

ACCURACY OF CONTRAST-ENHANCED COMPUTED TOMOGRAPHY FINDINGS IN DIAGNOSING THE CAUSE OF SMALL BOWEL OBSTRUCTION

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Abstract

Objective: Prospective evaluation of the diagnostic accuracy of Contrast-Enhanced Computed Tomography (CECT) in diagnosing small bowel obstruction (SBO), detecting its causes and complications in patients with SBO.

Study Design: Prospective comparative study

Place and duration of study: Combined Military Hospital Kharian, Pakistan, from September 2024 to February 2025.

Methodology: Adult patients with clinical presentation of SBO who underwent CECT followed by exploratory laparotomy or clinical resolution with negative follow-up CECT as the reference standard. Diagnostic accuracy parameters, which were used were sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy.

Results: Two hundred patients were studied with mean age 54.14 ± 17.48 years, male 52.5% and female 47.5%. Out of these, 109 patients (54.5%) had confirmed SBO on exploration. CECT demonstrated sensitivity of 91.7%, specificity of 89.0%, PPV of 90.9%, NPV of 90.0%, and overall accuracy of 90.5%. The most common cause (37.6%) was intestinal adhesions, followed by hernias (20.2%) and tumors (14.7%). The accuracy of CECT in identifying the cause in 87.2% of cases was proven, and the transition point marking was correct in 91.7% of intraoperatively confirmed SBO cases. 27 patients had mesenteric ischemia and bowel perforation (24.7% of cases).

Conclusion: CECT proves excellent diagnostic accuracy in the diagnosis of SBO with high sensitivity and specificity. CECT is significantly reliable in identifying the etiology and complications of SBO, proving it a very valuable addition to clinical decision-making.

INTRODUCTION

Small bowel obstruction (SBO) comprises approximately 15-20% of surgical admissions, and it is among the commonest causes of emergency presentation in surgery. This condition is characterized by mechanical blockage of intestinal contents, which can rapidly progress to life-threatening complications, including bowel

ischemia, necrosis, fluid sequestration, and perforation if not diagnosed and managed in a prioritized timeline.¹ Mortality rate in cases of SBO has been drastic, high till 25% with the findings of bowel ischemia and reluctant management by surgical intervention.²

Clinical diagnosis of SBO varies greatly, as patients' presenting complaints, progression of

history, physical examination findings, and laboratory investigation values are often not enough to confirm the diagnosis confidently, to determine its causes, or to detect possible dangerous outcomes.³ Traditional supine and erect abdominal X-rays, which are widely available and commonly used as an initial test, have limited sensitivity of only 50-80% for detecting SBO and provides lesser knowledge regarding the causes and potentially dangerous outcomes.⁴

In recent years, contrast-enhanced computed tomography (CECT) has proven to be the best diagnostic investigation for evaluating suspected SBO. Latest guidelines from well-known radiological associations over the globe, including the American College of Radiology, recommend CECT as the first-line imaging investigation for adult patients with clinical suspicion of SBO.⁵ CECT is Quick, non-invasive, and thorough in evaluation of the abdomen, and yields vital findings that align with the clinical decision-making algorithm, finalizing conservative as compared to operative intervention for management.

A lot of studies have already proven CECT's superior diagnostic performance compared to routine radiography, with a known pooled sensitivity 91% and specificity 89% for the diagnosis of SBO.⁶ Not only confirming the presence of obstruction, but CECT also proved to be the best noninvasive investigation to find the transition point, clarifying the underlying cause, and finding signs of ischemia, which demands urgent operative intervention.⁵

But, in spite of detailed studies in favor of CECT's diagnostic usage, there remains a significant change in reported performance stats, especially regarding diagnosing bowel ischemia and closed-loop obstruction.^{5,7} Patients across different nations present with different etiologies, and surgical outcomes are dependent upon both the diagnostic accuracy of the CECT and the decisions made afterwards.⁸ Hence, there is a need for continuous evaluation of the diagnostic accuracy of CECT in identifying SBO.

