e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 13(6); 346-351

Original Research Article

The Diagnostic Use of Multidetector Computed Tomography for Intestinal Obstruction

Deepak Agrawal[1], Nidhi Agrawal[2]

[1]Assistant Professor, Department of Radio-Diagnosis, Krishna Mohan Medical College and Hospital, Mathura

[2]Assistant Professor, Department of Radio-Diagnosis, Krishna Mohan Medical College and Hospital, Mathura

Received: 01-04-2023 / Revised: 18-05-2023 / Accepted: 22-06-2023

Corresponding Author: Dr. Nidhi Agrawal

Conflict of interest: Nil

Abstract

Background: CT is becoming a standard tool for intestinal blockage diagnosis. An accurate CT evaluation is currently the gold standard and the usual course of action for patients with suspected bowel obstruction, as the proportion of patients requiring surgery has decreased and the management of blockage has altered considerably. In general surgery units, intestinal blockage is a frequent surgical emergency that significantly increases patient morbidity and medical expenses. When diagnosing intestinal blockage, computed tomography (CT) has proven to be a crucial diagnostic tool that aids in the decision to proceed with early surgery. The CT provides details on the obstruction's location, etiology, and any consequences, including intestinal ischemia and closed-loop obstruction.

Aim: The aim of this study was to discuss the usefulness of MDCT in the evaluation of intestinal obstruction, the underlying causes, and the related conditions.

Material and Method: At the Department of Radiology, a prospective cohort research was carried out. In this investigation, twenty patients were involved. Before any patient was enrolled in the trial, their informed written consent was obtained. Patients with one or more of the following symptoms—constipation, acute abdomen, nausea, vomiting, and difficulty passing stool—were referred for MDCT examination. Patients who have been diagnosed with intestinal obstruction through preliminary investigations using abdominal radiography or ultrasonography and who are at least 18 years old and have a clinical suspicion of intestinal obstruction are referred for Contrast Enhanced Computed Tomography (CECT) from the emergency room or outpatient department (OPD). Of these patients, 15 were male and 5 were female.

Results: The dilated bowel loops in the referred patients were: 11/20 patients with small bowel dilatation (55%), 8/20 patients with large bowel dilatation (40%), and 1/20 patients with small and large bowel dilatation (5%). A high incidence of intestinal obstruction is noted in the age group above 50 years.

According to our research, blocked hernias and adhesive intestinal obstruction are the primary causes of SBO. According to our study, the primary causes of large bowel obstruction are intussusception and cancer sigmoid. The frequency of intussusception was highest in the age group over 18, the prevalence of sticky was highest in the age group between 18 and 50, and the prevalence of cancer sigmoid and obstructed hernias was highest in the age group over 50. These findings were obtained by correlating the patient age group with the cause of obstruction.

Conclusion: When it comes to determining the level and source of obstruction, MDCT is incredibly accurate. When diagnosing intestinal blockage, the MDCT has good diagnostic accuracy. As with other similar research, the results of this investigation demonstrated that CT is the preferred method for diagnosing intestinal blockage, identifying its cause, identifying the transition point, and predicting bowel ischemia. As a result, radiologists can help surgeons plan ahead for pre-operative care and management of patients who come with intestinal obstruction. When it comes to the diagnosis of different small intestinal disorders, MDCT is crucial. The MDCT evaluates both obstructive and non-obstructive lesions well.

Keywords: Intestinal Obstruction, Large Bowel, Multidetector Computed Tomography, Small Bowel, Acute Abdominal Pain, Inflammatory Bowel Disease.

Introduction

A new age in radiography began with the introduction of CT in the 1970s, with applications first to the head and then to the chest and abdomen. Studies on the abdomen were initially limited to the retro-peritoneum and solid organs, ultimately moving into the peritoneal cavity. Due to poor definition and sluggish data capture, bowel detail itself was not mentioned. [1] Enteroclysis and small-gut follow-through have numerous limitations since they only offer oblique insights into the bowel wall and its surrounding structures, as well as the issues brought on by overlapping bowel loops. [2] A frequent clinical disorder known as intestinal obstruction results from either mechanical or functional blockage of the gut, which stops the contents from passing through normally. It accounts for 15–20% of surgical admissions for acute abdominal pain and is a common reason for hospitalization. [3]

