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Original Article

Radiology Section

Multidetector Computed Tomography (MDCT) in Gastrointestinal Obstruction: One Symptom Myriad Differentials

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ABSTRACT

Introduction: Computed Tomography (CT) is a highly sensitive modality with its multi-planar capabilities, used in evaluation of acute cases of intestinal obstruction. It delineates the level and helps to identify various etiologies of obstruction, where plain radiographs can only suggest signs of obstruction. It has an added advantage of detecting further complications, thus framing appropriate surgical approach.

Aim: Our study aims at delineating variable CT spectrum of intestinal obstruction with highlight on atypical presentation.

Materials and Methods: Retrospective hospital data based study was conducted in the Radiology Department of Shree Krishna Hospital, Anand, Gujarat, India, between 2014-2017 including 40 patients with mechanical causes of obstruction and excluding patients with non-mechanical causes of obstruction.

Statistical analysis was done using percentages and proportions using MedCalc software version 17.6.

Results: The age range of patients was from 5 days to 83 years and the maximum number of patients i.e., 7 (17.5%) were in the age group of 41-50 years. Radiographic signs related to obstruction like air fluid levels, dilated bowel loops was seen in 26 out of 40 cases (sensitivity 60%). Small bowel obstruction dominated the case list with obstructed hernia as major causative factor.

Conclusion: Study highlights the contribution of MDCT in early identification of underlying etiology and complications of obstruction with additional contribution in road mapping and framing appropriate and individualized treatment strategy for patients.

Keywords: Ladd's band, Obstructed hernia, Recurrent cervical carcinoma, Volvulus

INTRODUCTION

Abdomen is considered as the "magic box" with endless differential diagnoses for one clinical symptom. Intestinal obstruction is one of the main entities of concern. Manifestations of intestinal obstruction can range from abdominal discomfort and distention to the state of shock requiring an emergency exploration [1]. Bowel obstruction can be mechanical or pseudo-obstruction i.e., paralytic ileus. Mechanical causes of bowel obstruction are myriad and can be divided into mural lesions (like tumour, stricture due to infection, inflammatory bowel disease, congenital causes or irradiation), luminal (bezoar, gall stone, worms or intussusceptions) or due to extrinsic causes (adhesions, hernia, volvulus, abdominal malignancy) [2]. In developed countries, post-surgical adhesions top the list, however, in developing and under developed countries obstructed hernias, infectious disease and mass lesions dominate the cause list [3]. In patients with bowel obstruction, elevated white blood cell counts or serum amylase and lactic acid levels suggest a complication and should prompt investigation and may require surgery [4].

In earlier era, exploratory laparotomy was often performed to solve the mystery of obstruction, but advances in Radiology have led to wiser utilisation of surgical therapies.

Dilated gas filled bowel loops are easily identified on the supine radiograph. In significant number of patients with bowel obstruction, abdominal radiograph appears normal or only equivocally abnormal, since the dilated loops are mainly fluid-filled. In such cases, CT aids as a necessary diagnostic tool [2,5]. The plain abdominal radiograph has sensitivity of about 66% for bowel obstruction [5,6].

Barium studies have their limited role mainly in patients with chronic obstruction. Ultrasonography is only of added value in diagnosis of fluid filled bowel loops and demonstrates to and fro movement of bowel contents. However, its role in

identifying the exact cause is often limited [2].

Contrast-enhanced abdominal CT has emerged as the dominant imaging tool due to easy access, quick acquisition and larger field of view assessment for excluding other symptomatic differentials. Multidetector CT (MDCT) has a sensitivity and specificity of 95% in diagnosing high grade obstruction and is comparatively less accurate in partial obstruction [7,8]. As with radiography, the hallmark is dilated bowel loops (2.5 cm for ileum, 3 cm for jejunum, > 9 cm for caecum and > 6 cm in rest of colon) with decompressed distal bowel loops [2]. CT provides an excellent appraisal of the bowel wall, its vessels, and adjacent mesentery, which consequently helps in identification of coexistent ischemia and/or infarction [7-9]. It also helps assessing the presence of bowel perforation and the associated free extraluminal gas. In cases of neoplastic pathologies causing obstruction, it depicts the primary organ of origin, the extent of lesion and its relation with adjoining structure as well as helps identify the metastatic lesions to other viscera [2].

