

## Diagnostic Accuracy of Contrast-Enhanced CT Scan in the Diagnosis of Small Bowel Obstruction: A Validation Study Using Operative Findings as the Gold Standard

Najma Hameed, Inayat Shah Roghani\*

Department Of Diagnostic Radiology, Northwest General Hospital Peshawar, Pakistan

\*Corresponding author's email address: [roghani786@yahoo.com](mailto:roghani786@yahoo.com)

(Received, 24<sup>th</sup> November 2024, Accepted 2<sup>nd</sup> January 2025, Published 31<sup>st</sup> January 2025)

**Abstract:** Small bowel obstruction (SBO) is a common surgical emergency requiring prompt and accurate diagnosis to prevent complications such as ischemia and perforation. Contrast-enhanced computed tomography (CT) has emerged as a crucial imaging modality for SBO detection. This study evaluates the diagnostic accuracy of contrast-enhanced CT in diagnosing SBO, using operative findings from laparotomy as the gold standard. **Objective:** To evaluate the diagnostic accuracy of contrast-enhanced computed tomography (CT) in diagnosing small bowel obstruction (SBO), using operative findings from laparotomy as the gold standard. **Methodology:** This cross-sectional validation study was carried out at the Radiology Department of North West General Hospital, Peshawar from 25-12-2022 to 25-06-2023. One hundred and eighty-four patients aged 18 to 65 years, presenting with clinically suspected SBO, were included. The sample size was calculated using a sensitivity of 76.6%, a specificity of 75%, 16% prevalence, and a 95% confidence level. Contrast-enhanced CT scans were performed using a 16-slice Toshiba scanner, and findings were compared with operative results. We assessed the diagnostic accuracy of contrast-enhanced CT. **Results:** Out of 194 patients, SBO was detected on CT in 113 (58.2%) cases, with 99 true positives and 14 false positives. Among the 81 patients classified as negative on CT, 12 were false negatives, and 69 were true negatives. CT demonstrated a sensitivity of 89.19%, specificity of 83.1%, PPV of 87.61%, NPV of 85.19%, and diagnostic accuracy of 86.60%. **Conclusion:** Contrast-enhanced CT is a reliable and accurate diagnostic tool for SBO, with high sensitivity and specificity, making it essential for early diagnosis and management, minimizing complications such as ischemia or perforation.

**Keywords:** Pregabalin, Hemodynamics, Pneumoperitoneum

**[How to Cite:** Hameed N, Roghani IS. Diagnostic accuracy of contrast-enhanced CT scan in diagnosis of small bowel obstruction keeping operative findings on laparotomy as gold standard. *Biol. Clin. Sci. Res. J.*, 2025; 6(1): 127-130. doi: <https://doi.org/10.54112/bcsrj.v6i1.1482>

### Introduction

Even with recent improvements in surgical methods and the increased application of minimally invasive techniques, small bowel obstruction (SBO) continues to be an ongoing problem for both surgeons and surgeons. In the past ten years, there has been a growing focus on clarifying the indications as well as the timing of surgical treatment for SBO. The primary factors contributing to SBO include herniation, malignancy, as well as postoperative and inflammatory adhesive disease (1-3). Globally, hernias represent the leading cause of SBO, whereas in developed nations such as the US, adhesions resulting from prior abdominal and pelvic surgeries account for 65 to 75% of all SBO cases. Hernias as well as neoplasms, both benign and malignant, account for the next most prevalent causes at 10% and 5%, as well (4-6).