Using computed tomography (CT) to diagnose intestinal blockage has become standard practice. This is due to a significant shift in the management of blockage brought about by a decline in the number of patients requiring surgery. [4] In general surgery units, intestinal blockage is a frequent cause of surgical emergencies that results in significant patient morbidity and healthcare costs. The anatomical site of intestinal blockage has not changed in the past ten years, but dietary and lifestyle changes have resulted in major changes to the etiological causes. The most common causes of intestinal blockage are peritoneal adhesions, which are followed by malignancy and abdominal wall hernias. [5,6] The most typical symptoms include constipation, vomiting, abdominal distension, and abdominal pain. When treating intestinal blockage, clinical presentation, laboratory results, and radiographic examinations should all be taken into account. [7]

Because plain abdominal radiography is more easily accessible, less expensive, and available in peripheral setups, it continues to be the major imaging modality used to evaluate patients with intestinal obstruction. Its poor specificity of 57% to 67% and sensitivity of 46% to 69% are its drawbacks. [8] In the assessment of intestinal blockage, computed tomography (CT) has become a useful diagnostic technique. It has been shown to have a greater sensitivity of 93%, specificity of up to 100%, and accuracy of 94% in identifying intestinal obstruction. In addition to confirming the diagnosis, CT provides adequate information on serious disorders such as pneumatosis intestinalis and closed-loop obstruction, which necessitate prompt surgical intervention. The "small bowel feces sign," mesenteric edema, intraperitoneal free fluid, and hypo-enhancing gut walls are the key CT findings that indicate the need for urgent surgical intervention. [9]

A significant advancement in CT technology was multidetector computed tomography (MDCT), also known as multi-slice, multi-detector row, and multi-section CT. It has changed CT from a trans axial cross-sectional method to a real three-dimensional (3D) imaging modality that enables superb three-dimensional (3D) data volume displays together with variable cut planes. With the significant performance boost that MDCT scanners offer, it is possible to significantly extend scan length, decrease section collimation, and save scan time. [10] Multi-Detector Computed Tomography (MDCT) in the diagnosis of intestinal obstruction, most of which concentrated on the western population [9,11] and Northern parts of India. [12,13] Most of the previous studies [12,14] have compared the diagnostic accuracy of CT with other imaging modalities like X-ray and ultrasound. The diagnostic accuracy of CT against laparotomy, the gold standard, has only been compared in a small number of investigations. The main objective of the current study was to assess the diagnostic accuracy of CT in identifying intestinal obstruction's presence, degree, and cause.

Material and Methods

A prospective cohort study was done at the Department of Radiology. Twenty patients were included in this study. Informed written consent was obtained from every patient before his or her enrollment in the trial. Patients were referred for MDCT assessment complaining of one or more of the following symptoms: inability to pass stools, constipation, acute abdomen, vomiting, and nausea. Patients ≥18 years of age with clinical suspicion of intestinal obstruction who are referred from the emergency or Outpatient Department (OPD) for Contrast Enhanced Computed Tomography (CECT) and those diagnosed of having intestinal obstruction by preliminary investigations either by ultrasonography or abdominal radiography and 15 patients were men and five were women. Scanning protocol includes anatomical coverage 350–500 mm, scan direction craniocaudal, and acquisition time of 5-6 sec. Factors used were mA 200- 300 mA and kVp 120; rotation time 0.55 sec and pitch 1.014.

Inclusion Criteria: Patients ≥18 years of age with clinical suspicion of intestinal obstruction who are referred from the emergency or Outpatient Department (OPD) for Contrast Enhanced Computed Tomography (CECT) and those diagnosed of having intestinal obstruction by preliminary investigations either by ultrasonography or abdominal radiography were included in the study.

Exclusion Criteria: Patient aged <18 years, who are haemo-dynamically unstable, those with deranged renal function tests, allergic to contrast

media, pregnant females, patients with ileus, those managed conservatively and patients refusing consent was excluded from the study.

Multidetector Computed Tomography Examination

- Patients were examined in this study by using a 16-channel multi-slice CT scanner (Alexion; Toshiba Medical Systems Corporation)
- Prior to the examination, the patients had been fasting for at least 6 h
- A large bore (18 G) intravenous line was placed in the antecubital fossa
- Water or diluted oral contrast agent was given to 16 patients. This was given orally within 120 min in a continuous regular manner (150 ml every 20 min), the remaining 100 ml is given on the table. The amount of fluid intake differed according to the patient's tolerance. The amount offered to each patient is 1000 ml (7.5 ml of oral contrast medium +992.5 ml of water)
- A diluted positive contrast rectal enema was done for 15 patients just prior to the examination. The amount of enema infusion differs according to the patient's tolerance and patient's age
- IV contrast medium (about 50 ml) of nonionic contrast medium iopromide (Ultravist 300; Schering AG) according to the body built (1.5 ml/kg body weight) was given by an automatic injector at a rate of 3 ml/s
- All imaging was performed with slice collimation 2.5 mm, pitch 1–1.5, matrix 512 × 512, 200–350 mA, and 120–140 kV
- The studies were read on the Vitrea workstation (version 5.2.487.4267) of the CT machine and interpreted in conjunction with help from referring physicians
- All data were collected and statistically analyzed to present the results