The current study aims to study the spectrum of CT imaging findings depicted in patients with gastrointestinal obstruction.

MATERIALS AND METHODS

This retrospective hospital data based study was conducted in the Radiology Department of Shree Krishna Hospital, Anand, Gujarat, India, between 2014-2017. Patients with clinical history of gastrointestinal obstruction (based on clinical history like abdominal pain, vomiting, non-passage of stools etc., and radiographic features) who underwent contrast enhanced CT-scan of abdomen and pelvis were tabulated. From all patients, 40 patients with mechanical causes of obstruction were included in study. Study included patients of both sex, irrespective of their religion, age or socioeconomic status. All patients with non-mechanical causes of obstruction, pseudo-obstruction and paralytic ileus were excluded from the study. Study was ethically approved by institutional ethical committee with study number IEC/ HMPCMCE/ 2017 / Ex. 31. The Registration Number of IEC is ECR/331/Inst/GJ/2013/RR-16.

Procedure

Study was performed with CT-scan machine (64 Slice Optima CT 660 (Wipro GE Healthcare Pvt. Ltd.). After being NPO for 6-8 hours, patients were given 750 ml of oral contrast (positive - trazograff / neutral - mannitol) 60-90 minutes before the study. After obtaining informed consent from patient, plain CT was followed by contrast scan by injecting 2 ml/kg body weight iodinated low osmolar non-ionic contrast media. Scanning was done from level of diaphragm to symphysis pubis. Scanning parameters were spiral aquisition with slice thickness of 6 mm and collimation 6 x 2.5 mm, pitch: 1.4; kVp: 130; mAs: 80. The axially acquired images were further reformatted in coronal and sagittal images with slice thickness of 1.25 mm and reconstruction increment of 1 mm.

Assessment

The imaging results were analyzed for bowel involvement (stomach, small bowel, large bowel or both), bowel peristalsis, site of transition zone and associated underlying cause for obstruction. Bowel diameter and associated signs for developing complications like gangrenous change, perforation were also seen. Bowel vasculature was also assessed for any occlusion. Radiological diagnosis was retrospectively analyzed and correlated with assembled surgical and pathological data.

STATISTICAL ANALYSIS

Collected data was presented in the form of tables and diagrams. Frequency and percentages were calculated wherever applicable. Calculations were made using MedCalc software version 17.6.

RESULTS

Age: The age range of patients was from 5 days to 83 years and the maximum number of patients i.e., 7 (17.5%) were in the age group of 41-50 years. Mean age in study group was 40.9 years. [Table/Fig-1] shows age distribution in all 40 patients.

Sex: There was a female predominance with 24 (60 %) females and 16 (40%) males.

Symptoms: Abdominal pain was most common symptom seen in 100 % of cases. Other symptoms seen was abdominal distention (92%), non-passage of stools (80%), vomiting (80%) etc.

Plain radiograph assessment: Radiograph is used as screening tool for obstruction. However, we could find signs related to obstruction like air fluid levels, dilated bowel loops in 26 out of 40 cases. Sensitivity measures around 65% and positive predictive value 0.65.

Age (in years)	Number of Patients	Percentage (%)
0-10	4	10
11-20	4	10
21-30	3	7.5
31-40	6	15
41-50	7	17.5
51-60	6	15
61-70	5	12.5
71-80	4	10
81-90	1	2.5

[Table/Fig-1]: Agewise distribution in 40 patients:

Site of involvement: Lesions were further classified on basis of site of involvement or transition zone as shown in [Table/Fig-2].