This study plans to prospectively evaluate the diagnostic ability of CECT in diagnosing SBO, delineating its cause, and ruling out complications

in patients presenting to the Combined Military Hospital Kharian, Pakistan. Our objectives include determining the sensitivity, the specificity, positive and negative predictive values of CECT for SBO diagnosis, assessing its accuracy in finding the underlying cause and exact transition point localization, and evaluating its performance in diagnosing complications requiring immediate operative intervention.

METHODOLOGY

This prospective comparative study was carried out at the Department of General, Thoracic and Paediatric Surgery, Combined Military Hospital (CMH) Kharian, Pakistan, over the period of 06 months from September 2024 to February 2025, CMH Kharian, is a 750-bed tertiary care teaching hospital serving military personnel and their families dependent on them. The hospital has a well-established emergency department with fully equipped operating theaters and a dedicated team of surgeons and the latest radiology facilities. The study protocol was properly approved by the Institutional Review Board of CMH Kharian (IRB approval number: CMH-KHN/IRB/2024/A/25/58). Written informed consent was obtained from all participants or attendants prior to inclusion. The conduct of the study was fully aligned with the principles of the Declaration of Helsinki.

Inclusion Criteria: Adult patients (≥ 18 years) presenting to the emergency department with a clinical impression of small bowel obstruction were prospectively included.

Exclusion Criteria: Patient with known allergy to iodinated contrast media, serum creatinine >1.8 mg/dL, pregnancy, hemodynamic instability requiring immediate surgical intervention without imaging, or refused consent for participation in research.

The sample size was calculated using Buderer's method for diagnostic accuracy, using Gohar et al.'s estimates for sensitivity 92.2%, specificity 87.8% and prevalence of 50%, and the desired precision of $\pm 7\%$. The required sample size turned out to be 168.⁹ Clinical impression of SBO was

defined by the presence of at least three of the given characters: crampy abdominal pain, vomiting, constipation, abdominal distension, and decreased or absent bowel sounds on physical examination.

All patients underwent CECT examination using a 128-slice CT scan machine (Siemen's sensation). The imaging protocol included the following:

- Pre-contrast phase: Helical attainment from the diaphragm to the symphysis pubis
- Arterial phase of scan: 25-30 seconds post-contrast injection
- Portal venous phase: 65-70 seconds post-contrast injection
- Technical parameters: 120 kVp, automated tube current modulation, 1.25 mm slice thickness, 1.0 pitch

Intravenous contrast material (Omnipaque 350mg, Biotest Pharmaceuticals) was administered at 3-4 mL/kg body weight (max 150 mL) through a 16-gauge peripheral venous cannula at 2-3 mL/second using a power injector. Oral contrast was not given to avoid complications and potential aspiration hazards.

CT scan images were separately reviewed by two experienced radiologists, one consultant with 12 years of abdominal imaging experience and another senior resident with 4th year of abdominal CECT experience, both had no knowledge of clinical outcomes. Reporting conflicts were discussed through a consensus discussion. The parameters given below were systematically checked:

1. Presence of SBO: Defined by bowel dilatation >3.0 cm with a visible transition point
2. Location of obstruction: Start, mid, or distal small bowel
3. Degree of obstruction: Complete or partial
4. Cause: Adhesions, hernias, tumors, inflammatory conditions, or other etiology
5. Complications: Bowel wall ischemia, perforation, or closed-loop obstruction

The diagnostic standard of SBO was established through:

- Per-operative findings in patients who had surgical intervention.
- Clinical follow-up with resolving symptoms and normal small intestine function within 48-72 hours of conservative non-surgical management and follow-up CECT imaging showing resolution of obstruction in indecisive cases.

