



Original Research Article

THE COMPARISON OF ACCURACY AND PRACTICABILITY BETWEEN SPIRAL CT AND ULTRASOUND IN THE DIAGNOSIS OF INTESTINAL OBSTRUCTION

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ABSTRACT

Background: Intestinal obstruction represents a common surgical emergency requiring prompt and accurate diagnosis for optimal patient management. While spiral computed tomography (CT) is considered the gold standard imaging modality, ultrasonography offers advantages in terms of accessibility, cost-effectiveness, and radiation avoidance. Comparative data regarding diagnostic performance and practicability between these modalities in Indian healthcare settings remain limited.

Material and Methods: A prospective diagnostic accuracy study was conducted at Bharti Hospital, Pune, involving 100 patients presenting with clinically suspected intestinal obstruction between June 2023-June 2025. All patients underwent both abdominal ultrasonography and spiral CT examination. Diagnostic accuracy parameters and practicability indices were evaluated and compared between modalities.

Results: Among 100 patients (mean age: 48.6 ± 16.4 years; 62% male), intestinal obstruction was confirmed in 84 cases. Spiral CT demonstrated significantly higher sensitivity (95.2% vs. 78.6%; $p=0.002$), specificity (93.8% vs. 81.3%; $p=0.038$), and overall accuracy (94.0% vs. 79.0%; $p=0.001$) compared to ultrasonography. CT showed superior performance in determining obstruction etiology (88.1% vs. 61.9%; $p<0.001$) and level (92.9% vs. 71.4%; $p<0.001$). However, ultrasonography demonstrated advantages in mean examination time (12.4 ± 3.2 vs. 18.6 ± 4.8 minutes; $p<0.001$), cost ($\text{₹}850 \pm 120$ vs. $\text{₹}3,200 \pm 450$; $p<0.001$), and immediate bedside availability.

Conclusion: Spiral CT demonstrates superior diagnostic accuracy for intestinal obstruction compared to ultrasonography. However, ultrasonography remains a valuable initial screening tool due to its practicability advantages, particularly in resource-limited settings and for unstable patients.

Keywords: Intestinal obstruction, spiral computed tomography, ultrasonography, diagnostic accuracy, bowel obstruction, acute abdomen

INTRODUCTION

Intestinal obstruction constitutes one of the most common surgical emergencies encountered in clinical practice, accounting for approximately 15-

20% of all acute surgical admissions and representing a significant cause of morbidity and mortality worldwide.^[1] Prompt and accurate diagnosis is essential for appropriate clinical decision-making, as

delayed recognition or misdiagnosis can lead to bowel ischemia, perforation, sepsis, and death.^[2]

The clinical presentation of intestinal obstruction, including abdominal pain, distension, vomiting, and obstipation, often overlaps with numerous other abdominal pathologies, necessitating reliable imaging confirmation.

Radiological imaging plays a pivotal role in the diagnostic algorithm for suspected intestinal obstruction, serving to confirm the diagnosis, determine the level and cause of obstruction, and identify complications requiring urgent surgical intervention.^[3] Plain abdominal radiography, while traditionally the initial imaging modality, has demonstrated limited sensitivity and specificity, particularly for partial obstruction and early presentations.^[4]

Computed tomography has emerged as the preferred imaging modality for evaluating suspected intestinal obstruction due to its high diagnostic accuracy, multiplanar imaging capabilities, and ability to identify underlying etiology.^[5] Spiral (helical) CT technology has further enhanced diagnostic performance through rapid volumetric acquisition, reduced motion artifacts, and improved multiplanar reconstruction capabilities.^[6] Studies have reported CT sensitivity ranging from 90-96% and specificity of 93-100% for detecting mechanical intestinal obstruction.^[7]

Ultrasonography offers an alternative imaging approach with distinct advantages including wide availability, portability, absence of ionizing radiation, and lower cost.^[8] Advances in ultrasound technology and operator expertise have improved its diagnostic capabilities for gastrointestinal pathology. Several studies have demonstrated reasonable accuracy for ultrasonography in detecting intestinal obstruction, with reported sensitivity ranging from 75-95%.^[9] Furthermore, ultrasonography enables real-time assessment of bowel peristalsis and wall characteristics, potentially providing functional information not obtainable with CT.^[10]

Despite substantial international literature comparing these imaging modalities, data from Indian healthcare settings remain relatively limited. Population-specific factors including disease prevalence patterns, healthcare resource availability, and patient presentation characteristics may influence optimal imaging utilization strategies.^[11] Furthermore, comprehensive evaluation incorporating both diagnostic accuracy and practicability parameters is essential for developing evidence-based imaging protocols appropriate to local healthcare contexts.