Gastric involvement: Out of two patients with gastric level obstruction, One of patient was diagnosed with gastric volvulus and other had trichobezoar.

Small bowel pathologies: Obstructed hernia and tubercular lesions dominated the etiological list among visualized causes. In most of cases of tubercular/vascular involvement, both small and large bowels were usually involved. Out of total 7 patients with obstructed hernia, 2 patients had peri-stomal herniation of bowel loops along ileostomy or colostomy sites, 1 patient had obstructed internal hernia with Ladd's bands, 3 patients had obstructed inguinal hernia and one patient had obstructed obturator hernia. Visualized spectra involving small bowel are tabulated in [Table/Fig-3].

Large Bowel Pathologies: Malignant mass lesions predominated among the list followed by tubercular involvement. Various etiologies for obstruction in large bowel are tabulated in [Table/Fig-4].

Finding on CT-Scan	Number of Patients	Percentage (%)
Stomach	2	5
Small Bowel	19	47.5
Large Bowel	14	35
Both Small and Large Bowel	5	12.5

[Table/Fig-2]: Distribution of patients depending on site of obstruction and bowel involvement.

Finding on CT-Scan	Number of Patients (24)	Percentage (%)
Diverticulum with Diverticulitis	2	8.33
Mass Lesion	4	16.67
Tubercular	5	20.83
Vascular (vein/arterial)	4	16.67
Volvulus	1	4.17
Obstructed Hernia	7	29.16
Congenital	1	4.17

[Table/Fig-3]: Spectrum of CT findings in small bowel.

Bowel Diameter: Bowel diameter for small intestine ranged from 3.0 to 4.3 cm. In cases of obstruction, large bowel diameter ranged from 6 cm to 8.5 cm.

Bowel wall ischemia changes were seen in 6 out of 40 patients. Our cases are shown in [Table/Fig 5-7].

DISCUSSION

Acute intestinal obstruction is a common surgical emergency globally with high morbidity and mortality, thus requiring early and accurate diagnosis. Although, the mortality due to acute intestinal obstruction is decreasing in urban areas due to early presentation and prompt medical attention, the same doesn't apply to rural population because of late presentation with complications due to reluctance for surgery, poverty and lack of knowledge [10]. Before the introduction of CT-scans, the preoperative diagnosis was delayed, being entirely dependent on clinical, laboratory and standard radiological tests like plain radiograph [11]. Introduction of CT-scan in radiological examinations has revolutionized the diagnosis of intestinal obstruction deciding between scalpel and non-scalpel patients [7]. Surgeons are keener for early diagnosis of bowel obstruction, to avoid development of associated complications of strangulation, bowel ischemia, necrosis and perforation, thus increasing patient morbidity and mortality [11]. CT correctly delineates bowel involvement whether large or small, etiology of obstruction, extent of involvement and other associated complications [7,8]. Angiographic acquisition of CT-scan imaging has led to earlier diagnosis of underlying vascular cause [7,8]. Bowel wall enhancement pattern and presence of air foci in wall and surroundings are common things to be seen in strangulation [8]. A comprehensive approach that includes clinical examination, proper patient history and triage examinations such as plain abdominal radiography and CT will help the clinician develop an individualized treatment plan and thus decreasing complications [5,12,13].

Finding on CT-Scan	Number of Patients (19)	Percentage (%)
Diverticulum with Diverticulitis	1	5.26
Mass Lesion	8	42.1
Tubercular	4	21.0
Vascular (vein/arterial)	2	10.5
Volvulus	1	5.26
Congenital	2	10.5
Post-operative Stricture	1	5.26

