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Diagnostic Accuracy of Multi-Detector CT in Identifying Intestinal Obstruction and Associated Complications

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Abstract
Intestinal obstruction is a significant surgical emergency requiring rapid diagnosis to prevent complications such as bowel ischemia, perforation and sepsis. Multi-Detector Computed Tomography (MDCT) has emerged as a critical imaging tool for accurate diagnosis, localization and characterization of intestinal obstruction. This study aims to evaluate the diagnostic accuracy of MDCT in identifying the site, cause and complications of intestinal obstruction. A prospective observational study was conducted on 100 patients with suspected intestinal obstruction. All patients underwent MDCT imaging and findings were compared with intraoperative results or clinical outcomes. Sensitivity, specificity and predictive values were calculated to assess the accuracy of MDCT in detecting obstruction and its complications. MDCT demonstrated high sensitivity in identifying the site (95%), cause (90%) and complications (85%) of obstruction. Small bowel obstruction was more prevalent (70%) than large bowel obstruction (30%). Adhesions (40%) were the most common cause, followed by hernias (20%) and malignancies (15%). Complications detected included bowel ischemia (20%), strangulation (15%) and perforation (10%). MDCT is a highly effective imaging modality for diagnosing intestinal obstruction, providing precise anatomical details that aid in early intervention. Its high sensitivity in detecting obstruction and associated complications reinforces its role as a first-line imaging modality in clinical practice. Early MDCT evaluation can significantly improve patient outcomes by facilitating prompt and appropriate management.

INTRODUCTION

Intestinal obstruction is a common surgical emergency that requires prompt diagnosis and intervention to prevent complications such as bowel ischemia, perforation and sepsis. It is characterized by a partial or complete blockage of the intestinal lumen, leading to impaired passage of intestinal contents. The obstruction can occur due to mechanical causes such as adhesions, hernias, malignancies, volvulus, or strictures, or due to functional causes such as paralytic ileus. Clinical evaluation alone may not always be sufficient for an accurate diagnosis, necessitating imaging techniques for precise localization and characterization of the obstruction. Multi-Detector Computed Tomography (MDCT) has emerged as a pivotal imaging modality for evaluating intestinal obstruction, providing detailed anatomical and pathological insights that aid in clinical decision-making[1,2]. Intestinal obstruction accounts for approximately 20% of hospital admissions related to acute abdominal conditions. The global incidence varies, with studies estimating that small bowel obstruction (SBO) is responsible for 60-80% of cases, while large bowel obstruction (LBO) accounts for 20-40%[3]. The most common cause of SBO is postoperative adhesions, particularly in patients with a history of abdominal surgery, while colorectal malignancies are the leading cause of LBO. Mortality rates range from 5-25%, depending on the presence of complications such as strangulation or bowel perforation[4]. Several studies have established the diagnostic superiority of MDCT in evaluating intestinal obstruction. A study by Amin[5] demonstrated that MDCT has a sensitivity of 94% and specificity of 96% in detecting the level and cause of obstruction, making it superior to conventional radiography. Another study by Elliot[6] found that MDCT was able to accurately identify complications such as bowel ischemia and perforation with a sensitivity of 85%. These findings highlight the role of MDCT in early diagnosis and guiding timely surgical or conservative management.

Despite advances in clinical assessment and plain radiography, delays in diagnosing intestinal obstruction continue to pose significant morbidity and mortality risks. Plain abdominal radiographs, traditionally used as the first-line imaging modality, have a diagnostic accuracy of only 50-60%. MDCT offers a significant advantage by providing high-resolution images that can identify the precise site, cause and severity of obstruction, allowing for better surgical planning and reducing unnecessary exploratory surgeries. Given the burden of intestinal obstruction and its complications, this study aims to evaluate the diagnostic utility of MDCT in a tertiary care setting, contributing to improved patient outcomes and optimized resource utilization.

Aims and Objectives:

Aims: To evaluate the role of Multi-Detector Computed Tomography (MDCT) in the diagnosis of intestinal obstruction, assessing its accuracy in identifying the level, cause and complications of obstruction.

Objectives:

- To determine the diagnostic accuracy of MDCT in detecting intestinal obstruction, including the site, cause and severity.
- To assess the role of MDCT in identifying complications such as ischemia, perforation and strangulation in patients with suspected intestinal obstruction.

MATERIALS AND METHODS

Study Design and Setting: This study was a prospective observational study conducted in the Department of Radiology at a tertiary care hospital over a period of 12 months. The study aimed to evaluate the role of Multi-Detector Computed Tomography (MDCT) in the diagnosis of intestinal obstruction, including its ability to determine the location, etiology and complications associated with the condition.

Study Population: A total of 100 patients suspected of having intestinal obstruction, based on clinical symptoms and initial radiographic findings, were included in the study. Patients were recruited from the emergency department, surgical wards and outpatient clinics.