The aim of this study was to compare the diagnostic accuracy and practicability of spiral CT versus ultrasonography for diagnosing intestinal obstruction in patients presenting to a tertiary care center in Pune, India, using surgical and clinical outcomes as the reference standard.

MATERIALS AND METHODS

Study Design and Setting

This prospective diagnostic accuracy study was conducted at the Department of Radiodiagnosis in collaboration with the Department of General Surgery, Bharti Hospital, Pune, Maharashtra, India. The study period extended from June 2023-June 2025.

Study Population

Patients presenting to the emergency department or surgical outpatient clinic with clinical features suggestive of intestinal obstruction were considered for inclusion.

Inclusion Criteria

- Age ≥ 18 years
- Clinical suspicion of intestinal obstruction based on symptoms (abdominal pain, distension, vomiting, constipation/obstipation)
- Ability to undergo both ultrasonography and CT examination
- Availability of definitive diagnosis through surgery or clinical follow-up

Exclusion Criteria

- Pregnancy
- Hemodynamic instability precluding CT examination
- Known contrast allergy (for contrast-enhanced CT)
- Severe renal impairment (eGFR < 30 mL/min/1.73m²)
- Previous abdominal imaging within 24 hours at another facility
- Incomplete imaging or outcome data

Sample Size Calculation

Based on previous literature reporting sensitivity differences of approximately 15% between CT and ultrasonography for intestinal obstruction detection, with $\alpha=0.05$, power=80%, and anticipated disease prevalence of 80%, a minimum sample size of 92 patients was calculated. We enrolled 100 patients to account for potential incomplete data.

Imaging Protocols

Ultrasonography:

Abdominal ultrasonography was performed using a **Philips Affinity 50 G** machine with curvilinear 3.5-5 MHz and linear 7.5-12 MHz transducers. Examinations were performed by radiologists with minimum five years of experience in abdominal imaging. The graded compression technique was employed for optimal bowel visualization. Systematic evaluation included assessment of bowel dilatation, wall thickness, peristaltic activity, presence of transition zone, free fluid, and bowel wall vascularity using color Doppler.

Spiral CT:

CT examinations were performed using a **Philips Incisive 128-slice** scanner. Non-contrast scans were obtained initially, followed by intravenous contrast-enhanced imaging (Iohexol 350 mgI/mL, 80-100 mL) when not contraindicated. Scan parameters included

slice thickness of 3-5 mm, pitch of 1.0-1.5, and tube voltage of 120 kVp. Multiplanar reconstructions (coronal and sagittal) were routinely generated.

Diagnostic Criteria

Ultrasonography criteria for intestinal obstruction:

- Small bowel dilatation >3 cm or colon dilatation >6 cm
- Presence of transition point with caliber change
- Increased or absent peristalsis
- Free intraperitoneal fluid
- "Keyboard" or "stacked coin" appearance of small bowel

CT criteria for intestinal obstruction:

- Small bowel dilatation >3 cm or colon dilatation >6 cm
- Transition zone with proximal dilatation and distal decompression
- Identification of obstructing lesion or cause
- Small bowel feces sign
- Presence of complications (ischemia, perforation)

Assessment Parameters

Both modalities were evaluated for:

1. Presence or absence of intestinal obstruction
2. Level of obstruction (small bowel vs. large bowel)
3. Cause of obstruction
4. Presence of complications (strangulation, ischemia, perforation)

Practicability Assessment

Practicability parameters included:

- Examination time (minutes)
- Time from request to report availability (minutes)
- Direct cost to patient (Indian Rupees)
- Bedside availability (yes/no)
- Radiation exposure (CT only; mSv)

