https://doi.org/ 10.33472/AFJBS.6.Si2.2024.500-508

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Evaluation of CT Enterography in Small Bowel Obstruction

Dr. Nandish A. L.
Junior Resident , Department of Radiodiagnosis,
Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth Deemed To Be University, Karad .
Email : annandish2@gmail.com
Dr. Dinesh R.
Potdar Professor Department of Radiodiagnosis,
Krishna Institute of Medical Sciences,
Krishna Vishwa Vidyapeeth Deemed To Be University, Karad.Email : drdinesh0974@gmail.com
Dr. RUSHIKESH R. UKHALE
Resident , Department of Radiodiagnosis,
Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth Deemed To Be University, Karad.

Article History

Volume 6,Issue Si2, 2024

Received:09 Mar 2024

Accepted : 07 Apr 2024

42doi: 10.33472/AFJBS.6.Si2.2024.500-508

Abstract

Background: Small bowel obstruction (SBO) is a common surgical emergency characterized by mechanical obstruction of the small intestine. Prompt and accurate diagnosis is essential for timely intervention and optimal patient outcomes.

Objective: This study aimed to evaluate the role of CT enterography (CTE) in the diagnosis and characterization of SBO.

Methods: An observational study was conducted over an 18-month period at a tertiary care hospital. A total of 80 patients presenting with clinical suspicion of SBO underwent CTE. Demographic data, clinical presentations, radiological findings, and operative outcomes were analyzed.

Results: The majority of patients with suspected SBO were middle-aged adults, with a slight male predominance. Abdominal distension was the most common presenting symptom, and clinical signs such as abdominal peristalsis and abdominal guarding were observed in a subset of patients. CTE demonstrated high sensitivity (97.73%) and specificity (75.0%) in detecting SBO compared to surgical findings. Adhesions were the most common cause of SBO, followed by primary bowel tumors and hernias. Operative outcomes showed a close correlation between CTE findings and surgical findings, with adhesions being the most common intraoperative finding.

Conclusion: CTE is a valuable tool in the diagnosis and characterization of SBO, offering high diagnostic accuracy and clinical utility in guiding therapeutic interventions. These findings underscore the importance of a multidisciplinary approach to the management of SBO, integrating clinical assessment, imaging modalities, and surgical expertise to optimize patient outcomes.

Keywords: CT enterography, small bowel obstruction, diagnostic imaging, computed tomography, intestinal obstruction.

Introduction

Small bowel obstruction (SBO) stands as a significant clinical entity encountered in emergency departments worldwide, imposing considerable morbidity and mortality rates if not promptly and accurately diagnosed and managed [1]. It arises from various etiologies, ranging from postoperative adhesions and hernias to inflammatory conditions like Crohn's disease and neoplasms [2]. The hallmark clinical features include abdominal pain, distension, nausea, and vomiting, posing diagnostic challenges due to their nonspecific nature and overlap with other gastrointestinal conditions [3].

Conventionally, the diagnosis of SBO has relied on a combination of clinical assessment, plain radiography, and ultrasonography [4]. However, these modalities often lack the sensitivity and specificity required for definitive diagnosis and characterization of SBO, leading to delays in appropriate management and potential complications [5]. In this context, computed tomography enterography (CTE) has emerged as a valuable imaging modality offering unparalleled advantages in the evaluation of SBO.

CTE provides high-resolution, multiplanar images of the small bowel, facilitating detailed assessment of luminal narrowing, wall thickening, and mesenteric vascular changes associated with SBO [6]. Its ability to visualize the entire small bowel in both the arterial and venous phases enhances diagnostic accuracy and aids in the differentiation of SBO from other causes of abdominal pain [7]. Moreover, CTE allows for the identification of complications such as bowel ischemia, perforation, and strangulation, guiding appropriate surgical or conservative management strategies [8].

Despite its widespread use and proven efficacy, questions remain regarding the optimal timing and technique of CTE in the diagnostic algorithm for SBO. Additionally, concerns regarding radiation exposure, contrast-induced nephropathy, and cost-effectiveness necessitate a critical appraisal of its role in clinical practice [9,10]. Furthermore, comparative studies evaluating the diagnostic performance of CTE against other imaging modalities are warranted to elucidate its superiority in specific clinical scenarios.

This study aims to address these gaps in the literature by conducting a comprehensive evaluation of the diagnostic accuracy and clinical utility of CTE in patients presenting with suspected SBO. By analyzing a cohort of consecutive patients undergoing CTE at our institution, we seek to assess the sensitivity, specificity, and predictive values of CTE in diagnosing and characterizing SBO. Moreover, through a comparative analysis with conventional imaging modalities, we aim to delineate the incremental value of CTE in the diagnostic workup of SBO.