Diagnosis of SBO may occasionally be achieved through a physical examination; however, additional tests for diagnosis are frequently necessary for comprehensive surgical assessment and management. The traditional approach to diagnosing SBO relied on physical examination; however, the advent of CT has significantly enhanced the precision and characterisation of this condition (7-8). Diagnostic modalities for SBO include CT, MRI, ultrasonography, and plain radiographs. Among these, contrast-enhanced CT has proven to be highly effective in providing detailed visualization of bowel loops, transition points, and complications such as ischemia. Currently, there are no serum markers available to reliably predict uncomplicated SBO, limiting their utility in emergency settings.10-13 However, metabolic acidosis and elevated levels of intestinal fatty acid binding protein are sometimes observed in cases of strangulated SBO, though these markers are not routinely accessible. 14, 15 A study reported discrepancies between CT findings and intraoperative observations, with CT sensitivity recorded at 76.6%, specificity at 75%,

positive predictive value (PPV) at 94.2%, and negative predictive value (NPV) at 40%. The overall diagnostic accuracy in that study was reported as 78%.16

The aim of this study is to determine the diagnostic accuracy of contrast enhance CT scan in diagnosis of small bowel obstruction keeping operative findings on laparotomy as gold standard. As no such study has been conducted in our population for the last 2 years, so this study will provides us the latest and updated magnitude for diagnostic accuracy of contrast enhance CT scan in diagnosis of small bowel obstruction keeping operative findings on laparotomy as gold standard in our setup. If in our study, the accuracy of contrast enhance CT scan in diagnosing small bowel obstruction is found to be high as given in literature, then we will recommend CT scan as a screening tool for the diagnosing of small bowel obstruction because CT scan is quick, safe and almost readily available. More over the results of this study will be shared with other health professionals. .

### Methodology

The study was conducted in the Radiology Department of North West General Hospital from 25-12-2022 to 25-06-2023, Peshawar, employing a cross-sectional validation design following obtaining ethical approval. The target population included patients aged 18 to 65 years presenting with clinically suspected SBO, as per predefined criteria. These criteria encompassed moderate to severe abdominal pain, nausea, vomiting, and constipation persisting for 2–5 days. Exclusion criteria eliminated severely decompensated patients, pregnant women, and those with abnormal kidney function to minimize bias and confounding effects. The sample size of 194 was calculated based on a sensitivity of 76.6% and specificity of 75% for contrast-enhanced CT in diagnosing SBO, with



a 16% prevalence of SBO<sup>16</sup>, a 95% confidence level, and a 15% desired precision.

Patients fulfilling the inclusion criteria were referred from the emergency, outpatient, and surgical departments. Data collection involved detailed history-taking, clinical examination, and imaging studies using a 16-slice Toshiba CT scanner. Oral and intravenous non-ionic contrast media were administered to enhance imaging quality. The CT scans covered the abdomen and pelvis in contiguous axial sections, following a specified protocol to ensure accuracy.

Subsequently, all patients underwent laparotomy performed by expert surgeons, and findings were meticulously documented. Both CT and operative results were analyzed for correlation. The diagnostic accuracy of CT was calculated by evaluating sensitivity, specificity, positive predictive value, and negative predictive value using a 2x2 table.

SPSS 26 was used for data analysis. Continuous variables, including age, symptom duration, and BMI, were expressed as means and standard deviations, while categorical variables, such as gender and imaging findings, were presented as frequencies and percentages. Stratification was applied to account for potential effect modifiers, such as age, gender, BMI, and symptom duration, to ensure robust statistical analysis.

**Results**

The study conducted involved 194 patients, with an age range of 19 to 65 years, averaging 39.98 ± 13.12 years. Their average BMI was recorded at 24.93 ± 1.37 kg/m<sup>2</sup>. The mean duration of symptoms was 3.51 ± 1.07 days (Table 1).

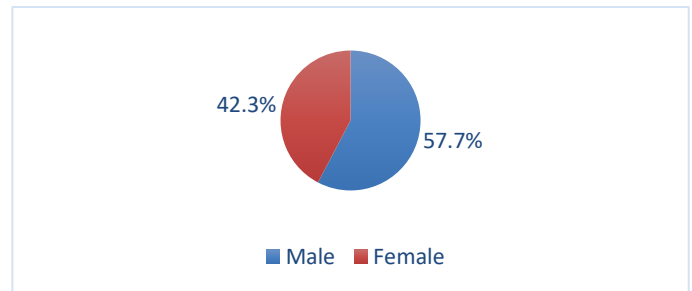
Gender distribution comprised 112 males (57.7%) and 82 females (42.3%) (Figure 1). Contrast-enhanced CT scans identified small bowel obstruction in 113 cases (58.2%), while operative findings confirmed obstruction in 111 cases (57.2%). The comparative analysis revealed that among those with small bowel obstruction identified on CT, 99 were

confirmed on laparotomy, whereas 14 were not. Similarly, 12 patients with negative CT findings were confirmed positive on laparotomy, leaving 69 patients negative by both modalities (Table 3).