- Need for patient preparation

Reference Standard

The gold standard for diagnosis confirmation included:

- Intraoperative findings for surgically managed patients
- Clinical course and resolution with conservative management
- Follow-up imaging confirmation within one week

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corporation, Armonk, NY). Continuous variables were expressed as mean \pm standard deviation (SD), while categorical variables were presented as frequencies and percentages. Diagnostic accuracy parameters (sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy) with 95% confidence intervals were calculated for both modalities. McNemar's test compared paired proportions between modalities. Chi-square test and Fisher's exact test were employed for categorical comparisons. Independent and paired samples t-tests were used for continuous variables as appropriate. Cohen's kappa coefficient assessed inter-modality agreement. A p-value <0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Characteristics

A total of 100 patients meeting inclusion criteria were enrolled. The mean age was 48.6 ± 16.4 years (range: 19-82 years), with male predominance (62.0%). The most common presenting symptoms were abdominal pain (94.0%), vomiting (82.0%), and abdominal distension (78.0%). Demographic and clinical characteristics are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of Study Population (N=100)

Variable	Value
Age (years), mean \pm SD	48.6 \pm 16.4
Age groups, n (%)	
18-30 years	16 (16.0)
31-50 years	38 (38.0)
51-70 years	34 (34.0)
>70 years	12 (12.0)
Gender, n (%)	
Male	62 (62.0)
Female	38 (38.0)
Presenting symptoms, n (%)*	
Abdominal pain	94 (94.0)
Vomiting	82 (82.0)
Abdominal distension	78 (78.0)
Constipation/Obstipation	68 (68.0)
Fever	24 (24.0)
Duration of symptoms (hours), mean \pm SD	42.8 \pm 28.6
Previous abdominal surgery, n (%)	34 (34.0)
Comorbidities, n (%)	
Diabetes mellitus	22 (22.0)
Hypertension	28 (28.0)
Inguinal hernia	18 (18.0)
Management, n (%)	
Surgical	64 (64.0)
Conservative	36 (36.0)

Multiple symptoms possible; SD: Standard deviation

Final Confirmed Diagnoses

Intestinal obstruction was confirmed in 84 patients (84.0%), while 16 patients (16.0%) had other diagnoses or functional ileus. Among confirmed obstruction cases, small bowel obstruction (69.0%) was more common than large bowel obstruction (31.0%). Adhesions (35.7%) and hernias (23.8%) were the most common etiologies.

Comparative Diagnostic Accuracy

Spiral CT demonstrated significantly higher diagnostic accuracy compared to ultrasonography across all parameters. CT correctly identified 80 of 84 confirmed obstruction cases and correctly excluded 15 of 16 non-obstruction cases. Detailed diagnostic performance comparison is presented in Table 2.

Table 2: Comparative Diagnostic Accuracy of Spiral CT and Ultrasonography

Parameter	Spiral CT	Ultrasonography	p-value
Detection of Obstruction			
True Positives, n	80	66	-
True Negatives, n	15	13	-
False Positives, n	1	3	-
False Negatives, n	4	18	-
Sensitivity, % (95% CI)	95.2 (88.3-98.7)	78.6 (68.3-86.8)	0.002
Specificity, % (95% CI)	93.8 (69.8-99.8)	81.3 (54.4-96.0)	0.038
PPV, % (95% CI)	98.8 (93.3-99.9)	95.7 (87.5-99.1)	0.182
NPV, % (95% CI)	78.9 (54.4-93.9)	41.9 (24.5-60.9)	0.008
Overall Accuracy, %	95.0	79.0	0.001
Cohen's Kappa (κ)	0.84	0.48	-
Level Identification (n=84)			
Correct identification, n (%)	78 (92.9)	60 (71.4)	<0.001
Etiology Identification (n=84)			
Correct identification, n (%)	74 (88.1)	52 (61.9)	<0.001
Complication Detection (n=22)			
Correct identification, n (%)	20 (90.9)	12 (54.5)	0.006

CI: Confidence interval; NPV: Negative predictive value; PPV: Positive predictive value

Practicability Comparison

Ultrasonography demonstrated significant advantages in several practicability parameters compared to spiral CT. Examination time, cost, and

time to report availability were significantly lower for ultrasonography. Detailed practicability comparison is presented in Table 3.