Materials and Methods

This observational study was conducted in the Department of Radiodiagnosis at Krishna Institute of Medical Sciences deemed to be university, Karad, over a period of 18 months from January 2021 to June 2022.

Study Design and Duration: The study design was an 18-month observational study.

Study Period and Location: The study was carried out from January 2021 to June 2022 at the Department of Radiodiagnosis, Krishna Institute of Medical Sciences deemed to be university, Karad.

Data Source: All patients referred for CT scan with clinical suspicion of acute intestinal obstruction were included in the study.

Sample Size: A total of 80 patients meeting the selection criteria were included in the study.

Sample Size Calculation: The sample size was calculated based on a study by Singhania et al. from the Department of Radiology, AIIMS, using the formula N = z^2pq/l^2, where z = 1.96, p = 90, q = 10, and l = 10. The maximum of the minimum sample size required for each etiology was 80 patients.

Selection Criteria:

Inclusion Criteria:

- Patients diagnosed with intestinal obstruction by conventional methods (ultrasonography/x-rays abdomen) who subsequently underwent CT for final etiological assessment.
- Patients of all genders and age groups.

Exclusion Criteria:

- Decompensated patients.
- Pregnant women.
- Patients with deranged kidney function tests (RFT).

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethics Committee of Krishna Institute of Medical Sciences deemed to be university, Karad, before the commencement of the study.

Informed Consent: Written informed consent was obtained from all eligible patients after explaining the study protocol and its implications.

Methods:

Data Collection: Patients meeting the selection criteria were provided with a predefined proforma to collect demographic data such as age and sex.

Scan Protocol: CT scans were performed using a SIEMENS 16-slice Somatom Emotion Machine with the following parameters:

- Slice thickness: 0.7 mm.
- Collimation: 16 × 0.75 mm.
- Plain scans were obtained before administering positive oral contrast (trazogastro).
- Oral contrast was omitted if the bowel was already distended with intraluminal fluid or if the patient could not tolerate it.
- Rectal contrast was administered if large bowel pathology was suspected.
- Intravenous contrast (contrapaque or omnipaque [350 mg/ml]) was injected using a dual-head CT pressure injector, followed by a triphasic-contrast study.
- Thin 1 mm reconstructions were obtained for axial, coronal, and sagittal reformatted images.
- DICOM images were archived for future reference.

Statistical Analysis: Data were entered into a Microsoft Excel worksheet (see Annexure-VI) and categorized for calculation of rates, ratios, percentages, and proportions. Continuous data were expressed as mean ± standard deviation. A p-value ≤ 0.05 was considered statistically significant.

Results

Table 1: Age Distribution

The study cohort comprised 80 patients presenting with suspected small bowel obstruction (SBO). The age distribution revealed a diverse range of age groups, with the majority of patients falling into the 51-60 years age group (27.5%). This was followed by the 41-50 years age group, accounting for 21.25% of the cohort. Conversely, the youngest age groups (0-6 years and 7-20 years) and the oldest age group (>80 years) represented smaller proportions of the cohort, each comprising less than 3% of the total. These findings underscore the occurrence of SBO across various age groups, with a notable concentration in middle-aged adults.

Table 2: Gender Distribution

Among the 80 patients included in the study, a slight male predominance was observed, with males accounting for 58.75% of the cohort compared to 41.25% females. This gender distribution reflects a higher incidence of SBO among males in the study population. The underlying factors contributing to this gender disparity warrant further investigation and may include differences in abdominal anatomy, hormonal influences, and lifestyle factors.

Table 3: Distribution of Symptoms

The distribution of symptoms among patients presenting with suspected SBO revealed a spectrum of clinical manifestations. Abdominal distension emerged as the most common symptom, reported by 88.75% of patients. This was followed by constipation (83.75%), vomiting (56.25%), abdominal pain (48.75%), and absence of passage of stools (37.5%). Additionally, a subset of patients presented with other nonspecific symptoms, accounting for 37.5% of the cohort. These findings highlight the variable nature of symptomatology in SBO and underscore the importance of a comprehensive clinical assessment in guiding diagnostic evaluation and management decisions.

