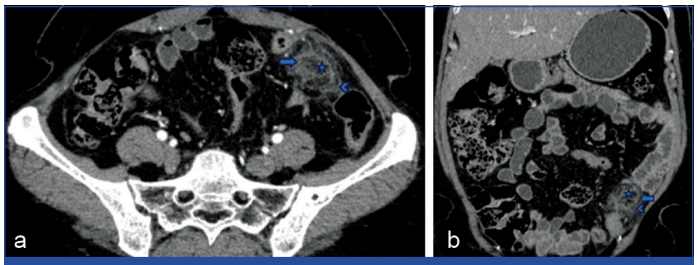
[Table/Fig-4]: Case of acute pancreatitis in a 41-year-old female with acute abdominal pain in the epigastric region. Ultrasonographic images: (a) show a gaseous abdomen (star). CECT abdomen axial (b) & coronal (c) images in portal-venous phase show hypodense collection (arrow) within pancreatic body region with adjacent peripherally enhancing collection (arrow head) in peripancreatic region.



[Table/Fig-5]: Case of acute appendicitis in 30-year-old female with acute right iliac fossa pain. Ultrasonographic image: (a) shows lymph nodes (star) in right iliac fossa region. CECT abdomen axial (b), sagittal (c) & coronal (d) images show dilated appendix (blue arrow) with appendicolith (arrow head) and peri appendiceal fat stranding (curved arrow).



[Table/Fig-6]: Case of acute mesenteric ischaemia in 35-year-old female with diffuse acute abdominal pain. Ultrasonographic image: (a) shows moderate ascites. Serial Axial CECT abdomen images from cranial to caudal; (b & c) show symmetrical bowel wall thickening (arrow) and ascites (star). Midline sagittal CECT abdomen image shows complete stenosis of superior mesenteric artery near its origin (arrow head).



[Table/Fig-7]: Case of Epiploic appendagitis in 47-year-old female with acute left iliac fossa pain. CECT abdomen axial (a) and coronal (b) images show fat attenuation lesion (star) with peripheral rim of enhancement (arrow) and surrounding fat stranding (arrow head).

DISCUSSION

Acute abdomen has a varied number of causes, ranging from benign self-limiting to those that need to be treated surgically right away. Although plain abdominal radiographs and USG are used as initial screening modalities, MSCT has become the imaging modality of choice for many patients due to its various advantages [15-17].

The present study revealed a male predominance with a mean age of 41 years, consistent with the survey by Balamurugan PP et al.,

Diagnosis	USG Findings (n=81)			CT Findings (n=81)	
	Negative findings (normal sonogram)	Positive findings		Findings corroborate with USG diagnosis	Findings suggestive of new/ alternative diagnosis
		Inconclusive/ non-specific findings	Findings suggestive of specific diagnosis		
Mesenteric ischaemia	6	0	0	0	6
Pancreatitis	16	5	0	5	16
Appendicitis	7	6	0	6	7
GB perforation	0	3	0	0	3
Cholecystitis	1	1	0	1	1
SMA stenosis	4	0	0	0	4
Ureteric calculus	5	6	0	0	11
Intestinal obstruction	2	3	0	3	2
Intestinal perforation	1	5	0	0	6
Diverticulitis	6	0	0	0	6
Epiploic appendagitis	2	0	0	0	2
Intussusception	2	0	0	0	2
Chi-square	1.822				
p-value	0.033*				

[Table/Fig-8]: Comparison of USG findings with CT findings in relation to diagnosis.

which reported that 74% of cases with acute abdomen were male, with most of them aged 30-60 years [9]. Bharathi PK and Tippani D also reported a male predominance, with a male-to-female ratio of 3:1 and an average age of 32.5 years [12].

Pancreatitis: In the present study, five cases of acute pancreatitis with inconclusive USG findings were confirmed on CT and associated complications like intra- and extra-pancreatic collections and necrotic areas were also well seen on MSCT. MSCT also diagnosed several cases with acute pancreatitis, which had a normal USG. In the study by Viyannan M et al., and Rafiq S et al., the sensitivity of MSCT for diagnosing acute pancreatitis was 100% [17,18]. The study by Bharathi PK and Tippani D revealed that 80% of cases had enlargement of the pancreas with collections in intra- or extra-pancreatic areas, and 60% had alterations in enhancement, displaying necrosis with complications of ascites and pleural effusion [12].