Data was analyzed using SPSS version 23.0 (IBM Corporation, Armonk, NY). Normality of the data was checked. Continuous variables, which were normal, were expressed as mean \pm standard deviation, while the continuous variables, which were not normal, were expressed as median \pm interquartile range, and categorical variables were presented as frequencies and/or percentages. The diagnostic accuracy of CECT was checked by properly calculating the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy with 95% confidence intervals. The Chi-square test was applied to compare categorical variables, while the Student's t-test or Mann-Whitney U Test was utilized for continuous variables. A p-value <0.05 was considered statistically significant. Receiver operating characteristic (ROC) curve analysis was done to check the overall diagnostic performance.

RESULTS

During the one-year study duration, 200 patients participated in the study. The mean age was 54.14 \pm 17.478 years (range: 18-90 years). The age wasn't significantly different between both groups, with an independent t-test p-value of 0.450. In total, 105 males (52.5%) and 95 females (47.5%) were enrolled in the study, p-value 0.614.

The most common presenting complaints were pain abdomen (198 patients, 99.0%), vomiting (186 patients, 93.0%), abdominal distension (172 patients, 86.0%), and constipation (164 patients, 82.0%). Past surgical history of abdominal surgery was present in 120 patients (60.0%), with appendectomy (30%), cholecystectomy (20%), and gynecological surgeries (10%).

Out of the 200 patients evaluated, small bowel obstruction was confirmed in 109 patients (54.5%) per operatively (78 patients) and by clinical follow-up (31 patients). CECT correctly diagnosed SBO in 100 patients (69 operatively and

31 by resolution of the SBO using a conservative approach with resolution of SBO on follow-up CECT abdomen), and correctly ruled out SBO in 81 patients. The diagnostic performance stats are summarized in Tables I & II.

Table I: Diagnostic Accuracy Stats of CECT for Small Bowel Obstruction

		Surgical Cause		Total
		Positive	Negative	
CECT Cause	Positive	100	9	109
	Negative	10	81	91
Total		110	90	200

CECT means Contrast-Enhanced Computed Tomography

The Chi-Square p-value <0.0001 and the kappa value of 0.808 with a p-value of <0.0001, showing strong agreement between CECT findings and the Surgical outcome.

Table II: Diagnostic Accuracy Stats of CECT for Small Bowel Obstruction

Parameter	Value
Sensitivity	91.7% (100/109)
Specificity	89.0% (81/91)
Positive Predictive Value	90.9% (100/110)
Negative Predictive Value	90.0% (81/90)
Overall Accuracy	90.5% (181/200)

CECT means Contrast-Enhanced Computed Tomography

The area under the ROC curve was 0.905 (95% CI: 0.857-0.952, p<0.0001), showing a very good diagnostic performance.

Out of the 109 CECT SBO cases, adhesions were the most causative factor resulting in obstruction

for 41 cases (37.6%). Hernias were the second most common cause with 22 cases (20.2%), followed by tumors in 16 cases (14.7%). The complete distribution of causes is shown in Table III.

Table III: Etiology of Small Bowel Obstruction (n=109)

Cause	Number of Cases	Percentage
Adhesions	41	37.6%
Hernias	22	20.2%
- External hernias	14	12.8%
- Internal hernias	8	7.4%
Malignant tumors	16	14.7%
- Primary small bowel	7	6.4%
- Metastatic disease	9	8.3%
Gallstone ileus	2	1.8%
Volvulus	10	9.17%
Intussusception	8	7.33%
Foreign Body	3	2.75%
Stricture	7	6.42%
Total	109	100.0%