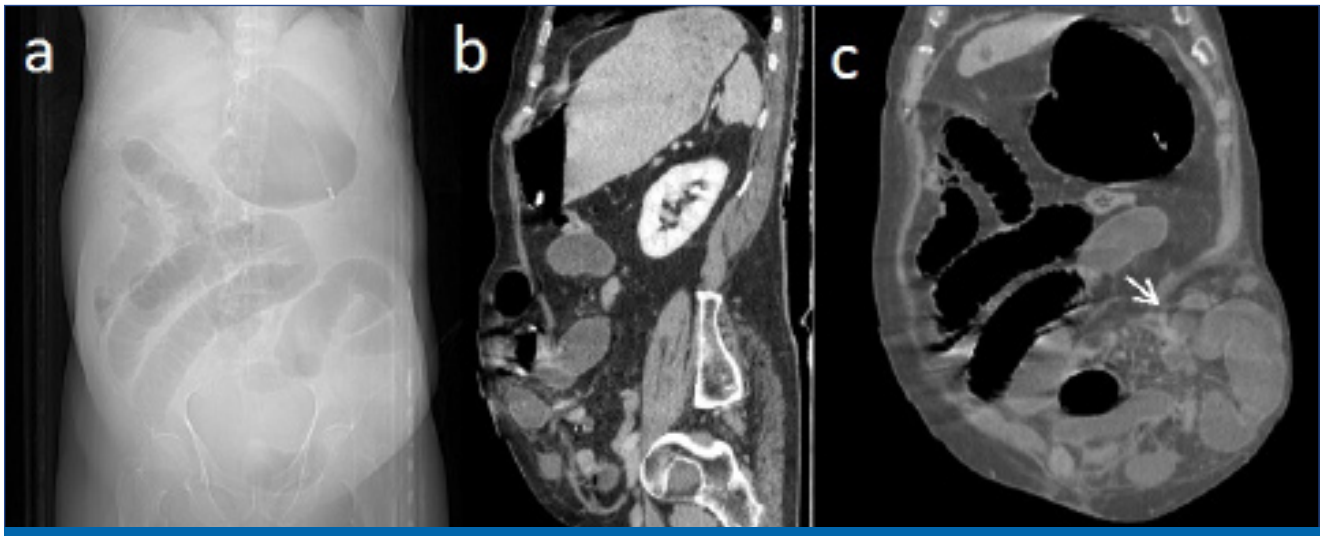
[Table/Fig-4]: Spectrum of CT findings in large bowel.

Mean age of presentation in our cases was around 40.9 years with maximum patients presenting in age group of 41-50 years. Similar observations were seen in study by Malik AM et al., [3] and Adhikari et al., [4].

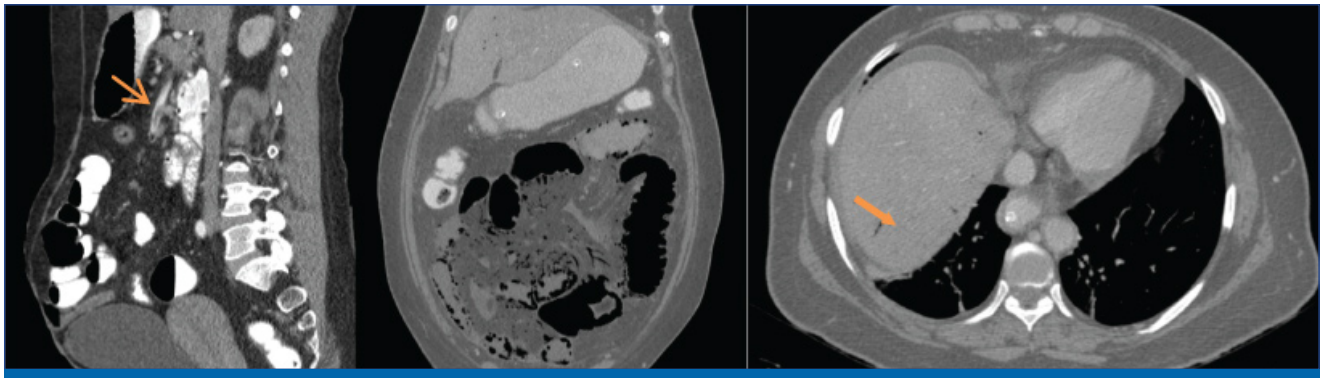
There was a female predominance with 24 (60%) females and 16 (40%) males. Although, maximum of studies show male predominance, female predominance in our study might be due to different population set-up.