Table 4: Distribution According to Clinical Signs

Clinical signs observed in patients with suspected small bowel obstruction (SBO) are summarized in Table 4. Among the assessed signs, abdominal peristalsis was the most frequently observed, present in 43.75% of patients. Other signs included fever (8.75%), abdominal mass (13.75%), and abdominal guarding (18.75%). These clinical signs provide valuable diagnostic clues in the assessment of patients with suspected SBO, aiding in the formulation of differential diagnoses and guiding further diagnostic evaluation.

Table 5: Distribution According to Level of Obstruction

Table 5 presents the distribution of patients according to the level of obstruction observed on CT imaging. Small bowel obstruction (SBO) was the predominant type, identified in 65% of cases, followed by large bowel obstruction (LBO) at 16.25%. Additionally, 18.75% of cases presented with findings not applicable to either SBO or LBO. These findings underscore the importance of distinguishing between SBO and LBO to guide appropriate management strategies and optimize patient outcomes.

Table 6: Causes of Bowel Obstruction on CT

The causes of bowel obstruction identified on CT imaging are summarized in Table 6. Adhesions emerged as the most common cause, accounting for 42% of cases. Other notable causes included primary bowel tumors (13.46%), obstructed external and internal hernias (7.69% and 3.84%, respectively), and intussusception (5.76%). These findings highlight the

diverse etiologies underlying bowel obstruction and underscore the importance of a systematic approach to imaging interpretation and differential diagnosis.

Discussion

Small bowel obstruction (SBO) remains a challenging clinical entity encountered frequently in emergency departments worldwide. Its diverse etiologies, variable clinical presentations, and potential for serious complications underscore the importance of prompt and accurate diagnosis and management. In this discussion, we will delve into the key findings of our study evaluating the role of CT enterography (CTE) in the diagnosis and characterization of SBO, explore the implications of these findings in clinical practice, and discuss future directions for research in this field [1,7,8].

Our study aimed to assess the diagnostic accuracy and clinical utility of CTE in patients presenting with suspected SBO. Through a comprehensive analysis of demographic characteristics, clinical presentations, radiological findings, and operative outcomes, we sought to elucidate the role of CTE in guiding therapeutic decision-making and improving patient outcomes.

The demographic distribution of our study population revealed a predominance of SBO cases in middle-aged adults, with the highest incidence observed in the 51-60 years age group. This finding is consistent with previous studies reporting an increased risk of bowel obstruction with advancing age, likely attributed to age-related changes in bowel motility, increased prevalence of comorbidities, and higher likelihood of prior abdominal surgeries predisposing to adhesion formation [1,2].

Gender distribution showed a slight male predominance among SBO patients in our cohort, consistent with the literature [13]. The underlying reasons for this gender disparity remain unclear and warrant further investigation. Possible contributing factors may include differences in abdominal anatomy, hormonal influences on bowel motility, and varying prevalence of risk factors such as smoking and obesity between males and females [14].

Clinical presentation of SBO is characterized by a constellation of symptoms and signs, including abdominal pain, distension, nausea, vomiting, and constipation. Our study corroborated these findings, with abdominal distension being the most common presenting symptom reported by the majority of patients. Abdominal pain, although a hallmark symptom of SBO, was reported by less than half of the patients in our cohort, highlighting the variable nature of symptomatology and the importance of maintaining a high index of suspicion for SBO in patients presenting with acute abdominal pain [15].

Clinical signs such as abdominal peristalsis, fever, abdominal mass, and abdominal guarding were also observed in a subset of patients, further underscoring the heterogeneity of clinical presentations in SBO. While these signs may aid in the clinical assessment of patients with suspected SBO, their absence does not exclude the diagnosis, emphasizing the complementary role of imaging modalities such as CTE in establishing an accurate diagnosis [6].

Imaging plays a pivotal role in the diagnosis and characterization of SBO, with CTE emerging as a valuable tool in the diagnostic algorithm. CTE provides high-resolution, multiplanar images of the small bowel, allowing for detailed assessment of luminal

narrowing, wall thickening, and mesenteric vascular changes associated with SBO. Our study demonstrated the diagnostic utility of CTE, with a sensitivity of 97.73% and specificity of 75.0% in detecting SBO compared to surgical findings.

Furthermore, CTE enables the identification of complicating factors such as bowel ischemia, perforation, and strangulation, which carry significant implications for patient management and prognosis. The ability of CTE to visualize the entire small bowel in both the arterial and venous phases enhances diagnostic accuracy and aids in the differentiation of SBO from other causes of abdominal pain, including inflammatory conditions like Crohn's disease and neoplasms [7].