CECT correctly diagnosed the cause in 95 of 109 SBO cases, proving an accuracy of 87.2% for diagnosing the cause of SBO. The highest accuracy was seen in cases of hernias (95.5%) and adhesions (92.7%), while the tumor diagnostic result was a bit lower but still had sufficient accuracy (81.3%). CECT successfully marked the transition point in 100 of 109 confirmed SBO cases (91.7%). The obstruction locations were: proximal small bowel (jejunum) in 27 cases (14.21%), midpoint of small bowel in 70 cases (62.2%), and distal portion of small bowel (ileum) in 13 cases (11.9%). 35 out of 109(32.1%) CECT-proven SBO cases were found to have serious complications. Bowel wall ischemia was the most striking complication, detected in 20 patients (18.3%) based on CT

findings. Others were nonspecific small bowel wall thickening, pneumatosis intestinalis, free fluid, and mesenteric fat stranding due to surrounding inflammatory or infective process. All 20 patients with suspected bowel ischemia were immediately operated on by exploratory laparotomy, and per-operative findings confirmed ischemic changes in 18 patients, giving a positive predictive value of 90% for CECT-diagnosed bowel wall ischemia. Free fluid in the peritoneal cavity was noted in 76 patients (69.7%) with confirmed SBO, while bowel wall perforation indicated by free air in the peritoneal cavity was identified in 7 patients (6.4%). Closed-loop obstruction was suspected on CECT in 8 patients (7.33%), but intraoperatively, only 6 cases had it.

Table IV: Complications Diagnosed on CECT in SBO Patients (n=109)

Complication	CECT Findings	Surgical Confirmation	PPV
Bowel ischemia	20	18	90%
Perforation	7	7	100.0%
Closed-loop obstruction	8	6	75.0%
Significant free fluid	76	71	93.4%

SBO means Small Bowel Obstruction

CECT means Contrast-Enhanced Computed Tomography

Based on CECT findings and clinical assessment, 78 patients were operated on, while 122 were initially treated conservatively. Of those who were managed conservatively, 31 had confirmed SBO on CECT that settled with nonsurgical management, while 91 did not have SBO. Out of the remaining 91, 10 further underwent surgery. So in total, 88 underwent surgery (79 had intraoperatively confirmed SBO and 9 had no SBO intraoperatively), 31 were managed conservatively, which were considered to be equivalent to surgically proven, as with follow-up CECT confirmed resolution of SBO, and 81 were declared not to have any SBO.

The mean time after doing a CECT scan till the finalization of surgical decision was 2.4 ± 1.8 hours for the patients requiring operative intervention due to complications, and 8.7 ± 4.2 hours for those who were having uncomplicated SBO. No mortality was noted in the study cohort during the hospitalization period for this disease or due to any other comorbid.

Subgroup analysis was performed using binary logistic regression, which showed that CECT performance was aligned across different age groups, with no statistically notable variation in diagnostic accuracy between patients <51 years and ≥ 51 years ($p=0.994$). Similarly, no notable variation was seen between male and female

patients ($p=0.670$) or between patients with and without past surgical history ($p=0.699$).

DISCUSSION

This prospective study comprehensively reveals that CECT has excellent diagnostic accuracy in cases of small bowel obstruction, with a sensitivity of 91.7 %, a specificity of 89.0%, and an overall accuracy of 90.5%. The findings noted from this study are in subtle accordance with the ranges of values noted in related present-day literature and support CECT's role as the preferred initial radiological modality for the patients in whom small bowel obstruction is suspected.

The sensitivity results of our study are closely related to the pooled sensitivity of 90% reported in a comprehensive meta-analysis by Ahmad SJS et al., encompassing over 9418 patients across 65 studies.¹⁰ The specificity of 89.0% in our study cohort is also aligned with published data by Shaikh M et al., reinforcing the reliability of CECT in ruling out SBO when clinical suspicion exists.¹¹

The positive predictive value of 90.9% observed in our study has significant clinical application, as it indicates that approximately 9 out of 10 patients with positive CECT findings truly have SBO. This high PPV supports comfortable and logical clinical decision-making on the basis of CECT findings, particularly in determining the time of surgical intervention, whether urgent, immediate or

planned on the next OT list. In the same manner, the negative predictive value of 90.0% reassures that patients with negative CECT findings have a very low probability of carrying SBO, which favors the surgeon's comfort in applying a conservative treatment plan for SBO.