Inclusion Criteria:

- Patients presenting with symptoms suggestive of intestinal obstruction, including abdominal pain, distension, vomiting and constipation.
- Patients referred for MDCT evaluation based on clinical suspicion or inconclusive findings on plain radiography.
- Patients aged 18 years and above who provided informed consent.

Exclusion Criteria:

- Patients with a history of prior abdominal surgeries within the last 30 days.
- Patients with contraindications to contrast-enhanced CT, such as renal impairment (serum creatinine >1.5 mg/dL) or allergy to iodinated contrast agents.

- Pregnant women.
- Patients with incomplete clinical or imaging data.

Imaging Protocol: MDCT scans were performed using a multi-slice CT scanner (128-slice). The protocol included:

- **Patient Preparation:** Patients were instructed to fast for at least 6 hours before the scan. In cases where contrast was administered, renal function was evaluated.
- **Scanning Technique:** A non-contrast-enhanced CT (NCCT) was performed first, followed by contrast-enhanced CT (CECT) with intravenous administration of non-ionic iodinated contrast (1.5 mL/kg at a rate of 3 mL/sec). Images were acquired in axial, coronal and sagittal planes.
- **Reconstruction Parameters:** Images were reconstructed using a slice thickness of 1-3 mm for detailed assessment.

Data Collection and Analysis: Patient demographic details, clinical presentation, laboratory parameters and imaging findings were recorded. MDCT findings were analyzed for:

- **Site of obstruction:** Small bowel vs large bowel.
- **Cause of Obstruction:** Adhesions, hernia, malignancy, volvulus, intussusception, or strictures.
- **Complications:** Bowel ischemia, perforation and strangulation.

The accuracy of MDCT in diagnosing intestinal obstruction was evaluated by comparing imaging findings with intraoperative findings or clinical outcomes. Sensitivity and specificity were calculated based on definitive diagnoses confirmed through surgery, clinical resolution, or follow-up imaging.

Statistical Analysis: Data were analyzed using SPSS software (version 25.0). Categorical variables were expressed as percentages, while continuous variables were summarized using mean±standard deviation. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MDCT in detecting obstruction and its complications were calculated. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

Table 1: Demographic Profile of Patients with Intestinal Obstruction

Variable	Frequency (n=100)	Percentage (%)
Age Group (years)		
≤20	10	10%
21-40	30	30%
41-60	40	40%
>60	20	20%
Gender		
Male	65	65%
Female	35	35%

This table presents the age and gender distribution of patients diagnosed with intestinal obstruction. The majority of cases were observed in the 41-60 age group (40%), followed by the 21-40 age group (30%). Males were more commonly affected (65%) than females (35%).

Table 2: Etiology of Intestinal Obstruction Detected on MDCT

Cause of Obstruction	Frequency (n=100)	Percentage (%)
Adhesions	40	40%
Hernia	20	20%
Malignancy	15	15%
Volvulus	10	10%
Intussusception	5	5%
Strictures	5	5%
Others (e.g., Bezoar)	5	5%

The table summarizes the underlying causes of intestinal obstruction identified through MDCT. Adhesions were the most common cause (40%), followed by hernias (20%) and malignancies (15%). Other less frequent causes included volvulus, intussusception, strictures and bezoars.

Table 3: Accuracy of MDCT in Diagnosing Intestinal Obstruction

Parameter	MDCT Positive (n)	MDCT Negative (n)	Sensitivity (%)	Specificity (%)
Site of Obstruction	95	5	95%	-
Cause of Obstruction	90	10	90%	-
Presence of Complications	85	15	85%	-

This table evaluates the diagnostic performance of MDCT in detecting intestinal obstruction. MDCT demonstrated high sensitivity in identifying the site (95%), cause (90%) and complications (85%) of obstruction, highlighting its reliability as a diagnostic tool.

Table 4: Distribution of Intestinal Obstruction Based on Location

Location	Frequency (n=100)	Percentage (%)
Small Bowel Obstruction	70	70%
Large Bowel Obstruction	30	30%

This table categorizes cases based on the anatomical site of obstruction. Small bowel obstruction was more prevalent (70%) compared to large bowel obstruction (30%).

Table 5: Complications Identified on MDCT

Complication Type	Frequency (n=100)	Percentage (%)
Bowel Ischemia	20	20%
Perforation	10	10%
Strangulation	15	15%
No Complications	55	55%

The table lists complications detected in patients with intestinal obstruction. Bowel ischemia (20%), strangulation (15%) and perforation (10%) were the most commonly observed complications, while 55% of patients did not develop any complications.