The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of the contrast-enhanced CT scan in diagnosing small bowel obstruction were 89.19%, 83.1%, 87.61%, 85.19%, and 86.60%, respectively.

Stratification of diagnostic accuracy with various parameters can be seen from Table 4 to Table 7.

Sensitivity 89.19%, Specificity 83.1%, Positive predictive value 87.61%,



Negative predictive value 85.19% and diagnostic accuracy 86.60%

**Figure 1 Gender distribution of the patients**

**Table 1 Baseline characteristics**

Variables	Mean	Std. Deviation
Age (Years)	39.98	13.116
Height (Meter)	1.6808	.01835
Weight (kg)	70.39	3.445
BMI (kg/m <sup>2</sup> )	24.9268	1.37249
Duration of symptoms (Days)	3.51	1.074

**Table 2 Small bowel obstruction on CT and operative findings**

SBO on CT and operative findings		N	%
Small bowel obstruction on CT	Positive	113	58.2%
	Negative	81	41.8%
Small bowel obstruction on operative findings	Positive	111	57.2%
	Negative	83	42.8%

**Table 3 Diagnostic accuracy of contrast-enhanced CT scan**

		Small bowel obstruction on operative findings		Total
		Positive	Negative	
Small bowel obstruction on CT	Positive	99	14	113
		89.2%	16.9%	58.2%
	Negative	12	69	81
		10.8%	83.1%	41.8%
Total		111	83	194
		100.0%	100.0%	100.0%

**Table 4 Stratification of diagnostic accuracy with age**

Age distribution (Years)	Sensitivity	Specificity	PPV	NPV	Accuracy
18 to 35	89.13%	82.35%	87.23%	84.85%	86.25%
36 to 50	86.84%	73.08%	82.50%	79.17%	81.25%
51 to 65	92.59%	95.65%	96.15%	91.67%	94.00%

**Table 5 Stratification of diagnostic accuracy with gender**

Gender	Sensitivity	Specificity	PPV	NPV	Accuracy
Male	89.47%	81.82%	83.61%	88.24%	85.71%
Female	88.89%	85.71%	92.31%	80.00%	87.80%

**Table 6 Stratification of diagnostic accuracy with duration of disease**

Duration of disease (Days)	Sensitivity	Specificity	PPV	NPV	Accuracy
2 to 3	93.1%	77.78%	84.38%	89.74%	86.41%
> 3	84.91%	89.47%	91.84%	80.95%	86.81%

**Table 7 Stratification of diagnostic accuracy with BMI**

BMI (kg/m <sup>2</sup> )	Sensitivity	Specificity	PPV	NPV	Accuracy
18 to 24.9	84.75%	82.98%	86.21%	81.25%	83.96%
> 24.9	94.23%	83.33%	89.09%	90.91%	89.77%

## Discussion

Our study demonstrated a sensitivity of 89.19%, specificity of 83.1%, and diagnostic accuracy of 86.60%. When comparing these metrics with other studies, our findings align closely but also reflect some variability due to patient demographics, sample sizes, and the technology used.

For instance, Gohar et al. found that the sensitivity and specificity of CT for SBO were 92.2% and 87.8%, respectively, with an overall diagnostic accuracy of 89.9% (17). These findings underscore the reliability of CT in confirming obstruction and elucidating its underlying causes, such as adhesions, hernias, or intestinal tuberculosis. The slight differences in diagnostic accuracy between our study and theirs can be attributed to the larger sample size in their research (267 patients versus our 194) and higher mean duration of symptoms ( $12.11 \pm 4.13$  days compared to our  $3.51 \pm 1.07$  days). Longer symptom duration might allow more pronounced radiological features, enhancing diagnostic precision.

