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Original Research Article

MULTIDETECTOR COMPUTED TOMOGRAPHY IN BOWEL OBSTRUCTION – A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Multidetector computed tomography (MDCT) provides rapid, detailed imaging crucial for diagnosing and assessing bowel obstruction in acute abdominal conditions. **Objectives:** This study aimed to assess the diagnostic efficiency of multidetector computed tomography (MDCT) in cases of bowel obstruction, with a focus on determining the level and cause of the blockage. Special attention was paid to MDCT's ability to distinguish between high- and low-grade obstructions.

Materials and Methods: A cross-sectional study was undertaken over one year in the Department of Radiodiagnosis at Rohilkhand Medical College and Hospital, Bareilly. A total of 60 patients suspected of having bowel obstruction were chosen using simple random sampling. Those included had clinical signs suggestive of bowel obstruction and consented to participate. Exclusion criteria included pregnancy, abnormal renal function, and severely unstable patients.

Results: Most cases involved the small intestine (86.7%), compared to the large bowel (13.3%). About 60% of patients had a complete obstruction, and 38.3% had a partial one. The leading cause was extrinsic, primarily adhesions (58.3%). Dilated loops were evident in all subjects, and a transition zone could be identified in 63.3%. MDCT was shown to be highly sensitive in detecting severe obstructions, though less so in mild cases. Notable complications included perforation (21.7%) and strangulation (8.3%), underscoring the importance of early detection.

Conclusion: MDCT is a powerful diagnostic tool for bowel obstruction, particularly when traditional radiography and clinical signs are inconclusive. It is highly effective for identifying the site, cause, and severity of obstruction, especially in high-grade cases.

Keywords: Multidetector computed tomography (MDCT), Bowel Obstruction, acute abdominal conditions

INTRODUCTION

The concept and treatment of bowel obstruction date back to ancient medicine, with Hippocrates being among the first to define the condition. As early as 350 BC, Praxagoras reportedly performed an enterocutaneous fistula procedure to relieve bowel obstruction, marking one of the earliest surgical interventions for this disorder.[1] Bowel obstruction arises when the forward movement of intestinal contents is hindered, either due to a mechanical block or functional impairment. Functional obstructions can be acute or chronic and are associated with abnormal intestinal motility. The blockage may be partial or complete, leading to symptoms such as abdominal pain, nausea, vomiting, constipation (progressing to obstipation),

and distention — all of which disrupt normal digestion and absorption.

Among the types of obstructions, small bowel obstructions (SBOs) occur more frequently than large bowel obstructions (LBOs) and are a leading cause of surgical intervention involving the small intestine. SBOs can be classified as partial, complete, or closed-loop; the latter involves a segment of bowel that is occluded at both the proximal and distal ends. Common mechanical causes of SBO include postoperative adhesions and hernias.[2]

Approximately 15% of patients presenting with acute abdominal complaints in emergency settings are diagnosed with intestinal obstruction, which accounts for around 20% of emergency surgical procedures.[3] Although about 80% of these cases respond to conservative management, rapid identification is essential, especially when complications like strangulation or ischemia (Figure 1) are suspected. SBOs are responsible for nearly 80% of all bowel obstruction cases and contribute significantly to hospital admissions and surgical workload, especially in the context of acute abdominal pain in the United States.[4,5]

Bowel obstruction is typically caused by mechanical blockages or disturbances in gastrointestinal motility. These can be categorized into extrinsic causes (e.g., adhesions, hernias, volvulus, and extrinsic masses), intrinsic causes (e.g., tumors, Crohn's disease, intussusception)(Fig 4), and intraluminal causes (e.g., bezoars or foreign bodies). Small bowel obstruction is most often due to extrinsic factors, whereas LBO is usually linked to intrinsic lesions, such as malignancies or severe inflammation.[6]

Conventional radiography is the first-line imaging technique for diagnosing suspected bowel obstruction, although it has variable diagnostic accuracy ranging from 46% to 80%. When plain radiographs are inconclusive, contrast studies may be employed, though they are contraindicated in patients with poor bowel motility.7 Ultrasound can support the diagnosis in selected cases by identifying dilated loops >2.5 cm and an obstructed segment >10 cm in length.

