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Original Article

Role of Multidetector Computed Tomography in the Evaluation of Intestinal Obstruction

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Abstract

Background: Intestinal obstruction is responsible for approximately 20% of surgical admissions for acute abdominal conditions. Multidetector computed tomography (MDCT) plays an important role in revealing the site, level, and cause of obstruction and demonstrating threatening signs of bowel inviability.

Materials and Methods: This was a prospective study conducted on 40 patients with suspected intestinal obstruction, in the Department of Radiodiagnosis at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala) in collaboration with the Department of Surgery. Computed tomography (CT) scan was done in all the patients suspected of intestinal obstruction with ingenuity CT (64 MDCT, Philips Medical Systems). The study was done with oral contrast (wherever required) and intravenous contrast agents.

Results: Out of 40 patients, 27 were males and 13 were females. The most frequently encountered symptom was pain abdomen. The majority of the patients showed markedly dilated gut loops. The level of obstruction was diagnosed in large bowel in 2 patients. Terminal ileum was the most common site of obstruction followed by proximal ileum, jejunum, I-C junction, and rectosigmoid. Adhesion was the most common cause of obstruction followed by abdominal tuberculosis, malignancy, intussusceptions, malrotation, ischemia, and intra-abdominal collections. The final diagnosis was confirmed by laparotomy or histopathological examination.

Conclusion: MDCT by using its multiplanar and three-dimensional capabilities is highly accurate and specific in detecting the presence of intestinal obstruction. It can demonstrate the exact site of obstruction in a high percent of cases. It is highly sensitive and specific in diagnosing the cause of obstruction. In addition to primary gut pathology, MDCT can detect various associated and incidental findings which are not suspected clinically.

Key words: Abdomen, Computed tomography, Intestine, Obstruction

INTRODUCTION

Intestinal obstruction is responsible for approximately 20% of surgical admissions for acute abdominal conditions. The small bowel is involved in 60-80% of cases of intestinal obstruction. In spite of advances in imaging and a better understanding of the pathophysiology of the small bowel, its obstruction is still frequently misdiagnosed.[1] Computed tomography is being increasingly used for the evaluation of patients with vague abdominal symptoms and may provide the initial opportunity to detect and characterize tumors of small bowel. Multidetector-row computed tomography (MDCT) provides high-resolution imaging and help in precise localization and characterization of lesions.[2] The purpose of this study was to assess the efficacy of MDCT for the diagnosis of nonocclusive mesenteric ischemia (NOMI) by analyzing multi-planar reconstructed (MPR) images of all NOMI cases which showed irregular narrowing of the superior mesenteric artery (SMA), spasm of the arcades of SMA, and poor demonstration of intramural vessels. MPR images of two patients who had angiography were concordant with their angiograms.

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The mean diameter of SMA of NOMI patients was 3.4 ± 1.1 mm, which was statistically smaller than that of 13 control patients, 6.0 ± 1.5 mm ($P < 0.05$).[3] In patients with nonstrangulating small bowel obstruction (SBO), the presence of a transition point on CT scan should alert the surgeon to the increased likelihood that operative management may be required. Transition point was the only significant factor predictive of operative management for SBO on multivariable logistic regression analysis (OR: 19, 95% confidence interval 1.8-201, $P = 0.014$).[4]

MATERIALS AND METHODS

This prospective study was conducted in the Department of Radiodiagnosis and Imaging at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala) in collaboration with the department of Surgery. The study was conducted on 40 patients with the evidence of intestinal obstruction. A total of 40 patients were selected on the basis of CT findings suggestive of intestinal obstruction were included in the study. Patients with pregnant female, allergic to contrast media to be injected, in which emergency laparotomy was indicated, were excluded. Informed consent was obtained from the patients or from the nearest kin of the patients included in this study. A complete history of patient's present/past illness was taken, and detailed clinical examination was performed in all the cases and findings were recorded in the pro forma attached. Routine laboratory investigations such as Hb, TLC, and DLC were carried out in all patients. X-ray chest (PA view) and X-ray abdomen supine and erect (AP view) were also done, and findings were duly recorded on the attached pro forma.