Assessment: The images were read by an experienced radiologist. The presence or absence of intestinal obstruction was confirmed on MDCT; if the obstruction was present, then the site of the transition zone, underlying cause for obstruction, and complications like bowel ischemia and perforation were further assessed. Radiological diagnosis was related to the intraoperative findings and histopathological diagnosis.

Statistical Analysis: Data were collected and entered into a computer using SPSS (the statistical package for social sciences) program for statistical analysis(version 20; SPSS Inc., Chicago, Illinois, USA) (2) Data from questionnaires were entered as numerical or categorical, as appropriate Quantitative data shown as mean, SD, and range (2) Qualitative data expressed as frequency and percent.

Result

This study included 20 patients, 5/20 women (20%) and 15/20 men (80%). The mean age was 36.85 years ranging from 18 to 50 years.

Table 1: Distribution of the patient age group according to the site of obstruction

Age group	Small bowel n (%)	Large bowel n (%)	Small and large n (%)
Between 18-50 years	4 (18)	2 (25)	0 (0)
Above 50 years	7 (64)	3 (37.5)	1 (100)
Total	11 (100)	8 (100)	1 (100)

The referred patient age groups included in our study were: 5/20 patients, between 18 and 50 years (25%) and 15/20 patients above 50 years (75%). The dilated bowel loops in the referred patients were: 11/20 patients with small bowel dilatation (55%), 8/20 patients with large bowel dilatation (40%), and 1/20 patients with small and large bowel dilatation (5%). A high incidence of intestinal obstruction is noted in the age group above 50 years.

Table 2: Distribution of causes of obstruction according to the affected bowel loops.

Final Diagnosis	Radiological diagnosis [*n* (%)]			
	Intrinsic	Extrinsic	Intraluminal	Ileus
Between 18 and 50 years	3 (37.5)	4 (44.4)	2 (100)	0 (0)
Above 50 years	5 (62.5)	5 (55.6)	0 (0)	1 (100)
Total	8 (100)	9 (100)	2 (100)	1 (100)

Extrinsic causes were dominant in patients with SBO, while intrinsic causes were dominant in patients with LBO.

Table 3: Frequency distribution of causes of the small bowel and large bowel dilatation.

Dilated small bowel loops	n (%)	Dilated large bowel loops	n (%)
Adhesive	3 (27)	Cancer sigmoid	3 (32.5)
Obstructed hernia	4 (37)	Intussusception	3 (32.5)
Cancer cecum	1 (9)	Hirschsprung's disease	1 (12.5)

Midgut malrotation	2 (18)	Transverse colon volvulus	1 (12.5)
Ileal atresia	1 (9)	Total	8 (100)
Total	11 (100)		

Adhesive intestinal obstruction and obstructed hernias are the main causes of SBO in our study. Cancer sigmoid and Intussusception are the main cause of large bowel obstruction in our study. Correlating patient age group to the cause of obstruction showed a prevalence of intussusception in the age group above 18 years, a prevalence of adhesive in the age group between 18 and 50 years, and a prevalence of cancer sigmoid and obstructed hernias in the age group above 50 years.

Table 4: Correlation between radiological and final diagnosis

Final Diagnosis	**Radiological diagnosis [n (%)]**			
	Intrinsic	**Extrinsic**	**Intraluminal**	**Ileus**
Intrinsic	7 (100)	0 (0)	0 (0)	0 (0)
Extrinsic	0 (0)	8 (100)	0 (0)	0 (0)
Intraluminal	0 (0)	0 (0)	3 (100)	0 (0)
Ileus	0 (0)	0 (0)	0 (0)	2 (100)
Total	7 (100)	8(100)	3 (100)	2(100)

Those results were compared with the final clinical surgical diagnosis with 100% accuracy, sensitivity, and specificity.