Computed tomography (CT), particularly with intravenous contrast, surpasses traditional modalities by evaluating both intraluminal and extraluminal structures. It is especially useful in identifying complications such as ischemia, strangulation, or vascular involvement. A meta-analysis has shown conventional CT to have a sensitivity of up to 92% and specificity of 93% for complete obstruction.[8]

Early identification of the source of bowel obstruction is crucial to prevent severe complications such as ischemia and necrosis. Diagnosis relies on radiographic findings, clinical examination, and patient history. Radiological investigations include CT scans, contrast studies, and standard radiographs. Conventional radiographs have low sensitivity, specificity, and accuracy, with values of 69%, 57%, and 46-80%, respectively. Their accuracy in identifying the origin and location of obstruction is even lower. CT scans, however, can identify the source of intestinal obstruction in 93% to 95% of cases, making it the most commonly used imaging modality for this purpose. The sensitivity, specificity, and accuracy of CT scans range from 63% to 78% and 66%, respectively, depending on the obstruction's severity.[9,10]

The Multidetector Computed Tomography (MDCT) scan offers a highly sensitive and accurate non-invasive method for detecting intestinal obstruction. It not only identifies the location of the obstruction but also determines its origin, whether intrinsic, extrinsic, or intraluminal. MDCT has significantly improved the ability to accurately diagnose bowel obstruction, leading to more prompt and appropriate treatment. Its widespread use as a primary modality can lower morbidity and mortality associated with these cases. Thesensitivity of MDCT ranges from 94% to 100%, with overall accuracy between 90% and 95%.[11] Some studies suggest that MDCT is more helpful in determining the origin and severity of obstruction rather than merely detecting the obstruction itself. Early detection of bowel obstruction is vital to prevent complications such as ischemia and necrosis. Bowel obstruction is typically diagnosed based on history, clinical examination, and radiographic abnormalities; however, plain radiographs are known to have low sensitivity, specificity, and accuracy, with values of 69%, 57%, and 46-80%, respectively. Additionally, MDCT has proven useful not only in identifying the location of obstruction but also in pinpointing its cause.[12]

MATERIALS AND METHODS

This was a cross-sectional observational study conducted over a one-year period in the Department of Radiodiagnosis at Rohilkhand Medical College and Hospital, Bareilly. The study commenced following ethical approval from the Institutional Research and Ethics Committee. A total of 60 patients suspected clinically of having bowel obstruction were enrolled using a simple random sampling technique to ensure representative selection.

Sample Selection and Ethics: Patients were included if they had clinical features suggestive of intestinal obstruction, irrespective of complications, and provided written informed consent.

Exclusion Criteria

- Pregnancy
- Impaired renal function
- Hemodynamically unstable or critically ill patients

Imaging Protocol

All patients underwent CT imaging using a 16-slice GE BRIGHT SPEED ELITE CT scanner. Pre-scan preparation involved a 4-hour fasting period.

Patients were scanned in the supine position with arms raised above the head, and contrast media (oral and intravenous) was administered as clinically indicated.
Technical parameters for the scan included:
Tube voltage: ≤ 120 kVp
Tube current: modulated by the automatic exposure control system
Scout images were acquired from the diaphragm to the lesser trochanter.
Scanning was performed in a craniocaudal direction with breath-hold during inspiration to reduce motion artifacts.
Imaging was done in both.
Arterial phase (diaphragm to iliac crest)
Venous phase (diaphragm to symphysis pubis)
Multiplanar reformatted images were reconstructed in axial, coronal, and sagittal planes. Slice thickness was
≤ 3 mm for soft tissue
≤ 2 mm for bone evaluation with 20–40% overlap

Statistical Analysis

All data were entered and analyzed using SPSS version 23.0 (licensed). Descriptive statistics such as frequency, percentages, means, and standard deviations were applied. Inferential statistical tests were chosen based on the distribution and nature of the variables. A p-value < 0.05 was considered to indicate statistical significance, ensuring the reliability of findings.