Ultrasound examination was done on all the patients on HD-6 (Phillips Medical Systems) USG machine, and detailed findings were recorded in the proforma attached. Technique of CT scan: CT scan was done in all the patients suspected of intestinal obstruction with Ingenuity CT (64 MDCT, Philips Medical Systems). The study was done with oral contrast (wherever required) and IV contrast agents. From the topogram, the long spiral was made by choosing the area of examination from domes of diaphragm to the pelvis. Scanning was done by using a pitch of 0.797, collimation of 64 × 0.625 reconstructed slice thickness of 5 mm, and increment of 5 mm. Factors selected were 120 kV and 300 mAS. Contrast enhanced CT scan of abdomen was obtained after intravenous (IV) administration of 80 ml of non-ionic contrast (iohexol) containing 300 mg/ml of iodine as a single bolus and CT was done in a single breath hold or in quite respiration if patient could not hold his/her breath. The axial sections were obtained with MPR and were studied in detail. Oral contrast (iohexol/water) was given wherever required. CT findings were recorded as per the pro foma for the degree, level, cause, and complication of obstruction. The CT findings were correlated with surgical/clinical follow-up.

OBSERVATIONS AND RESULTS

The maximum number of patients presenting with intestinal obstruction were in the age group of <20 years, i.e., 8 patients (20%). The youngest patient in the present series was 4 years old, whereas the oldest patient was 75 years old. On X-ray abdomen (Erect), air-fluid levels were seen in 25 (62.50%) patients. Whereas no air-fluid levels were seen in 11 patients (27.50%). X-ray abdomen was not done in 4 patients (10%). In this study on 40 patients with intestinal obstruction, the provisional cause of intestinal obstruction was determined on ultrasonography (USG) in 12 (30%) patients. Provisional cause of obstruction could not be determined in 27 (67.50%) patients. USG was not done in one patient (2.50%) (Table 1). MDCT was done in all 40 patients with intestinal obstruction. Out of the 40 patients, the majority of the patients, i.e., 31 (77.50%) showed markedly dilated gut loops. Moderately dilated gut loops were seen in 8 patients (20%). Mild dilatation of gut loops was seen in one patient (2.50%) (Table 2 and Figure 1).

In this study on intestinal obstruction, the level of obstruction was diagnosed in the small bowel in 38 (95%)

Table 1: Site of obstruction determined on USG

Site of obstruction on USG	Number of patients (%)
Determined	8 (20)
Indeterminate	31 (77.50)
USG not done	1 (2.50)

USG: Ultrasonography

Table 2: MDCT based grading of bowel dilatation in patients with intestinal obstruction

Findings	Number of patients (%)
Markedly dilated gut loops (>3.5 cm)	31 (77.50)
Moderately dilated gut loops (3-3.5 cm)	8 (20)
Mildly dilated gut loops (2.5-3.0)	1 (2.50)

MDCT: Multidetector computed tomography

Table 3: Diagnosis of level of obstruction by MDCT

Level of obstruction	Number of patients (%)
Small bowel	38 (95)
Large bowel	2 (5)
Total	40 (100)

MDCT: Multidetector computed tomography

patients. The level of obstruction was diagnosed in large bowel in 2 (5%) patients (Table 3). Ileum was the most common site of obstruction in this study. Out of the total 40 patients, 15 (37.50%) had distal ileal obstruction. Proximal ileal obstruction was seen in 12 (30%) patients. Jejunal obstruction was seen in 6 (15%) patients and ileo-cecal obstruction was also seen in 4 (10%) patients. Rectosigmoid was the site of obstruction in 2 (5%) patients. No definite site of obstruction was seen in one patient who had ischemic dilatation of small gut (Table 4). On MDCT, out of total 40 patients, adhesion was found

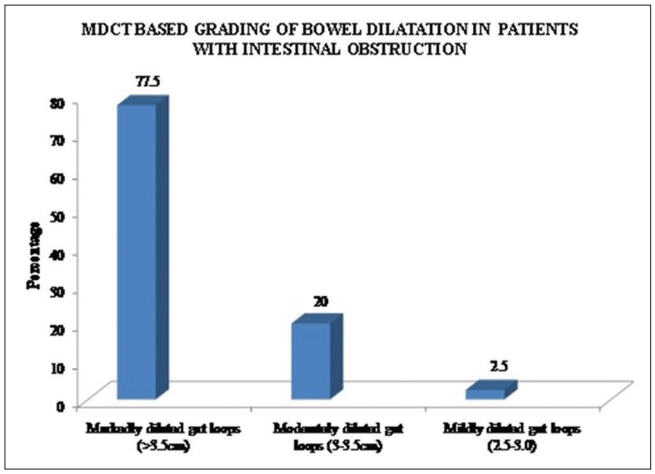

Figure 1: Axial and coronal contrast-enhanced computed tomography images show pulled up caecum with circumferential asymmetrical wall thickening of caecum and ileo-cecal junction causing narrowing and irregularity of the lumen (black arrow). There is marked dilatation of the proximal ileal loops with small bowel feces sign (white arrow). Small amount of ascites is seen (black arrow head). Left adnexal cyst is also seen (arrow head)