Afzal et al., in their study of multi-detector CT (MDCT), reported a remarkably high sensitivity of 98.39% and diagnostic accuracy of 93.2%. However, their specificity was comparatively lower at 65.22% (18). This discrepancy highlights a potential overestimation of SBO cases due to false positives. Their higher sensitivity could be related to the advanced imaging capabilities of MDCT, which provides more detailed insights into bowel transitions and complications, such as ischemia. Additionally, the inclusion of patients with chronic or severe obstruction might have influenced their findings.

Li et al.'s meta-analysis, encompassing 45 studies and 4,004 patients, found pooled sensitivity CT in diagnosing SBO at 91% and specificity at 89% (19). These figures resonate closely with our study outcomes, affirming the robustness of CT across diverse populations and study settings. The meta-analysis also emphasized CT's role in identifying transition points, aetiology, and complications like ischemia. This broad dataset reinforces the universality of CT's diagnostic utility, albeit with noted inter-study heterogeneity.

Another notable study by El-Hossainy et al. evaluated CT's effectiveness and found a sensitivity of 76.6%, a specificity of 75%, and an accuracy of 78% (16). Their comparatively lower diagnostic metrics might stem from a smaller sample size (50 patients) and potential limitations in imaging protocols or operator expertise. Their study also highlighted CT's role in guiding surgical decisions, preventing unnecessary laparotomies in cases of partial obstruction, and emphasizing conservative management for uncomplicated SBO.

When stratifying diagnostic accuracy in our study based on age, gender, and BMI, interesting patterns emerged. Patients aged 51–65 years showed the highest diagnostic accuracy of 94%, consistent with findings by Li et al., which noted that enhanced CT efficacy was particularly pronounced in older populations (19). Gender-based accuracy differences in our study (85.71% in males versus 87.80% in females) were less significant, aligning with the broader literature indicating minimal sex-based variability. Regarding BMI, patients with BMI > 24.9 kg/m<sup>2</sup> exhibited better diagnostic outcomes, possibly due to enhanced visualization of bowel loops and transitions in individuals with lower visceral fat—a

phenomenon not explicitly explored in the comparative studies but worth further investigation.

Our study also demonstrated the utility of CT in stratifying disease severity by duration. For patients with symptoms lasting 2–3 days, sensitivity peaked at 93.1%, highlighting CT's effectiveness in early-stage diagnosis. This is supported by Gohar et al., who emphasized CT's role in prompt surgical decision-making, crucial for preventing complications like ischemia or perforation.<sup>17</sup>

While our study substantiates CT as a reliable modality for diagnosing SBO, it also reveals subtle nuances when juxtaposed with existing research. Variability in sensitivity and specificity across studies underscores the influence of factors like patient demographics, disease severity, and imaging technology. Future research focusing on optimizing imaging protocols and integrating advanced modalities like MDCT may further enhance diagnostic accuracy. These findings collectively affirm the indispensable role of CT in modern SBO management, ensuring timely and precise clinical interventions.

## Conclusion

In conclusion, contrast-enhanced computed tomography (CT) is a highly accurate and reliable modality for diagnosing small bowel obstruction (SBO), with a diagnostic accuracy of 86.60% in our study. The findings affirm that CT provides critical information for obstruction, enabling timely surgical interventions and reducing complications such as ischemia and perforation.

## Declarations

### Data Availability statement

All data generated or analysed during the study are included in the manuscript.

### Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-AHL-4093-2022)

### Consent for publication

Approved

### Funding

Not applicable

## Conflict of interest

The authors declared the absence of a conflict of interest.

## Author Contribution

### NH

Manuscript drafting, Study Design, Data Collection, Data Entry, and Data Analysis, and Article Drafting.

### ISR

Review of Literature, Conception of Study, Development of Research Methodology Design.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.