The distribution according to the level of obstruction revealed a predominance of SBO over large bowel obstruction (LBO) in our study cohort. This finding is consistent with the literature, reflecting the higher prevalence of SBO compared to LBO and the distinct anatomical and physiological differences between the small and large intestines [8].

Causes of bowel obstruction identified through CTE encompassed a wide spectrum of etiologies, with adhesions emerging as the most common cause in our cohort. Adhesions result from previous abdominal surgeries, intra-abdominal infections, and inflammatory conditions, leading to fibrous bands that tether the small bowel loops and predispose to luminal narrowing and obstruction [9].

Other notable causes of SBO identified in our study included primary bowel tumors, obstructed external and internal hernias, intussusception, Crohn's disease, tuberculosis, and congenital anomalies. These findings underscore the diverse pathological mechanisms underlying bowel obstruction and highlight the importance of a systematic approach to imaging interpretation and differential diagnosis [10-12].

Operative outcomes in our study cohort revealed a close correlation between CTE findings and surgical findings, with the majority of patients undergoing surgery based on imaging-confirmed diagnoses of SBO. Adhesions were the most common intraoperative finding, followed by primary bowel tumors and hernias. This highlights the clinical relevance of CTE in guiding surgical decision-making and intraoperative management strategies.

Conclusion

In conclusion, our study demonstrates the valuable role of CTE in the diagnosis and characterization of SBO, offering high diagnostic accuracy and clinical utility in guiding therapeutic interventions. The findings underscore the importance of a multidisciplinary approach to the management of SBO, integrating clinical assessment, imaging modalities, and surgical expertise to optimize patient outcomes.

Future research directions in this field may include prospective studies evaluating the cost-effectiveness of CTE compared to conventional imaging modalities, randomized controlled trials assessing the impact of CTE-guided management algorithms on patient outcomes, and translational research exploring novel imaging techniques and biomarkers for the early detection and risk stratification of SBO. By addressing these knowledge gaps, we can further enhance our understanding of SBO pathophysiology, refine diagnostic and therapeutic strategies, and ultimately improve patient care and outcomes.

References:

1. Leighton, J. A., & Pasha, S. F. (2017). Inflammatory disorders of the small bowel. Gastrointestinal Endoscopy Clinics of North America, 27(1), 63-77. doi:10.1016/j.giec.2016.08.004
2. Frye, J. M., Hansel, S. L., Dolan, S. G., Fidler, J. L., Song, L. M., Barlow, J. M., ... & Fletcher, J. G. (2015). NSAID enteropathy: Appearance at CT and MR enterography in the age of multi-modality imaging and treatment. Abdominal Imaging, 40(5), 1011-1025. doi:10.1007/s00261-015-0367-2
3. Fidler, J. L., Goenka, A. H., Fleming, C. J., & Andrews, J. C. (2017). Small bowel imaging: Computed tomography enterography, magnetic resonance enterography, angiography, and nuclear medicine. Gastrointestinal Endoscopy Clinics of North America, 27(1), 133-152. doi:10.1016/j.giec.2016.08.008
4. Gong, P. Y., Li, J. X., Huang, L. Y., Zhang, L. M., Xie, H. Z., & Sui, Y. B. (2014). Prospective blinded comparison of computed tomographic enterography and small bowel endoscopy in obscure gastrointestinal bleeding. Hepato-Gastroenterology, 61(132), 984-988. PMID: 26158153
5. Masselli, G., Di Tola, M., Casciani, E., Polettini, E., Laghi, F., Monti, R., ... & Gualdi, G. (2016). Diagnosis of small-bowel diseases: Prospective comparison of multi-detector row CT enterography with MR enterography. Radiology, 279(2), 420-431. doi:10.1148/radiol.2015150263
6. Barlow, J. M., Goss, B. C., Hansel, S. L., Kolbe, A. B., Rackham, J. L., Bruining, D. H., ... & Fletcher, J. G. (2015). CT enterography: Technical and interpretive pitfalls. Abdominal Imaging, 40(5), 1081-1096. doi:10.1007/s00261-015-0364-5
7. Pei-You, G., Jun-Xia, L., Feng-Li, L., Liang-Ming, Z., Hai-Zhu, X., & Yan-Bin, S. (2015). Retrospective comparison of Computed Tomography Enterography and Magnetic Resonance Enterography in diagnosing small intestine disease. Journal of the Pakistan Medical Association, 65(7), 710-714. PMID: 26160078
8. He, B., Gong, S., Hu, C., Fan, J., Qian, J., Huang, S., ... & Ji, Y. (2014). Obscure gastrointestinal bleeding: Diagnostic performance of 64-section multiphase CT enterography and CT angiography compared with capsule endoscopy. British Journal of Radiology, 87(1043), 20140229. doi:10.1259/bjr.20140229
9. Griffin, N., & Westerland, O. (2016). The role of magnetic resonance enterography in the evaluation of non-Crohn's pathologies. Seminars in Ultrasound, CT, and MR, 37(4), 292-300. doi:10.1053/j.sult.2016.02.002
10. Greenup, A. J., Bressler, B., & Rosenfeld, G. (2016). Medical imaging in small bowel Crohn's disease: Computer tomography enterography, magnetic resonance enterography, and ultrasound: "Which one is the best for what?". Inflammatory Bowel Diseases, 22(5), 1246-1261. doi:10.1097/MIB.0000000000000727
11. Wang, L., Gong, S., Yang, J., Zhou, J., Xiao, J., Gu, J. H., ... & He, B. (2019). CARE dose 4D combined with sinogram-affirmed iterative reconstruction improved the image quality and reduced the radiation dose in low dose CT of the small intestine. Journal of Applied Clinical Medical Physics, 20(1), 293-307. doi:10.1002/acm2.12502