to be the cause of obstruction in 13 (32.50%) patients (Figure 2). Abdominal tuberculosis was the cause in 9 (22.50%) patients. Intussusception was the reason of obstruction in 4 (10.00%) patients. Malignancy was the cause of obstruction in 6 (15%) patients. Malrotation and ischemia were the cause of obstruction in 3 (7.50%) patients each. Intraabdominal collections were the cause in 2 (5.00%) patients (Table 5). Loculated fluid collections were seen in 4 patients (10%). No evidence of any loculated collection was seen in 36 (90%) patients. The small bowel feces sign (SBFS) was seen in 12 patients (30%). SBFS was not seen in 28 patients (70%) (Figure 3). Abdominal lymphadenopathy was seen in 14 patients (35%) presenting with intestinal obstruction. No significant abdominal lymphadenopathy was seen in 26 patients (65%). Pneumatosis intestinalis was seen in 3 (7.5%) patients who presented with intestinal obstruction. Rest of the 37 (92.5%) patients did not have pneumatosis intestinalis. Gangrenous gut was seen in 5 (12.50%) patients. No evidence of gut gangrene was seen in 35 (87.50%) patients. Other findings seen in patients with intestinal obstruction include liver SOLs which were seen in 4 patients (10%). Pleural effusion was also seen in 4 patients (10%). Three patients had cholelithiasis, i.e., (7.5%). 2 patients had hepatosplenomegaly, lung nodules, and nephrolithiasis each, i.e., (5%). Liver parenchymal disease, pericardial effusion, and pneumobilia were seen in 1 patient each (2.50%), respectively.

This study depicted that 13 patients had intestinal obstruction due to adhesions (Figure 4). Out of 13 patients 9 patients underwent surgery. 4 patients were treated conservatively with NPO, IV fluids, antibiotics, and other

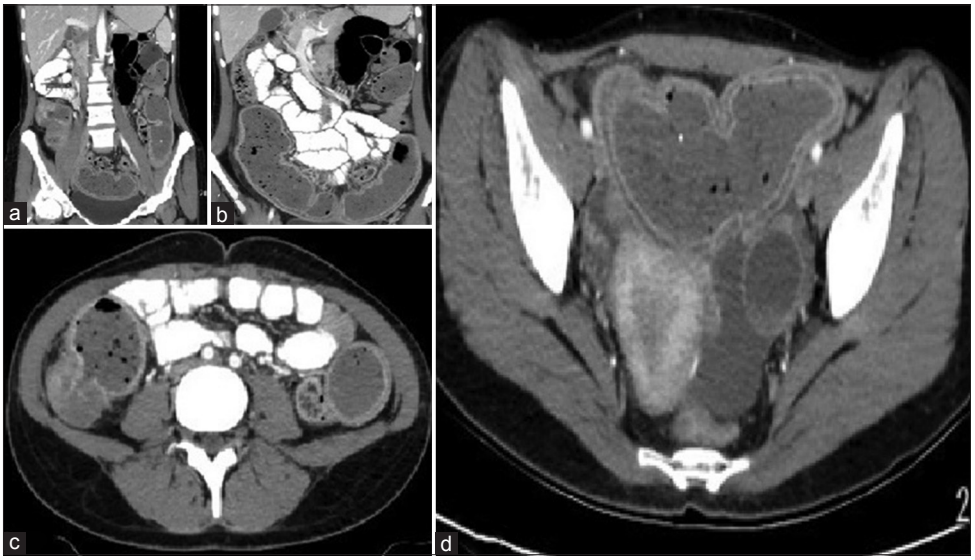

Figure 2: (a-d) Axial and coronal contrast-enhanced computed tomography abdomen images show circumferential mural thickening of terminal ileum causing narrowing of its lumen (white arrows) with marked dilatation of jejunal and ileal loops which show mottled air lucencies s/o small bowel feces sign (black arrows). Small amount of ascites is seen (black arrow head). Few enlarged lymph nodes are seen in mesentry (white arrow head)

Table 4: Diagnosis of site of obstruction by MDCT

Site of obstruction	Number of patients (%)
Jejunum	6 (15)
Proximal ileum	12 (30)
Distal ileum	15 (37.50)
Ileo-cecal junction	4 (10)
Rectosigmoid	2 (5)
Indeterminate	1 (2.50)