Table 3: Practicability Parameters Comparison between Spiral CT and Ultrasonography

Parameter	Spiral CT	Ultrasonography	p-value
Examination time (minutes), mean \pm SD	18.6 \pm 4.8	12.4 \pm 3.2	<0.001
Time from request to report (minutes), mean \pm SD	68.4 \pm 24.6	32.8 \pm 12.4	<0.001
Direct cost to patient (₹), mean \pm SD	3,200 \pm 450	850 \pm 120	<0.001
Bedside availability, n (%)	0 (0.0)	100 (100.0)	<0.001
24-hour availability, n (%)	85 (85.0)	100 (100.0)	<0.001
Requires patient transport, n (%)	100 (100.0)	0 (0.0)	<0.001
Requires contrast administration, n (%)	88 (88.0)	0 (0.0)	<0.001
Requires patient preparation, n (%)	42 (42.0)	0 (0.0)	<0.001
Radiation exposure (mSv), mean \pm SD	8.4 \pm 2.2	0	-
Contraindications encountered, n (%)	12 (12.0)	2 (2.0)	0.008
Patient discomfort (VAS 0-10), mean \pm SD	3.8 \pm 1.6	2.1 \pm 1.2	<0.001
Repeat examination feasibility	Limited	Excellent	-

SD: Standard deviation; VAS: Visual analog scale

Illustrative Imaging Findings

Representative CT images from the study cohort demonstrating various etiologies and complications

of intestinal obstruction are presented below, highlighting the diagnostic capability of spiral CT.

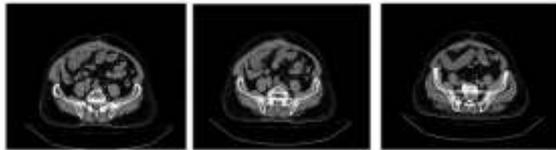


Fig 1 a,b,c: BOWEL ADHESIONS
Operated case of CA colon, post right hemicolectomy status. Multiple air fluid levels with prominence of small bowel loops (approx. 3.3 cm in largest caliber) is noted in the pelvic and right lumbar region. The transition point is approx. at level of proximal ileal loops in the infraumbilical region. The distal ileal loops and remaining large bowel loops appear collapsed. Few dilated small bowel loops maybe due to adhesion. No obvious mass is seen.

Figure 1: Post-operative adhesive small bowel obstruction

Caption: Axial and coronal CT images show dilated small bowel loops (asterisk) with a transition zone (arrow) in the infraumbilical region and collapsed distal loops, consistent with adhesive band obstruction in a patient status post right hemicolectomy.

Fig 2 a & b : INCARCERATED INCISIONAL HERNIA
A large anterior abdominal wall incisional hernia in left supraumbilical region. There is fat stranding noted in the herniated mesentery with fluid collection in the herniated sac and dilatation of the proximal transverse colon suggestive of incarcerated hernia/ partially obstructed hernia.
Another small incisional hernia in right infraumbilical/ anterior abdominal wall in RF region.

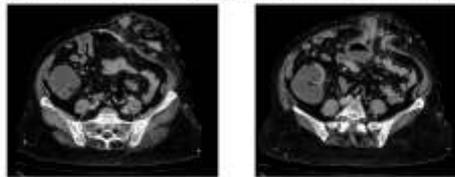


Figure 2: Incarcerated incisional hernia

Caption: Axial and sagittal CT images demonstrate a left supraumbilical anterior abdominal wall hernia containing mesentery with fat stranding (arrow) and fluid, causing proximal colon dilatation (arrowhead), indicative of incarceration and obstruction.

Fig 3 a, b, c & c : Known case of CA rectum WITH POST SURGERY RECURRENCE.
Ill-defined enhancing soft tissues in the pre sacral region surrounding the coloanal anastomosis with surrounding fat stranding suggestive of local recurrence. Stent is seen in situ, involving the distal ileal loops by the soft tissues in pelvis with resultant dilatation of the proximal small bowel loops with air fluid levels suggestive of obstruction.