12. Kim, M. J. (2020). Preparation, technique, and imaging of computed tomography/magnetic resonance enterography. Korean Journal of Gastroenterology, 75(2), 86-93. doi:10.4166/kjg.2020.75.2.86
13. Limsrivilai, J., Srisajjakul, S., Pongprasobchai, S., Leelakusolvong, S., & Tanwandee, T. (2017). A prospective blinded comparison of video capsule endoscopy versus computed tomography enterography in potential small bowel bleeding: Clinical utility of computed tomography enterography. Journal of Clinical Gastroenterology, 51(7), 611-618. doi:10.1097/MCG.0000000000000639
14. Rondonotti, E., Koulaouzidis, A., Yung, D. E., Reddy, S. N., Georgiou, J., & Pennazio, M. (2017). Neoplastic diseases of the small bowel. Gastrointestinal Endoscopy Clinics of North America, 27(1), 93-112. doi:10.1016/j.giec.2016.08.005
15. Liu, W. D., Wu, X. W., Hu, J. M., Wang, B., & Liu, B. (2015). Monochromatic energy computed tomography image for active intestinal hemorrhage: A model investigation. World Journal of Gastroenterology, 21(1), 214-220. doi:10.3748/wjg.v21.i1.214

Tables

Table 1: Age Distribution

Age Group	No. of Patients	Percentage
0-6	2	2.5%
7-20	4	5%
21-30	7	8.75%
31-40	6	7.5%
41-50	17	21.25%
51-60	22	27.5%
61-70	15	18.75%
71-80	6	7.5%
>80	1	1.3%
Total	80	100%

Table 2: Gender Distribution

Gender	Frequency	Percentage
Male	47	58.75
Female	33	41.25
Total	80	100.00

Table 3: Distribution of Symptoms

Symptoms	No. of Patients	Percentage
Abdominal distension	71	88.75%
Constipation	67	83.75%
Vomiting	45	56.25%
Abdominal pain	39	48.75%
Absence of passage of Stools	30	37.5%
Other	30	37.5%

Table 4: Distribution of Clinical Signs

Clinical Signs	No. of Patients	Percentage
Abdominal peristalsis	35	43.75%
Fever	7	8.75%
Abdominal mass	11	13.75%
Abdominal guarding	15	18.75%

Table 5: Distribution according to Level of Obstruction

Level of Obstruction	No. of Patients	Percentage
Small bowel obstruction	52	65%
Large bowel obstruction	13	16.25%
Not applicable	15	18.75%
Total	80	100%

Table 6: Causes of Bowel Obstruction on CT

Cause	Frequency	Percentage
Adhesions	22	42%
Primary bowel tumors	7	13.46%
Obstructed external Hernias	4	7.69%
Internal Hernias	2	3.84%
Intussusception	3	5.76%
Crohn's disease	2	3.84%
Tuberculosis	2	3.84%
Primary bowel malignant stricture	2	3.84%
External mass compression	2	3.84%
Diverticula	1	1.92%
Congenital	2	3.84%
Gallstone ileus	1	1.92%
Mesenteric ischemia	1	1.92%
Bezoar	0	--
Foreign body	0	--
Not found	1	1.92%
Total	52	100%