RESULTS

The study examined the age distribution of the participants, revealing that the highest number of study participants fell within the 21 to 30 years age group, accounting for 23.3% of the total sample. The second-largest group was from the 51 to 60 years category, representing 20.0% of the participants. In contrast, the least represented group was the 61 to 70 years age group, with only 5.0% of the participants. Overall, the study participants spanned a wide range of age groups, with a mean age of 34 years. The results suggest that intestinal obstruction was most commonly observed in individuals aged between 21 and 30 years (Table 1).
Gender Distribution
The gender distribution in the study indicated a clear predominance of female participants, who accounted for 66.7% of the cases, compared to 33.3% for male participants (Table 1). This suggests that bowel obstruction was more common among females in this study. Given that intestinal obstruction can be influenced by various factors such as hormonal, anatomical, or even cultural differences, the higher prevalence in females is an important finding that warrants further investigation.

Signs and Symptoms

The study also analyzed the prevalence of various signs and symptoms associated with bowel obstruction (Table 1). All 60 participants (100%) reported experiencing abdominal pain, a hallmark symptom of intestinal obstruction. Abdominal distension was present in 95% of participants, while 85% experienced nausea or vomiting. Constipation and fever were present in 65% of the cases. A smaller proportion (28.3%) of participants had a history of abdominal surgery. The results suggest that while abdominal pain and distension are nearly universal symptoms of bowel obstruction, other symptoms such as nausea, vomiting, and constipation also occur frequently.

Level of Intestinal Obstruction

The study findings showed that the majority of participants (86.7%) had small bowel obstruction, while only 13.3% had large bowel obstruction (Table 1). These findings corroborate existing evidence indicating that small bowel obstruction occurs more frequently than large bowel obstruction in clinical settings. This trend is consistent with prior epidemiological studies that document a higher incidence of small bowel obstruction relative to large bowel obstruction in clinical populations.

Transition Zone Identification

The study also assessed whether the transition zone could be identified in the participants. The transition zone, which is the point where the obstruction occurs, was identified in 63.3% of the cases, while it was not identified in 36.7% of the cases (Table 1). These findings underscore the diagnostic challenge posed by transition zone identification, which remains unfeasible in a significant proportion of cases and may hinder timely and effective clinical management.

Dilated Bowel Loops

In terms of radiographic findings, dilated bowel loops were present in all 60 participants (100%). This observation is pathophysiologically congruent with the obstructive mechanism, wherein intraluminal accumulation of gas and fluid proximal to the obstruction results in segmental bowel dilatation.

Type of Obstruction

The study classified the types of obstruction observed in the participants. It was found that 60% of the participants had total or complete obstruction, while 38.3% had partial or incomplete obstruction. Only 1.7% had a closed-loop obstruction (Table 2). The predominance of complete obstruction among participants reinforces its clinical significance, while the substantial proportion of partial obstructions highlights the variability in presentation severity.

Causes of Obstruction

The study identified the causes of obstruction in the participants. The majority of the cases (58.3%) had extrinsic causes, such as adhesions or hernias (Figure 3). Intrinsic causes, including neoplasms or inflammation, were found in 21.7% of the cases. Intraluminal causes, such as bezoars (Figure 5), were present in just 1.7% of cases, while no cause was identified in 18.3% of the participants (Table 3). These data emphasize the predominant contribution of extrinsic etiologies—most notably

postoperative adhesions—to the development of bowel obstruction.

Causes Versus Location of Obstruction

The study also examined the relationship between the cause of obstruction and its location. Adhesions were the most common cause of small bowel obstruction, with 14 cases identified in the small bowel. Infective causes were also observed in 12 cases, while inflammatory causes were seen in 7 cases. Other causes, including volvulus and neoplasms, were less common. A statistically significant association was observed between the etiology and anatomical site of obstruction ($p = 0.002$), suggesting a non-random distribution of causative factors (Table 4).