Figure 3: Malignant obstruction due to local recurrence of rectal carcinoma

Caption: Axial and coronal CT images show an ill-defined enhancing soft tissue mass (arrow) in the presacral region involving the anastomosis and distal ileal loops, resulting in proximal small bowel dilatation (asterisk).

Fig 4 a, b & c: MESENTERIC INJURY WITH HEMOPERITONEUM.
Distal ileal perforation – presently contained in the mesentery with proximal acute obstruction. Ischemia of the perforated segment secondary to thrombosis of an ileal arterial branch.

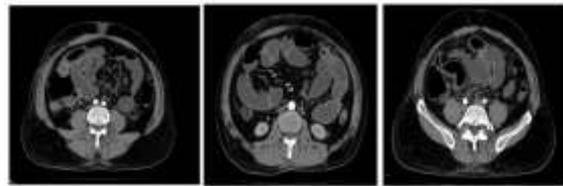


Figure 4: Mesenteric injury with hemoperitoneum and contained perforation

Caption: Axial CT images reveal a contained ileal perforation (arrow) within the mesentery, adjacent hemoperitoneum (arrowhead), and proximal dilated loops, with associated vascular thrombosis leading to segmental ischemia.

Fig 5 a,b, c & d ABDOMINAL KOCH'S
Circumferential wall thickening is noted in the terminal ileum, IC junction, proximal ascending colon, appendix with necrotic lymph nodes in RIF.

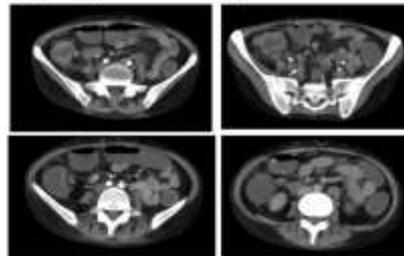


Figure 5: Intestinal tuberculosis (Abdominal Koch's)

Caption: Axial and coronal CT images demonstrate circumferential wall thickening of the terminal ileum and ileocecal junction (arrow), with necrotic lymph nodes in the right iliac fossa (arrowhead), a classic finding of abdominal tuberculosis causing obstruction.

Fig 6 a, b & c: GIST in right subhepatic region causing dilatation of small bowel loops.
Abrupt narrowing is noted in the jejunal loop inferior to the umbilicus and proximal to the lesion with mild twisting of the mesentery and mesenteric vessels in this region. Possibility of band/adhesion with partial twisting of the mesentery.



Figure 6: Small bowel obstruction secondary to a Gastrointestinal Stromal Tumor (GIST)

Caption: Axial and coronal CT images show a soft tissue mass in the right subhepatic region (arrow) causing abrupt jejunal narrowing, twisting of the mesentery (arrowhead), and proximal small bowel dilatation (asterisk).

Subgroup Analysis

In patients with previous abdominal surgery (n=34), CT demonstrated markedly higher accuracy for adhesion-related obstruction (sensitivity: 94.4% vs. 66.7%; p=0.012). For large bowel obstruction (n=26), both modalities showed reduced accuracy compared to small bowel obstruction, though CT remained superior (sensitivity: 88.5% vs. 65.4%; p=0.034). In obese patients (BMI >30 kg/m²; n=18), ultrasonography accuracy decreased substantially (68.0% vs. 92.0% for CT; p=0.008).

Complications and Outcomes

Among 22 patients with confirmed bowel complications (ischemia, strangulation, or perforation), CT correctly identified 20 cases (90.9%) compared to 12 cases (54.5%) by ultrasonography (p=0.006). Surgical intervention was performed in 64 patients (64.0%), with intraoperative findings correlating with CT findings in 60 cases (93.8%) and ultrasonography in 48 cases (75.0%).

DISCUSSION

This prospective study demonstrates that spiral CT provides significantly superior diagnostic accuracy compared to ultrasonography for diagnosing intestinal obstruction, determining obstruction level and etiology, and identifying complications. However, ultrasonography offers substantial practicability advantages that support its role as an initial screening modality in appropriate clinical contexts.