87.2% accuracy in truly diagnosing the underlying etiology of SBO was shown by our study, which is especially of subtle value for surgical planning and foreseeing the probable patient outcomes. The abundance of adhesions (37.6%) in our cohort shows that the cause was an increased number of patients with past surgical history of abdominal surgery (60.0%) in the study population, in accordance with known epidemiological patterns in which postoperative adhesions account for 65% of SBO cases in developed countries, as it is discussed in the literature by Tong, J.W.V. et al.¹²

The comparatively lesser proportion of adhesions as compared to Western literature, which is typically 65-75%, and higher incidence of hernias (20.2%) in our study showed regional differences in surgical technique and outcomes, late presentation patterns, or genetic predilection factors specific to the Subcontinental population. This finding in our study highlights the importance of regionally validating studies to establish locally proven and validated diagnostic algorithms for better surgical decision-making and ultimately better outcomes. CECT proved to be very particular for accurately diagnosing hernias (95.5%), likely due to the particular imaging patterns. Our study showed a reasonable accuracy for adhesions (92.7%), but it simultaneously proved the known difficulty in directly showing adhesive bands by radiology, requiring indirect help from secondary signs such as sudden caliber change and the "beak sign", as it is discussed by Gopireddy DR. et al. in their literature.¹³

The diagnosis of bowel ischemia was among the most important and valuable benefit of CECT in SBO evaluation, as its presence necessitates immediate surgical intervention to prevent bowel necrosis and ultimately decrease the mortality. Our study pointed out that CECT has a positive predictive value of 90% for ischemia detection, proving its capability in achieving perfect accuracy for this life-threatening complication.

The findings in our study are in accordance with recent retrospective data by Okumura T et al., suggesting that real-world sensitivity for ischemia detection may be less than for other causes.¹⁴ The difference between suspected and confirmed ischemia in 2 of 20 cases in our study stresses the significance of maintaining high surgical acumen and considering operative intervention even when radiology findings are indecisive.

The 100% positive predictive value for perforation detection, albeit in a small sample (7 cases), reflects CECT's exceptional performance in diagnosing pneumoperitoneum, a dangerous finding that necessitates urgent exploration. Toprek H. et al showed that finding specific patterns of air distributions can help in identifying the cause of pneumoperitoneum.¹⁵ These patterns can help the surgeons in performing surgery in a goal-oriented fashion and significantly decrease the time of surgery. Moreover, CECT helps in avoiding non-therapeutic surgery, as was shown by the work of Kaur S. et al, where diagnostic laparoscopy was compared to CECT, and it showed a significant decrease in performing non-therapeutic surgeries.¹⁶

Our study proves that clinical decision-making is significantly helped by CECT scan, with clear differentiation between patients needing immediate surgery (78 patients) and those planned for conservative management (122 patients). The proven short span from the conduct of CT to surgical decision and the operative intervention (2.4 hours for complicated cases) shows the efficiency achieved through rapid, accurate diagnosis.

Zero mortality in our study cohort proves an efficient patient flow system and an organized emergency diagnosis and management system, ultimately contributing to better outcomes. This outcome supports the integration of CECT into diagnostic algorithms for patients who are known to have the clinical picture of SBO, as it has also been discussed by Dominic W Proctor. Et al., in the observational study, where the widespread use in the United States of America since 1990 has resulted in decreased mortality.¹⁷

Our results are profoundly in line with the latest high-quality research evaluating CECT

performance in SBO cases. A 2025 systematic review by Ahmad SJS et al. reported a pooled sensitivity of 90% and specificity of 87% across 28 studies, which was observed to be nearly matched by our study.¹⁰ The same has also been shown by Afzal S. et al., in a cross-sectional study, but with a decrease in specificity of 65%.¹⁸ However, our study adds profound value through its prospective study design, thorough systematic evaluation of complications, and the most important and encouraging factor is the regional validation in the subcontinental population.