**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, <http://creativecommons.org/licenses/by/4.0/>. © The Author(s) 2025

## References

1. Diamond M, Lee J, LeBedis CA. Small bowel obstruction and ischemia. *Radiol Clin*. 2019; 57(4):689-703.
2. Tong JW, Lingam P, Shelat VG. Adhesive small bowel obstruction—an update. *Acute Med Surg*. 2020; 7(1):e587.
3. Ong AW, Myers SR. Early postoperative small bowel obstruction: A review. *The American J Surg*. 2020; 219(3):535-9.
4. Ouaiissi M, Gaujoux S, Veyrie N, Denève E, Brigand C, Castel B, et al. Post-operative adhesions after digestive surgery: their incidence and prevention: a review of the literature. *J Visc Surg*. 2012; 149(2):104-14.
5. Rami Reddy S R, Cappell M S. A systematic review of the clinical presentation, diagnosis, and treatment of small bowel obstruction. *Curr Gastroenterol Rep*. 2017; 19(06):28.
6. Ten Broek RP, Krielen P, Di Saverio S, Coccolini F, Biffi WL, Ansaloni L, et al. Bologna guidelines for diagnosis and management of adhesive small bowel obstruction (ASBO): 2017 update of the evidence-based guidelines from the World Society of Emergency Surgery ASBO working group. *World J Emerg Surg*. 2018; 13(1):1-3.
7. Catena F, De Simone B, Coccolini F, Di Saverio S, Sartelli M, Ansaloni L. Bowel obstruction: a narrative review for all physicians. *World J Emerg Surg*. 2019;14(1):20-5
8. Linden AF, Raiji MT, Kohler JE, Carlisle EM, Pelayo JC, Feinstein K, et al. Evaluation of a water-soluble contrast protocol for nonoperative management of pediatric adhesive small bowel obstruction. *J Pediatr Surg*. 2019; 54(1):184-188.
9. Behman R, Nathens AB, Look Hong N, Pechlivanoglou P, Karanicolas PJ. Evolving Management Strategies in Patients with Adhesive Small Bowel Obstruction: A Population-Based Analysis. *J Gastrointest Surg*. 2018; 22(12):2133-2141.
10. Calame P, Malakhia A, Turco C, Grillet F, Piton G, Delabrousse E. Transmural bowel necrosis from acute mesenteric ischemia and strangulated small-bowel obstruction: distinctive CT features. *Am J Roentgenol*. 2020; 214(1):90-5.
11. Jain A, Karim T, Dey S, Garg M, Mishra S, Attri PC. Role of computed tomography scoring system in the management of small-bowel obstruction. *Saudi Surg J*. 2017; 5(2):65-70.
12. Silva AC, Pimenta M, Guimaraes LS. Small bowel obstruction: what to look for. *Radiographics*. 2009; 29(2):423-39.
13. Baid G, Dawan ML, Parmar A. Role of CT scan in evaluation and management of intestinal obstruction. *Int Surg J* 2017;4:2257–61
14. Van Oudheusden TR, Aerts BA, de Hingh IH, Luyer MD. Challenges in diagnosing adhesive small bowel obstruction. *World J Gastroenterol*. 2013; 19(43):7489.
15. Saini DK, Chaudhary P, Durga CK, Saini K. Role of multislice computed tomography in evaluation and management of intestinal obstruction. *Clin Pract*. 2013; 3(2):e20.
16. El-Hossainy AF, Mustafa FM, Shazly MA, Yousef Selim YA. Role of computerized tomography in the management of intestinal obstruction in adults. *Al-Azhar Assiut Med J* 2019;17(4):321-30
17. Gohar F, Sohail S, Shaikh R. Diagnostic accuracy of computed tomography scan against surgical findings in small bowel obstruction cases. *KMUJ*. 2024; 16(1):61-66.
18. Afzal S, Ahmad F, Farooq F. Role of multi-detector computed tomography in the diagnosis of intestinal obstruction. *Cureus*. 2023; 15(1):e33730.
19. Li Z, Zhang L, Liu X, et al. Diagnostic utility of CT for small bowel obstruction: Systematic review and meta-analysis. *PLoS ONE*. 2019; 14(12):e0226740.