Appendicitis: In the present study, MSCT helped diagnose acute appendicitis in six cases who had inconclusive/non-specific findings on USG and in seven cases who had a normal USG. Like the current study, Balamurugan PP et al., also demonstrated better CT performance in achieving a specific diagnosis [9]. Factors that contributed towards non-diagnostic USG findings in acute appendicitis included retro-caecal location of appendix, excessive bowel gases and excessively obese body habitus.

Cholecystitis: In the present study, two cases were diagnosed as Cholecystitis on CT, one of which had non-specific findings on USG, while the other had normal USG. Three instances of GB perforation with inconclusive/non-specific findings on USG were confirmed on CT. Sravan Krishna Reddy A et al., reported a sensitivity of 81.8% & specificity of 100% for MSCT in diagnosing acute cholecystitis [19]. According to the study conducted by Ramachandra ML et al., CT imaging successfully identified gallbladder perforation in three out of four patients who underwent the scan, resulting in a reported sensitivity of 75% [20].

Intestinal and mesenteric pathologies: The MSCT helped to confirm intestinal obstruction diagnosed by USG in three cases. However, in two cases with normal USG, MSCT findings suggested intestinal obstruction. Mohan Kumar R et al., had four cases with tumours as primary reason of intestinal obstruction diagnosed on CT [21]. In five cases of intestinal perforation, USG findings were confirmed on CT. In one case with normal USG, CT findings suggested intestinal perforation. The study done by Balamurugan PP et al., revealed that CT can detect perforation, ischaemia and obstruction in bowel [9]. Hainaux B et al., found that multidetector CT predicted the site of gastrointestinal tract perforation in 73 (86%) of 85 patients [22].

In cases of mesenteric ischaemia, diverticulitis, epiploic appendagitis, and intussusception, USG was negative; however, MSCT suggested the diagnosis. The study conducted by Kanasaki S et al., revealed that, for diagnosing mesenteric ischaemia, MSCT is the preferred imaging method [23]. MSCT was advocated in detecting intussusceptions with 100% sensitivity, as reported by Ko HS et al., [24]. In the study by Dubuisson V et al., it was revealed that mesenteric ischaemia was rare, but its prognosis remains ferocious, mainly due to delay in diagnoses and management [3]. They advocated that, if mesenteric ischaemia is suspected, urgent CT angiography along with MPR should be done. They found that for diagnosing diverticulitis, CT had 98% specificity and 97% sensitivity; along 98% accuracy [3].

Overall USG vs CT Findings

The present study showed a high diagnostic accuracy of MSCT in cases of non-traumatic acute abdominal pain, with 100% sensitivity and 90.9% specificity [Table/Fig-9]. The study by Perry H et al., found an 88.1% accuracy of CT, with good to excellent agreement between preoperative CT findings and the results of emergency laparotomy [11]. The study by Mohan Kumar R et al., revealed that multidetector CT diagnosis was concordant with operative or histopathological findings in 95% of patients [21].

Parameters	Value (%)
Sensitivity	100.0
Specificity	90.9
Positive Predictive Value (PPV)	90.2
Negative Predictive Value (NPV)	100.0

[Table/Fig-9]: Sensitivity and specificity of MSCT in cases of acute abdomen with negative/inconclusive USG findings.

In four of the study patients, the MSCT findings were discordant with intraoperative outcomes. MSCT suggested a diagnosis of acute cholecystitis in one case, which was later found to be GB perforation during surgery. This could have been due to the time lapse between imaging and surgery. In three cases of suspected intestinal perforation, MSCT misidentified the site of perforation; one of these was subsequently confirmed intraoperatively to be an appendiceal perforation. The other two cases that were diagnosed as caecal perforation on CT were found to be ileal perforation intraoperatively. Although CT is said to be the most sensitive imaging modality for detecting pneumoperitoneum, the site of perforation is frequently difficult to localise, as it relies on non-specific features such as the site of air and bowel wall thickening [3].

Limitation(s)

The present study included only patients with negative or inconclusive ultrasound findings, which may have led to selection bias by excluding cases with definitive USG diagnoses and lack of blinding in the study design. This limits the generalisability of the results to the broader population of patients with acute abdominal pain. Also, the present research was a single-centre study carried out on a limited sample size; hence, future studies are recommended, which should be multicentric with larger sample sizes.

CONCLUSION(S)

The present research has demonstrated that MSCT aids in making a precise diagnosis in patients with acute abdominal conditions. When it comes to management, MSCT can successfully guide the clinician by identifying those who require surgery and those who do not. Hence, its concluded that MSCT can significantly reduce morbidity, mortality, and unnecessary surgical interventions in cases of acute abdomen, especially in patients with equivocal or inconclusive USG.

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