MDCT: Multidetector computed tomography

Table 5: Diagnosis of cause of obstruction by MDCT

Cause of obstruction	Number of patients (%)
Adhesions	13 (32.50)
Tubercular	9 (22.50)
Intussusception	4 (10.00)
Malrotation	3 (7.50)
Malignancy	6 (15)
Ischemia	3 (7.50)
Intra-abdominal collections	2 (5.00)

MDCT: Multidetector computed tomography

supportive measures. 2 patients in which adhesion was given as a cause of intestinal obstruction were found to have bands on surgical intervention. Nine patients were diagnosed with abdominal tuberculosis. 7 patients had raised erythrocyte sedimentation rate and symptoms such as weight loss, decreased appetite and two even had consolidation and nodular lesions on chest X-ray. 2 patients were also known case of pulmonary Koch's. 5 patients of these were operated and had tubercular stricture/ thickening. 4 patients were managed conservatively with NPO, IV fluids, antibiotics, and other supportive measures and started on antitubercular therapy (ATT). These patients had clinical improvement after commencement of ATT.

Three patients were diagnosed with malrotation leading to intestinal obstruction. These findings were confirmed on surgical intervention in two of them. However, one patient was managed conservatively. In this study, two patients were diagnosed with a malignant growth in the region of terminal ileum and cecum as a cause of intestinal obstruction. On surgical intervention and histopathological examination, it was confirmed as adenocarcinoma. Two patients in this study had diffuse asymmetrical thickening in the region of rectosigmoid causing gross dilatation of large gut loops. In both these cases, resection of the involved segment and colostomy was done followed by chemotherapy. Two patients in this study had lymph nodal mass diagnosed on MDCT. On fine needle aspiration cytology correlation, it was diagnosed as non-Hodgkin's lymphoma. These 2 patients were operated with resection of the lymph nodal mass and chemotherapy was given.

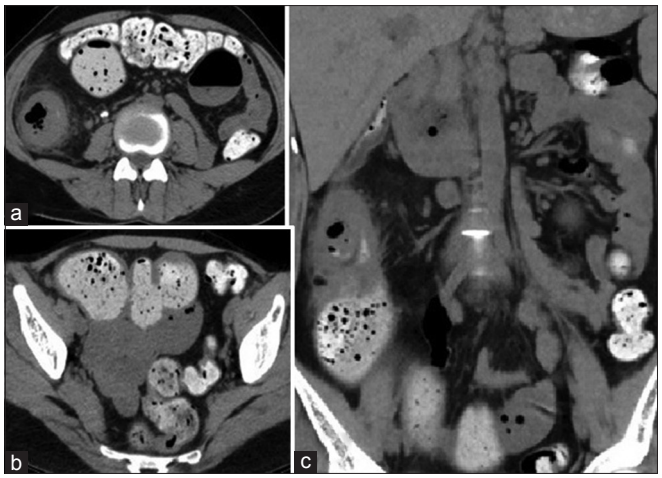

Figure 3: (a-c) Contrast-enhanced computed tomography abdomen axial, coronal and saggital images show markedly dilated, air and fluid filled jejunal and proximal ileal loops with adhesion of the gut loops to the anterior abdominal wall (white arrow). Loculated fluid collection is seen in the pelvis (black arrow). Drainage tube is seen *in situ*

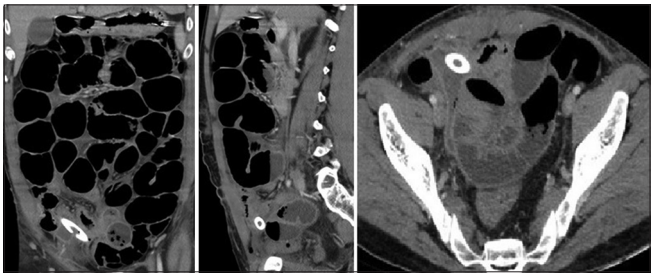

Figure 4: Contrast enhanced ct abdomen axial, sag images showing dilated small gut loops with positive fat notch sign due to adhesions

Three patients were diagnosed with intestinal ischemia. They had gut ischemia due to SMA thrombosis leading to gangrenous gut which was removed surgically in one patient. One of these patients died, and one was referred to higher center for further management. Two patients were found to have intra-abdominal collections. One patient had intra-abdominal collection after abdominal surgery. This patient was operated with drainage of collection and peritoneal lavage. The other patient had appendicular perforation with intra-abdominal collections. In this case appendicectomy with peritoneal lavage was done to relieve intestinal obstruction. Four patients were diagnosed with intussusception on MDCT. Two patients had ileo-ileal intussusception; one had ileo-cecal intussusception and one had jejunojejunal intussusception. Three patients were operated and findings were confirmed surgically. In two of the surgically managed patients, lymph nodes were seen as the lead point, and lipoma was seen as the lead point in one patient. One patient was managed conservatively in which lymph nodes were seen at the lead point and the symptoms resolved (Table 6).