Complications Associated with Bowel Obstruction

The study also reported complications associated with bowel obstruction. Strangulation or ischemia was present in 8.3% of the cases, while perforation occurred in 21.7% of the participants (Table 5). The occurrence of complications such as strangulation and perforation underscores the potential for rapid clinical deterioration, thereby reinforcing the critical need for prompt diagnostic evaluation and surgical intervention.

Table 1: Basic parameters

Category	Subcategory	Frequency	Percent (%)
Age Group	1 to 20 years	13	21.7
	21 to 30 years	14	23.3
	31 to 40 years	7	11.7
	41 to 50 years	11	18.3
	51 to 60 years	12	20.0
	61 to 70 years	3	5.0
Total		**60**	**100.0**
Gender	Male	20	33.3
	Female	40	66.7
Total		**60**	**100.0**
Signs and Symptoms	Pain Abdomen	60	100.0
	Abdominal Distension	57	95.0
	Nausea/Vomiting	51	85.0
	Constipation	39	65.0
	Fever	39	65.0
	Abdominal Surgical History	17	28.3
Level of Intestinal Obstruction	Large Bowel	8	13.3
	Small Bowel	52	86.7
Total		**60**	**100.0**
Transition Zone	Identified	38	63.3
	Not Identified	22	36.7
Total		**60**	**100.0**

Table 2: Distribution of study participants according to type of obstruction

Type of Obstruction	Frequency	Percent (%)
Closed Loop	1	1.7
Partial / Incomplete	23	38.3
Total / Complete	36	60.0
Total	**60**	**100.0**

Table 3: Distribution of study participants according to type of causes

Type of Causes	Frequency	Percent (%)
Extrinsic	35	58.3
Intraluminal	1	1.7
Intrinsic	13	21.7
No Cause Identified	11	18.3
Total	**60**	**100.0**

Table 4: Distribution of study participants according to causes versus location

CT Findings (Cause)	CT Findings (Location)		Total	p-value
	Large Bowel	Small Bowel		
Adhesions	0	14	14	
Infective	0	12	12	
Inflammatory	0	7	7	
Hernia	0	3	3	
Malrotation	0	3	3	
Volvulus	1	0	1	
Neoplastic	2	3	5	
Vascular	0	1	1	
Encapsulating Peritoneal Sclerosis	0	2	2	
Colonic Pseudo- Obstruction	1	0	1	
Postpartum Ileus	1	0	1	

Bezoar	0	1	1	0.002
Radiation Enteritis	0	1	1	
Intussuception	0	1	1	
Not identified	3	4	7	
Total	8	52	60	

Table 5: Distribution of study participants according to complications

Complication	Frequency	Percent (%)
Strangulation/Ischemic	5	8.3
Perforation	13	21.7

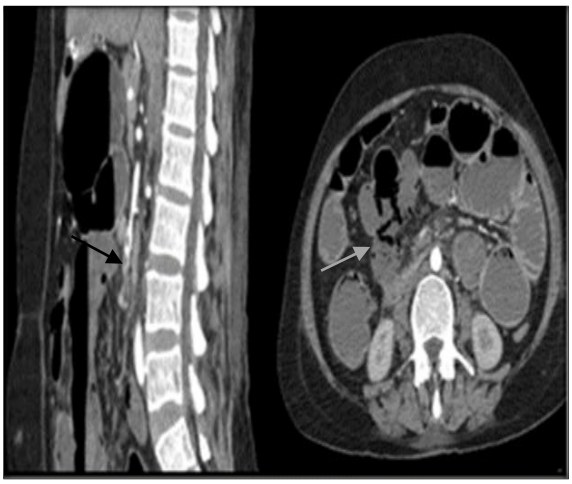

Figure 1: Sagittal arterial phase CECT abdomen image showing non enhancing filling defect in the lumen of SMA (black arrow), suggestive of thrombus and multiple dilated jejunal loops with pneumatosis intestinalis and poor mural enhancement in some of jejunal and ileal loops (grey arrow)