Our findings regarding CT diagnostic performance (sensitivity 95.2%, specificity 93.8%) align closely with established literature. Defined et al. reported similar accuracy rates in their systematic review of CT for small bowel obstruction, confirming the modality's status as the imaging gold standard.^[12]

The multiplanar imaging capabilities and tissue contrast resolution of spiral CT provide comprehensive evaluation unmatched by alternative modalities.

The ultrasonography sensitivity of 78.6% observed in our study falls within the range reported in previous investigations. Defined et al. demonstrated that ultrasonography can achieve sensitivities of 75-95% for bowel obstruction detection when performed by experienced operators utilizing optimal technique.^[13] The graded compression technique and high-frequency transducer utilization in our protocol likely contributed to the reasonable accuracy achieved.

The significant superiority of CT for identifying obstruction etiology (88.1% vs. 61.9%) reflects its superior ability to visualize retroperitoneal structures, mesenteric abnormalities, and subtle transition zone characteristics.^[14] Adhesive obstruction, the most common etiology in our series, often presents with minimal or absent ultrasonographic findings at the transition point. This limitation is particularly relevant given the high prevalence of adhesive obstruction following previous abdominal surgery.

This is exemplified in our series by the clear demonstration of obstructive etiologies ranging from common causes like adhesions (Figure 1) and hernias (Figure 2) to rarer pathologies such as tumors (Figure 3, Figure 6) and abdominal tuberculosis (Figure 5). Our observation that CT demonstrated markedly superior detection of bowel complications (90.9% vs. 54.5%) has critical clinical implications. Identification of strangulation and ischemia directly influences the urgency and nature of surgical intervention. The CT findings of bowel wall thickening, mesenteric haziness, reduced enhancement, and pneumatosis provide reliable indicators of compromised bowel viability.^[15] For instance, in our cohort, CT precisely identified a case of mesenteric injury with contained perforation and ischemia (Figure 4), findings that are often subtle or missed on ultrasonography.

The practicability analysis reveals significant advantages for ultrasonography that merit consideration in clinical decision-making. The substantially lower cost (approximately 75% reduction), shorter examination and reporting times, bedside availability, and absence of ionizing radiation represent meaningful benefits.^[16] These advantages assume particular importance in resource-limited healthcare settings and for patients with relative contraindications to CT.

The reduced ultrasonography accuracy in obese patients observed in our subgroup analysis reflects inherent physical limitations of acoustic imaging through thick abdominal walls. Beam attenuation and increased scanning depth significantly compromise image quality, limiting visualization of deep abdominal structures.^[17] Given rising obesity prevalence, this limitation affects an increasing proportion of patients.

The complementary use of both modalities represents a rational clinical approach. Initial ultrasonography can serve as a rapid screening tool, with CT reserved for cases with negative or equivocal ultrasound findings when clinical suspicion remains high, or when detailed etiological assessment is required for surgical planning.^[18] This tiered approach may optimize diagnostic accuracy while preserving resource utilization efficiency.

Several limitations warrant acknowledgment. Single-center design may limit generalizability. Operator-dependent variability in ultrasonography interpretation represents an inherent limitation. The exclusion of hemodynamically unstable patients may have selected against more severe presentations. Furthermore, the availability of CT at our institution may not reflect capabilities at smaller healthcare facilities.

CONCLUSION

This study demonstrates that spiral computed tomography provides significantly superior diagnostic accuracy compared to ultrasonography for

diagnosing intestinal obstruction, with notably enhanced performance for identifying obstruction level, underlying etiology, and bowel complications. CT correctly identified obstruction in 95.2% of cases compared to 78.6% for ultrasonography. However, ultrasonography offers substantial practicability advantages including lower cost, faster availability, bedside applicability, and absence of ionizing radiation. These characteristics support ultrasonography's continued role as an initial screening modality, particularly in resource-limited settings and for hemodynamically unstable patients requiring immediate bedside assessment. An integrated diagnostic approach utilizing ultrasonography for initial evaluation and CT for definitive assessment in equivocal or complex cases may optimize diagnostic accuracy while ensuring efficient resource utilization in clinical practice.

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