Table 6: Comparison of cause of intestinal obstruction made on MDCT with final diagnosis

MDCT diagnosis	Number of patients	Management	Final diagnosis based on surgery/HPE/follow-up
Adhesions	13	Operated=9 Conservative=4	6 adhesions 2 band
Tubercular	9	Operated=5 Conservative=4	4 adhesions1 band Antitubercular treatment
Malrotation	3	Operated=2 Conservative=1	Malrotation present
Malignancy	6	Operated=6	HPE=Adenocarcinoma (4); Non-Hodgkin's lymphoma (2)
Ischemia	3	Operated=1 Conservative=1 Died=1	Gangrenous gut
Intra-abdominal collections	2	Operated=2	Collections drained
Intussusception	4	Operated=3 Conservative=1	Intussusception present Lymph nodes as lead point (2) Lipoma (1) Transient (due to lymph node as lead point)

MDCT: Multidetector computed tomography

DISCUSSION

This study was conducted in 40 patients with a clinical diagnosis of intestinal obstruction to confirm the diagnosis, evaluate the site, and cause of obstruction. The MDCT findings were correlated with the operative findings where patients were subjected to laparotomy, and the final diagnosis was made on the basis of operative findings or by follow-up of conservatively managed patients. SBO accounts for a considerable proportion of emergency room visits, inpatient admissions, and surgical interventions in the United States. MDCT plays a key role in imaging patients presenting with acute symptoms suggestive of SBO, which helps in establishing the diagnosis, elucidating the cause of obstruction, and detecting complications such as ischemia or frank bowel necrosis and perforation.[5]

Chang *et al.* conducted a study on 151 patients. The most common presenting complaint in their study was pain abdomen which was seen in 134 (89%) patients.[6] Saini *et al.* studied 40 patients with intestinal obstruction and found that air-fluid levels were seen in 57.50% patients.[7] In this study, air-fluid levels were seen in 25 (62.50%) patients. No evidence of air fluid levels was seen in 11 (27.50%) patients.

Malik *et al.* in their study on 229 patients with intestinal obstruction concluded that 194 patients (85%) had SBO and 35 patients (15%) had a large bowel obstruction. They found post-operative adhesions accounted for 41% ($n = 95$) of the total cases, followed by abdominal tuberculosis (25%, $n = 58$), obstructed/strangulated hernias of different types (18%, $n = 42$). The most common cause of intestinal obstruction was postoperative adhesions.[8] In this study, 38 patients (95%) were diagnosed with SBO and 2 patients (5%) had a large bowel obstruction. The most common cause of intestinal obstruction was adhesions (32.50%). The result of this study matched with studies done by Oladele *et al.*[9] in which most common cause of obstruction was adhesions comprising 44%, Malik *et al.*[8] 41%.

Chang *et al.* conducted a retrospective study on 151 patients with intestinal obstruction and evaluated the presence of SBFS in 61 (40.40%) patients.[4] They conducted a study on 151 patients with intestinal obstruction and found that pneumatosis intestinalis was present in 4 (2.64%) patients.[6] In this study on 40 patients with intestinal obstruction, pneumatosis intestinalis was seen in 2 (5%) patients. In this study, SBFS was seen in 12 patients (30%) patients and rest of the patients with intestinal obstruction did not show SBFS.

Nowadays, MDCT is the new imaging technique employed in blunt trauma patients of abdomen and pelvis. It easily detects the solid organ injuries with associated bowel or mesenteric injuries and decreases the morbidity and mortality. But challenges still continue in abdominal and pelvic CT images of trauma cases.[10] Adhikari *et al.* conducted a retrospective study on 367 patients with intestinal obstruction. 288 (78.50%) patients were operated and 79 (21.50%) patients were managed conservatively.[11] The results of this study showed that MDCT using three multiplanar and three-dimensional (3D) evaluations of these isotropic data sets had allowed improved depiction and characterization of bowel pathology. Confirmation of the presence, site and exact cause of obstruction can be better evaluated on MDCT which considerably alters the management of such patients.

CONCLUSION

MDCT by using its multiplanar and 3D capabilities is highly accurate and specific in detecting the presence of intestinal obstruction. It can demonstrate the exact site of obstruction in a high percent of cases. MDCT is highly

sensitive and specific in diagnosing cause of obstruction. In addition to primary gut pathology, MDCT can detect various associated and incidental findings which are not suspected clinically.

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