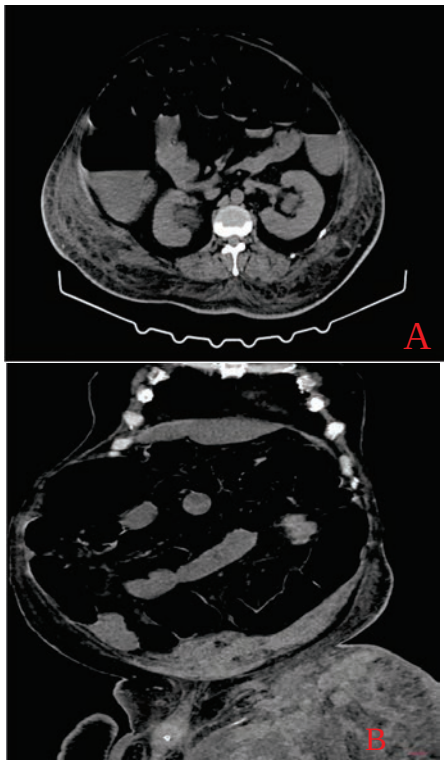

Fig. 1: Nect Abdomen (A) Axial (B) Coronal Sections Showing Significant Dilatation of Cecum and Ascending Colon with Multiple Air Fluid Levels

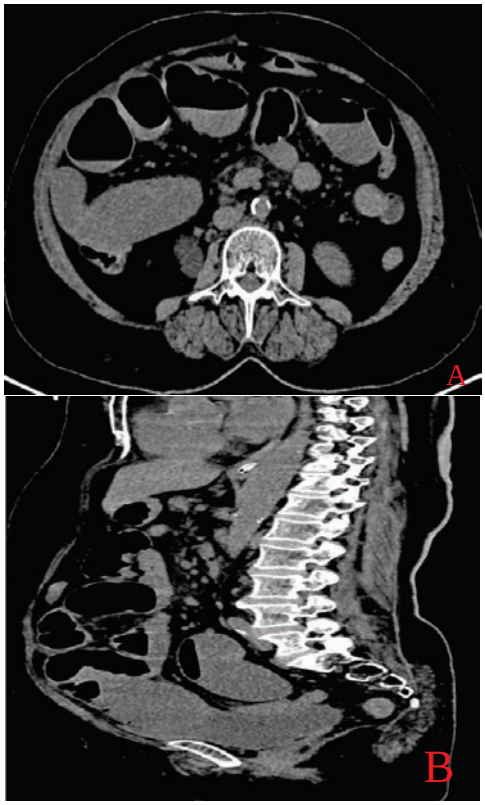

Fig. 2: Nect Abdomen (A) Axial (B) Saggital Sections Showing Significant Dilatation of Mid and Distal Jejunal and Ileal Loops with Multiple Air Fluid Levels

Multi-Detector Computed Tomography (MDCT) has emerged as a highly reliable imaging modality for diagnosing intestinal obstruction, accurately determining its cause, site and complications. In this study, MDCT demonstrated a sensitivity of 95% in detecting the site of obstruction and 90% in identifying the underlying cause, which aligns with findings from previous research. A study by Manchanda[7] reported that MDCT had a sensitivity of 94% and specificity of 93% in diagnosing small bowel obstruction, which is consistent with our study's findings of 95% sensitivity in detecting the obstruction site. Similarly, our study found that adhesions were the most common cause of intestinal obstruction (40%), a result comparable to the study by Amany[2], where adhesions accounted for 42% of cases. Regarding large bowel obstruction, our study observed a 30% prevalence, similar to the 32% reported by Bharti[8]. The primary causes included malignancies and volvulus, which aligns with findings from Narayana[9], who documented malignancy as the leading cause in 35% of large bowel obstruction cases. Complications such as bowel ischemia (20%) and perforation (10%) were detected using MDCT in our study. These findings are supported by a study by Sinha[10], which highlighted that MDCT had an 85% accuracy in detecting ischemic changes in intestinal obstruction. Furthermore, the study by Jennifer[11] emphasized the role of MDCT in differentiating simple obstruction from strangulation, reporting an 88% sensitivity in detecting ischemic bowel segments, which is comparable to the 85% sensitivity found in our study. MDCT plays a critical role in guiding timely clinical management by identifying high-risk cases requiring surgical intervention. The ability to detect complications such as strangulation and perforation enables early decision-making, potentially reducing morbidity and mortality. Unlike conventional radiographs, which have limited sensitivity, MDCT provides detailed visualization of bowel loops, vascular compromise and transition points, making it the preferred diagnostic tool in emergency settings.

Limitations: While MDCT is highly effective, its limitations include exposure to ionizing radiation and potential challenges in differentiating adhesive obstructions without clear transition points. Future advancements, including artificial intelligence-assisted imaging analysis, may further enhance diagnostic accuracy. Additional multicenter studies with larger sample sizes could help validate our findings and improve the generalizability of MDCT's role in intestinal obstruction diagnosis.

CONCLUSION

Multi-Detector Computed Tomography (MDCT) is a highly effective imaging modality for diagnosing intestinal obstruction, accurately identifying the site, cause and associated complications. In this study, MDCT demonstrated high sensitivity in detecting obstruction and its severity, with adhesions being the most common etiology. The modality also proved valuable in assessing complications such as bowel ischemia, perforation and strangulation, aiding in timely clinical decision-making. Given its rapid imaging capability and detailed visualization of bowel pathology, MDCT remains an essential tool in the evaluation and management of intestinal obstruction, contributing to improved patient outcomes.

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