Abdominal pain was most common symptom seen in 100% of cases. Other common symptoms in study were abdominal distention (92%), non-passage of stools (80%), vomiting (80%) etc. Similar findings were seen in study by Goyal SK et al., [14].

Plain radiograph is used as screening tool for obstruction. However, we could find signs related to obstruction like air



[Table/Fig-5a-c]: Peri-stomal obstructed hernia: (a) Scano-gram shows dilated small bowel. (b and c) Sagittal and coronal CT images showing colostomy defect in left lumbar region (arrow) with herniation of small bowel loops with proximal bowel loop dilatation. Multiple metastatic lesions in visualised liver.



[Table/Fig-6a-c]: Superior Mesenteric Artery (SMA) thrombus:(a,b and c) Sagital coronal and axial CT images show non-enhancing, intra-luminal thrombus in superior mesenteric artery (thin arrow in a),dilation and non-enhancement of visualized loops with intra-mural (pneumatosis intestinalis in b), mesenteric and portal venous air foci (thick arrow in c).

[Table/Fig-7a,b]: Sigmoid Colon intussusception with carcinoma as lead point: (a and b) Coronal and axial CT images reveal pulling of proximal sigmoid colon with heterogeneously enhancing mass lesion into the lumen of distal sigmoid and rectum (intussusceptum); giving target appearance suggestive of colo-colic intussusception.

fluid levels, dilated bowel loops in 26 out of 40 cases. Similar findings are quoted in various articles [5,13].

In whole spectrum of study, small bowel involvement was seen in larger number of patients as compared to large bowel which corresponded to results found in study by Malik AM et al., [3].

In small bowel obstruction cases, obstructed hernias dominated the list, results obtained resembled the study conducted in Ghana [15].

With the emergence of MR enterography for bowel pathologies, we can omit radiation exposure to patients due to CT-scan. However, lesion detection is better on CT-scan.

Atypical Cases Encountered

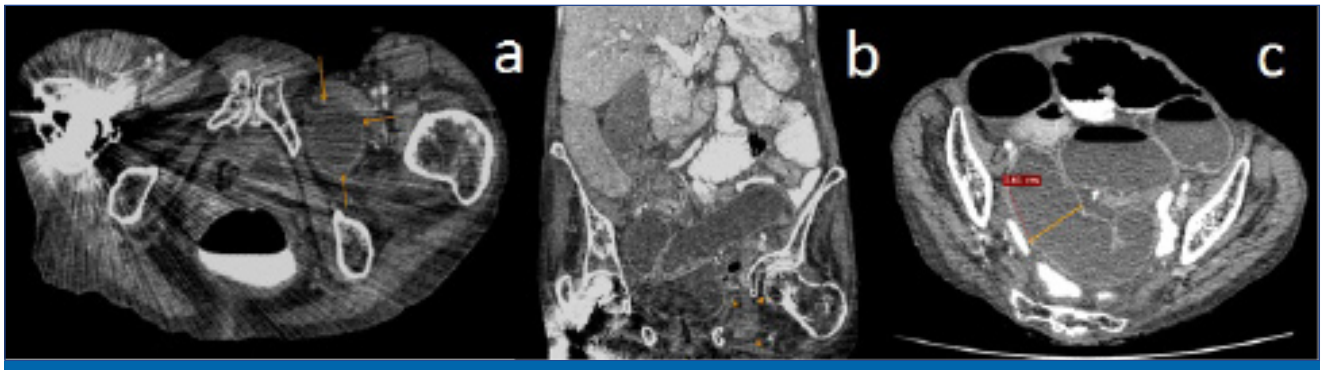
1. Obstructed obturator hernia: The obturator hernias are rare hernia accounting for 0.07–1% of all described hernias and 0.2-1.6% of all cases of mechanical obstruction of small bowel [16-18]. They have the highest mortality rate of all abdominal wall hernias (13–40%) with female domination ratio of 6:1 and more right sided prevalence [18]. The obturator foramen is covered by obturator membrane except at site of perforation by obturator nerve, artery, and vein in its antero-superior aspect. These structures travel obliquely in obturator