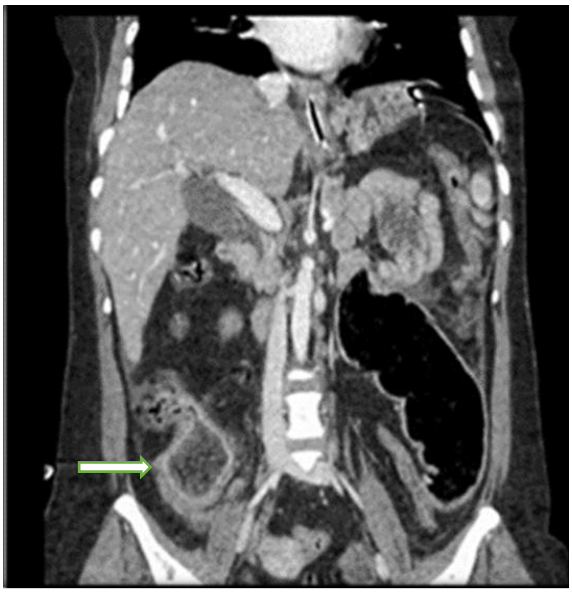

Figure 2: Coronal contrast enhanced CT abdomen image showing dilatation of ileal loops with asymmetrical circumferential wall thickening involving distal ileum and small bowel faeces sign (white arrow), suggesting distal small bowel obstruction with transition point at distal ileum

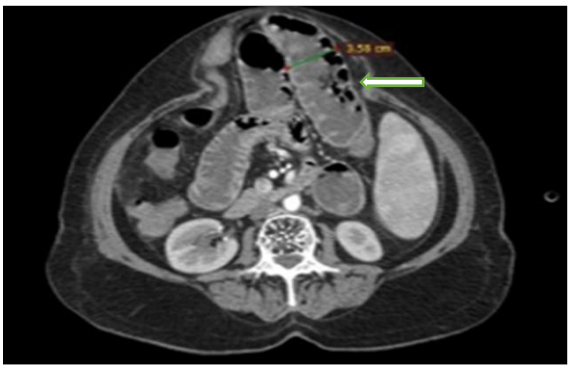

Figure 3: Axial contrast enhanced CT abdomen image showing anterior abdominal wall defect in the midline with dilated jejunal loops and mesentery as herniating content (white arrow) and multiple air-fluid levels, suggesting small bowel obstruction

Figure 4: Axial contrast enhanced CT image of abdomen showing bowel within bowel sign (Target sign) in the right lumbar region (grey arrow), suggesting intussuception with presence of orally administered contrast in the intussuscipien's lumen

Figure 5: Coronal contrast enhanced CT abdomen image showing dilated jejunal and ileal loops with a large heterogeneous mottled appearance mass (white arrow) in the pelvic distal ileal loops and history of indigestible material intake, suggesting bezoar causing subacute intestinal obstruction

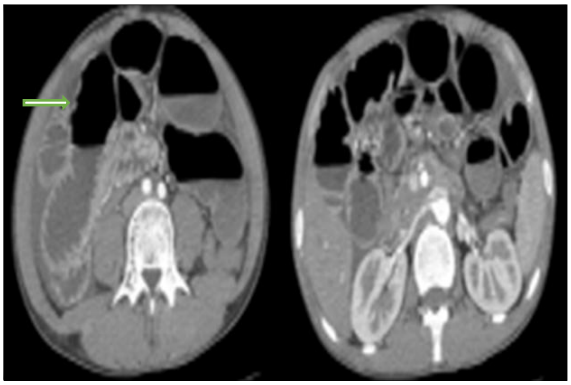

Figure 6: Dilated jejunal loops seen on right side of abdomen with multiple air-fluid levels (white arrow) and normal SMA-SMV relationship, suggesting small bowel obstruction with partial intestinal malrotation

DISCUSSION

We analyzed 60 cases of bowel obstruction diagnosed using MDCT, highlighting its clinical utility in emergency abdominal imaging. In our study, MDCT demonstrated a sensitivity of 100% and a specificity of 96% in detecting bowel obstruction, underscoring its diagnostic reliability within this sample size. This finding aligns with previous research, such as the study by Mohi JK et al. (2017), which demonstrated that CT scans are significantly more accurate for diagnosing acute bowel obstruction compared to ultrasonography and plain radiographs.[13] Their study revealed that CT was able to provide a correct diagnosis in 78% of cases, while ultrasonography was accurate only 10% of the time. Similarly, in the case of subacute bowel obstruction, CT had an accuracy of 62.5%, whereas ultrasonography and plain films could not provide accurate diagnoses. This supports the role of CT as a valuable diagnostic tool in bowel obstruction.