Our study's diagnostic accuracy has noted to be crossing some of western comparative studies keeping few biases a part, possibly reflecting the very organized and disciplined military hospital setting with tertiary care center having experienced radiologists and standardized imaging protocols and an efficient surgical team regularly evaluated by audits. This propagates the significance of maintaining quality care standards in both radio image attainment and reporting to optimize diagnostic performance and then application to its true sense by the end user, the surgeon.

There are some limitations in this study. The study was not done in a multicenter study, so we can not generalize the results. Moreover, the use of clinical follow-up instead of per-operative confirmation may have added to confirmation bias.

Based on our study findings, we recommend that CECT should be regarded as the radiological investigation of choice for adult patients with a clinical presentation of SBO in hospitals where it is easily available, along with the availability of a radiologist. The phenomenal diagnostic accuracy supports its routine diagnostic and surgical planning usage.

CONCLUSION

This prospective study confirms that contrast-enhanced computed tomography demonstrates excellent diagnostic accuracy for small bowel obstruction, with a sensitivity of 91.7%, specificity of 89.0%, and overall accuracy of 90.5%. CECT reliably identifies the etiology of obstruction in 87.2% of cases and successfully localizes the transition point in 93.6% of confirmed SBO cases.

The technique proves particularly valuable in detecting complications requiring urgent intervention, though continued vigilance is required given the imperfect sensitivity for bowel ischemia. These results support the continued use of CECT as the preferred initial imaging modality for suspected SBO in appropriately equipped healthcare facilities.

The findings demonstrate that CECT significantly impacts clinical decision-making, enabling appropriate triage between conservative and surgical management while providing essential information for operative planning. The excellent diagnostic performance observed in this Pakistani tertiary care setting validates the global applicability of CECT for SBO diagnosis across diverse healthcare environments.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MWR & MI: Data acquisition, data analysis, critical review, approval of the final version to be published.

YSK & AAJ: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MIS & MUS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

Schick MA, Kashyap S, Collier SA, et al. Small Bowel Obstruction. [Updated 2025 Jan 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK448079/>.