canal formed by obturator externus and internus muscles. Herniation of abdominal contents into obturator canal leads to obturator hernia. CT imaging of herniation of bowel through the obturator foramen and location between obturator externus muscle and pectineus muscle is diagnostic [18,19]. Our case is summarised in [Table/Fig-8].

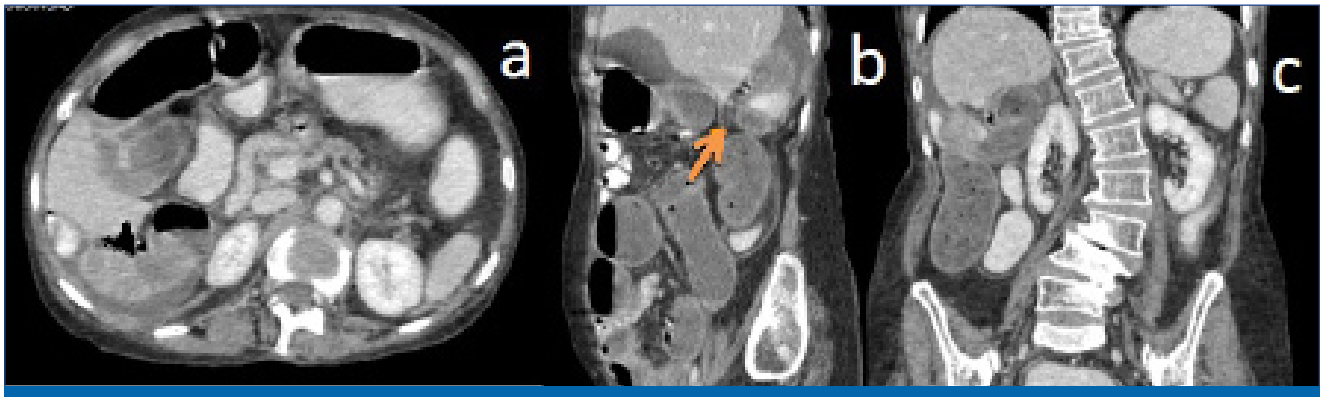
2. Internal hernia with Ladd's band: Ladd bands are form of anomalous peritoneal fibrous tissue and result in anomalous mesenteric fixation. They usually originate from caecum and extend to the sub hepatic region, posterior peritoneum or abdominal wall [20,21]. Our case was 60 years old female came to Emergency Department with abdominal pain, obstipation and vomiting for 1 week. CT-scan revealed abnormal herniation of jejunal loops in posterior and sub hepatic space. There was associated abnormal position of caecum, ascending colon and hepatic flexure. SMV was located anterior to SMA. Surgically, it proved to be presence of Ladd's band with widened foramen of Winslow and internal hernia in posterior and sub-hepatic space. Our case details are seen in [Table/Fig-9].

3. Ovarian carcinoma with bowel wall deposits causing intestinal obstruction: Many patients with ovarian carcinoma, present with symptoms of obstruction as initial presentation due to its predilection for intra-peritoneal spread [22]. Most commonly involved locations are recto-sigmoid region due to compression by pelvic tumour or transverse colon involvement with a bulky omental tumour. Bowel involvement may be seen in form of nodular or plaque like lesions along serosal and wall surfaces or complete bowel wall invasion [22,23]. In patients with bowel obstruction, evaluation of obstructing disease provides important information to assess the role of surgery and to rule out primary colonic malignancy. Presence of multiple site involvement, multiple obstructing lesions, diffuse bowel wall disease and extensive mesenteric infiltration precludes surgery [22,23]. Details of our patient are summarized in [Table/Fig-10].