Li Z et al. (2019) conducted a systematic review and meta-analysis confirming the high diagnostic efficacy of CT in SBO. Their findings supported the use of CT not only for diagnosing SBO but also for assessing ischemia, predicting surgical intervention, and identifying the transition point, all with a high degree of accuracy.[14] Additionally, Emara DM et al. (2021) reported an average sensitivity of 97.3% for MDCT in detecting bowel obstruction, further confirming the reliability of MDCT in clinical practice. Our study's results further highlight the value of MDCT as a highly accurate method for diagnosing bowel obstruction.[15]

In our study, the highest number of participants (23.3%) were in the 21 to 30 years age group, while the fewest (5%) were in the 61 to 70 years group, with an average age of 34 years. Although our study showed a younger average age (34 years) compared to Sultan A et al. (2020), who reported a mean of 54.7 years, this discrepancy may reflect population-specific factors or referral patterns.[16] Similarly, Afzal S et al. (2023) reported a mean age of 52.38 years. The male-to-female ratio in our study was 1:2, with 20 males and 40 females, suggesting that female participants are more likely to present with bowel obstruction.[17] This finding is similar to other studies, such as the one by Emara DM et al. (2021), where 60.5% of participants were male, though the gender ratio varies across studies.[15]

Regarding clinical presentation, 100% of participants in our study reported abdominal pain, 95% had abdominal distension, and 85% had nausea or vomiting. Constipation and fever were observed in 65% of participants, and 28.3% had a history of abdominal surgery. Sultan A et al. (2020) also noted abdominal distension as the most common symptom in their study, affecting 30.83% of participants. Abdominal pain emerged as the most commonly reported symptom, consistent with findings from prior studies.[16]

In terms of the location of the obstruction, 86.7% of our participants had small bowel obstruction, which is consistent with the findings of Emara DM et al. (2021),[15] and Sultan A et al. (2020), who also found a higher prevalence of small bowel obstruction.[16]

Regarding the type of obstruction, 60% of our participants had total or complete obstruction, 38.3% had partial or incomplete obstruction, and 1.7% had closed-loop obstruction. This distribution is consistent with clinical trends, where total obstruction predominates due to its more overt symptomatology. Our study also identified extrinsic causes in 58.3% of cases, with adhesions being the most common cause of obstruction. This finding aligns with the work of Sultan A et al. (2020), who also identified adhesions as the most common extrinsic cause of bowel obstruction.[16]

A statistically significant association ($p = 0.002$) was observed between the etiology and anatomical location of the obstruction, suggesting a non-random distribution of causative factors. Adhesions were most commonly associated with small bowel obstruction, a finding that matches the results of Sultan A et al. (2020), who also reported adhesions as the leading cause of obstruction.[16]

Regarding complications, our study found that strangulation or ischemic complications were present in 8.3% of cases, while perforation occurred in 21.7% of participants. Emara DM et al. (2021) also reported ischemic bowel diseases in 21.1% of their cases and small bowel perforation in 10.5%.15 The occurrence of ischemic and perforative complications highlights the urgency of timely imaging and surgical evaluation to mitigate morbidity.

CONCLUSION

MDCT, through its multiplanar reformatting and 3D reconstruction capabilities, demonstrates high sensitivity and specificity in identifying bowel obstruction. MDCT is particularly effective in

determining the anatomical level and extent of the obstruction.

It is especially sensitive in detecting high-grade obstructions and should be considered the imaging modality of choice in patients with inconclusive clinical or radiographic findings or where complications such as strangulation are suspected

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