Discussion

We looked at 20 patients in our study—15 men and 5 women. This demonstrated that intestinal blockage is more prevalent in men. We think that men are more likely than women to develop gastrointestinal cancers and hernias. In order to confirm the diagnosis, determine the cause of obstruction, and identify and anticipate complications like bowel ischemia, bowel wall necrosis, perforation, and secondary peritonitis, patients who present with acute symptoms such as abdominal pain, vomiting, abdominal distension, and constipation suggestive of intestinal obstruction benefit greatly from MDCT imaging. [11]

In the observations by Rosai et al 2004 [15] 50% of the small bowel, adenocarcinoma was found in the duodenum, especially near the ampulla. Julie et al 1998 [16] observed the manifestation of an annular narrowing with irregular overhanging edges or an ulcerative lesion in the cases of duodenal adenocarcinoma. Maglinte et al 1994 [17] proposed that on the administration of intravenous contrast, the tumor shows heterogenous enhancement. Patrice et al.2011 [4] found that SBO accounts for about 65–75% of obstructions and LBO accounts for 25–35%. Khurana et al.2002 [18] reported that the causes of mechanical SBO include: adhesions (most common, 75% of all causes), hernias, tumors, small bowel volvulus, inflammatory bowel disease, gallstone ileus, and mesenteric infarction ischemia.

Biondo et al.2004 [19] found that colorectal cancer accounted for 82% of obstructions. The second most common causes were extracolonic cancer and volvulus, each representing in the same study, about 5% of causes. Rarer causes included diverticular disease, hernias, ischemic colitis, inflammatory mass, colonic tuberculosis, and colonic invagination. Horton et al.2000 [20] are as follows: in patients with colorectal cancer, CT typically demonstrates a discrete soft-tissue mass that narrows the colonic lumen. Furthermore, a notable proportion of colorectal malignancies present with localized thickening of the colonic wall and luminal constriction; this appearance highlights the significance of appropriate colonic opacification and distention. Specifically, sigmoid and rectal tumors might present as asymmetric nodular wall thickening that causes the lumen to shrink. Rufener et al.2008 [21] defined intussusception as the invagination of a bowel loop with its mesenteric fold into the lumen of a contiguous portion of the bowel. It may be connected to proximal bowel obstruction and manifests as an aberrant target-like mass with a cross-sectional diameter larger than that of normal colon.

Garcia et al. 2003 [22] studied the use of the rectosigmoid index to diagnose Hirschsprung's disease and found that the use of the rectosigmoid index (widest diameter of the rectum divided by the widest diameter of the sigmoid colon. Submucosal hemorrhage, which is also a sign of bowel ischemia is seen as increased attenuation of the bowel wall on non-contrast scans. Atri M et al.2014 [23] reported that unenhanced CT had accuracy similar to an enhanced CT for the diagnosis of mechanical small bowel obstruction. A retrospective investigation found that hyperattenuating the intestinal walls on unenhanced images had a 56% sensitivity and 100% specificity for ischemia.

In the investigation, a single case of the uncommon kind of large bowel volvulus (LBV) was identified and surgical exploration verified the diagnosis. This is an instance of volvulus transverse colon.

The swirl indication of the blood arteries supplying the twisted intestinal loop held the key to solving the case. The coronal reformat was crucial and provided us with a wealth of information about transverse colon volvulus. The reported incidence of the various forms of LBV in the urban Australian population, in a study performed by Lau et al.2006 [24], is 59% for sigmoid volvulus (SV), 39% for cecal volvulus, and 2% for transverse colon volvulus. There were just 20 patients in the tiny sample size of this investigation. The study was not able to include patients with suspected gastrointestinal disease or patients with abnormal renal functioning. The study excluded pregnant females who had a suspected infection or inflammatory bowel disease. Due to radiation concerns, the trial was primarily limited to adult participants.

Conclusion

Our findings demonstrated 100% accuracy in both sensitivity and specificity. With confidence, our study has determined the function of MSCT in identifying and modifying therapy regimens for a variety of bowel obstruction causes. When it comes to the diagnosis of different small intestinal disorders, MDCT is crucial. The MDCT evaluates both obstructive and non-obstructive lesions well. When it comes to determining the level and source of obstruction, MDCT is incredibly accurate. When diagnosing intestinal blockage, the MDCT has good diagnostic accuracy. As with other similar research, the results of this investigation demonstrated that CT is the preferred method for diagnosing intestinal blockage, identifying its cause, identifying the transition point, and predicting bowel ischemia. As a result, radiologists can help surgeons plan ahead for pre-operative care and management of patients who come with intestinal obstruction.