- Anup Panthi, Ishwor Thapaliya, Laxman Khadka, Madhav Bhusal, Dev S, Jha SK, et al. The role of computed tomography in acute bowel obstruction due to a supraventricular hernia: a case report from Nepal. *Annals of Medicine and Surgery* [Internet]. 2024 May 24;86(7):4268–73. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC11230816/>. doi: 10.1097/MS9.0000000000002222.
- Aka AA, Wright JP, DeBeche-Adams T. Small Bowel Obstruction. *Clinics in Colon and Rectal Surgery*. 2021;34(04):219–26. doi: 10.1055/s-0041-1725204.
- Nelms DW, Kann BR. Imaging Modalities for Evaluation of Intestinal Obstruction. *Clinics in Colon and Rectal Surgery*. 2021 Jun 2;34(4). doi: 10.1055/s-0041-1729737.
- Chang KJ, Marin D, Kim DH, Fowler KJ, Camacho MA, Cash BD, et al. ACR Appropriateness Criteria® Suspected Small-Bowel Obstruction. *Journal of the American College of Radiology*. 2020 May;17(5):S305–14. DOI: 10.1016/j.jacr.2020.01.025
- Li Z, Zhang L, Liu X, Yuan F, Song B. Diagnostic utility of CT for small bowel obstruction: Systematic review and meta-analysis. *Hu J, editor. PLOS ONE*. 2019 Dec 30;14(12):e0226740. <https://doi.org/10.1371/journal.pone.0226740>
- Jaidee W, Teerasamit W, Apisarnthanarak P, Kongkaewpaisan N, Panya S, Kaewlai R. Small bowel transmural necrosis secondary to acute mesenteric ischemia and strangulated obstruction: CT findings of 49 patients. *Heliyon*. 2023 Jun 27;9(7):e17543. doi: 10.1016/j.heliyon.2023.e17543.
- Nielsen LBJ, Aerenlund MP, Alouda M, Azzam M, Bjerke T, Burcharth J, Dibbern CB, Jensen TK, Jordhøj JQ, Lolle I, Malik T, Ngo-Stuyt L, Nielsen EØ, Olausson M, Skovsen AP, Tolver MA, Smith HG. Real-world accuracy of computed tomography in patients admitted with small bowel obstruction: a multicentre prospective cohort study. *Langenbecks Arch Surg*. 2023 Aug 29;408(1):341. doi: 10.1007/s00423-023-03084-z.
- Gohar F, Sohail S, Shaikh R. “Diagnostic Accuracy of Computed Tomography Scan Against Surgical Findings in Small Bowel Obstruction Cases”. *KHYBER MEDICAL UNIVERSITY JOURNAL*, vol. 16, no. 1, Mar. 2024, pp. 61-6, doi:10.35845/kmuj.2024.23291.
- Ahmad SJS, Drvaric I, Ahmed AR, Jakob D, Kyriazidis IP, Pouwels S, et al. From obstruction to ischaemia: a systematic review and meta-analysis on the diagnostic accuracy of CT scans in identifying small and large bowel obstruction, underlying causes and predicting critical complications in adults. *BMJ Open*. 2025 Nov 4;15(11):e103887. doi: 10.1136/bmjopen-2025-103887.
- Shaikh M, Sahito AA, Azeem N, Khan A, Shaikh AH, Memon SA. Diagnostic Accuracy of CT Scan in Detection of Point of Transition of Small Bowel Obstruction. *apmc*. 2022Mar.31;16(1):33-6. doi.org/10.29054/apmc/2022.1037
- Tong JWV, Lingam P, Shelat VG. Adhesive small bowel obstruction - an update. *Acute Med. Surg.*, 7: e587. doi.org/10.1002/ams2.587
- Gopireddy DR, Soule E, Arif-Tiwari H, Sharma S, Kanmaniraja D, Jain K, et al. Spectrum of CT Findings Related to Bowel Adhesions Without Bowel Obstruction: A Comprehensive Imaging Review. *Journal of Clinical Imaging Science*. 2020 Dec 10;10:80. doi: 10.25259/JCIS_126_2020.

- Okumura T, Tsujinaka S, Satani N, Yamamoto K, Nakano T, Yamada T, et al. Diagnostic Utility of CT Findings as Indicators for Bowel Resection in Strangulated Small Bowel Obstruction. *J. Clin. Med.* 2025, 14, 8027. <https://doi.org/10.3390/jcm14228027>
- Toprak H, Yilmaz TF, Yurtsever İ, Sharifov R, Gültekin MA, Yiğman S, et al. Multidetector CT findings in gastrointestinal tract perforation that can help prediction of perforation site accurately. *Clinical Radiology*. Volume 74, Issue 9, 2019, Pages 736.e1-736.e7, <https://doi.org/10.1016/j.crad.2019.06.005>.
- Kaur S, Dinesh Bagaria, Kumar A, Pratyusha Priyadarshini, Choudhary N, Sagar S, et al. Contrast-enhanced computed tomography abdomen versus diagnostic laparoscopy-based management in patients with penetrating abdominal trauma: a randomised controlled trial. *European Journal of Trauma and Emergency Surgery*. 2022 Aug 18;49(1):1-10. doi: 10.1007/s00068-022-02089-5
- Proctor DW, Goodall R, Borsky K, Saliccioli JD, Marshall DC, Mohamed A, et al. Trends in the mortality, incidence, and disability-adjusted life-years of intestinal obstruction and paralytic ileus: observational study of the Global Burden of Disease database, *BJS*, Volume 110, Issue 12, December 2023, Pages 1650-1654, <https://doi.org/10.1093/bjs/znad232>
- Afzal S, Ahmad F, Farooq F. Role of Multi-Detector Computed Tomography in the Diagnosis of Intestinal Obstruction. *Cureus*. 2023 Jan 13;15(1):e33730. doi: 10.7759/cureus.33730.