4. Recurrent cervical stump lesion causing bowel involvement and obstruction: The rectum is most frequent site of involvement by recurrent cervical carcinoma, most commonly by contiguous extension of tumour from cervix stump or vaginal cuff [24]. It is not common for remainder of the colon and the small intestine to be involved by recurrent tumour and manifest as obstruction [25]. In one autopsy series, intestinal obstruction occurred in 12% of patients



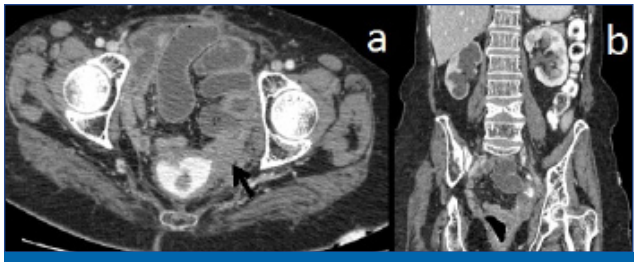
[Table/Fig-8a-c]: Obstructed obturator hernia: A 80 years old female patient with acute abdominal pain. (a, b and c) CT images show herniation of bowel loop through obturator membrane between obturator externus and pectineus muscle (arrows) with dilatation of proximal bowel loops.



[Table/Fig-9a-c]: Ladd's band with Internal hernia: (a, b and c) CT axial, sagittal and coronal images: Thin fibrous band (arrow) in sub-hepatic space with herniation of jejunal loops in posterior and sub-hepatic space (arrow head). There is associated dilatation of proximal small bowel loops.

[Table/Fig-10a-c]: Bilateral ovarian carcinoma with bowel wall deposits manifesting as obstruction: (a and b) Heterogeneously enhancing bilateral ovarian masses withmultiple deposits along recto-sigmoid bowel (arrow) causing luminal narrowing and proximal dilatation. (c) Multiple deposits at liver surface and omentum.

with bowel involvement [24]. Such lesion recurrences and obstructions can be demonstrated with barium examinations, CT and MR imaging. Other uncommon manifestations of recurrent disease involving the gastrointestinal tract include fistula formation and bowel wall thickening and clumping of bowel loops due to tumor implants in the mesentery [24,25]. Our case is summarized in [Table/Fig-11].



[Table/Fig-11a,b]: Recurrent cervical carcinoma with bowel involvement: (a and b) Axial and coronal images show recurrent lesion in left pararectal region (arrow) with ileal loops involvement with dilated bowel loops and 'small-bowel faeces sign'. There is associated bilateral hydrouretero-nephrosis.

5. Midgut volvulus: Congenital malrotation of small bowel is the major predisposing factor for midgut volvulus [26]. In malrotation, there is abnormal mesenteric fixation with abnormally short mesenteric root [26]. Midgut volvulus is most commonly seen in children; 60%–80% of patients present with bilious vomiting in neonatal period. However, volvulus may also present in adults with intermittent abdominal pain in cases with spontaneous reduction or frank symptoms of obstruction in non-reducible cases [26,27]. The CT appearance of bowel's wrapping around the superior mesenteric artery creates a distinctive whirlpool or cork screw sign is diagnostic for midgut volvulus. The volvulus causes congestion of mesenteric veins and lymphatics and can cause thrombosis and calcification of SMV [27]. The relationship of the superior mesenteric vein to the superior mesenteric artery can suggest the diagnosis of bowel malrotation.

CONCLUSION

MDCT is the need of the hour for proper three dimensional etiological evaluation of bowel obstruction giving comprehensive analysis and thereby helping therapeutic approach. We must closely analyze underlying etiology, zone of transition and signs of ischemia to solve the hidden mystery and prevent further clinical deterioration.

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