References

1. Freeman A H. CT and bowel diseases. BJR. 2001;74:4-14.
2. Hong S, Kim A, Byun J, Won H, Kim P, Lee M, et al. MDCT of small-bowel disease value of 3D imaging; AJR. 2006;187:1212-21.
3. Quintero JC, Pardo P, Abu-Suboh Abadia A. Intestinal obstruction. Management, CT evaluation, and what to look for. ECR 2012.
4. Patrice T, Denis H, Jean-Michel B. Bowel obstruction in CT of the acute abdomen. Taourel P, editor. Medical radiology. Berlin Heidelberg: Diagnostic Imaging, Springer Verlag; 2011. 273–308
5. Vercruysse G, Busch R, Dimcheff D, Al-Hawary M, Saad R, Seagull FJ, et al. Evaluation and management of mechanical small bowel obstruction in adults. Ann Arbor (MI): Michigan Medicine University of Michigan; 2021: 8.
6. Pujahari AK. Decision making in bowel obstruction: A Review. J Clin Diagn Res. 2016;10(11): PE07-PE12.
7. Souvik A, Hossein MZ, Amitabha D, Nilanjan M, Udipta R. Aetiology and outcome of acute intestinal obstruction: A review of 367 patients in eastern India. Saudi J Gastroenterol. 2010; 16(4):285-87.
8. Jang TB, Schindler D, Kaji AH. Bedside ultrasonography for the detection of small bowel obstruction in the emergency department. Emergency Medicine Journal: EMJ. 2011;28 (8):676-78.
9. Maglinte DD, Reyes BL, Harmon BH, Kelvin FM, Turner WW Jr, Hage JE, et al. Reliability and role of plain film radiography and CT in the diagnosis of small bowel obstruction. AJR Am J Roentgenol. 1996;167(6):1451-5.
10. Prokop Mathias. General principles of MDCT. Eur J Radiol. 2003; 45:4–10.
11. O'Malley RG, Al-Hawary MM, Kaza RK, Wasnik AP, Platt JF, Francis IR. MDCT findings in small bowel obstruction: Implications of the cause and presence of complications on treatment decisions. Abdom Imaging. 2015;40 (7):2248-62.
12. Mohi JK, Kajal S, Singh T, Singh J, Kaur N. Role of imaging in the evaluation of intestinal obstruction. Int J Med Res Rev. 2017;5 (6): 593-603.
13. Sekhon G, Vohra A, Singh K, Mittal A, Singal S, Singal R. Role of multidetector computed tomography in the evaluation of intestinal obstruction. Int J Sci Stud. 2016;4(8):109-14.
14. Suri S, Gupta S, Sudhakar PJ, Venkataramu NK, Sood B, Wig JD. Comparative evaluation of plain films, ultrasound, and CT in the diagnosis of intestinal obstruction. Acta Radiol. 1999;40(4):422-28.
15. Ackerman RJ. Gastrointestinal tract. In Surgical pathology. St Louis Mosby; 2004; 9: 615-87 0.
16. Buckley JA, Fishman EK. CT evaluation of small bowel neoplasm: Spectrum of disease. Radiographics 1998;18:379 - 392.
17. Maglinte DDT, Malignant tumors. In: Gore RM, Levine MS, Laufer I. eds. Textbook of Gastrointestinal Radiology Vol 1, Philadelphia Pa, Saunders,1994; 900 -930.
18. Khurana B, Ledbetter S, McTavish J, Wiesner W, Ros PR. Bowel obstruction was revealed by multidetector CT. Am J Roentgenol 2002; 178:1139–1144.
19. Biondo S, Parés D, Frago R, Martí-Ragué J, Kreisler E, De Oca J, et al. Large bowel obstruction: predictive factors for postoperative mortality. Dis Colon Rectum. 2004; 47:1889–1897.

20. Horton KM, Abrams RA, Fishman EK. Spiral CT of colon cancer: imaging features and role in management. Radiographics. 2000;20:419–4 30.
21. Rufener SL, Koujok K, McKenna BJ, Walsh M. Small bowel intussusception secondary to Peutz-Jeghers Polyp. Radiographics. 2008; 28: 284–288.
22. Garcia R, Arcement C, Hormaza L, Haymon ML, Velazco C, Brown R, et al. Use of the rectosigmoid index to diagnose Hirschsprung's disease. Clin Pediatr (Phila). 2007; 46:59–63.
23. Geffroy Y, Boulay-Coletta I, Julles MC, Nakache S, Taourel P, Zins M. Increased unenhanced bowel wall attenuation at multidetector CT is highly specific of ischemia complicating small-bowel obstruction. Radiology. 2014;270(1):159- 67.
24. Lau KC, Miller BJ, Schache DJ, Cohen JR. A study of large-bowel volvulus in urban Australia. Can J Surg. 2006; 49:203–207.