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Review Article

Imaging in Bowel Obstruction

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Abstract

Introduction: Small bowel obstruction (SBO) is a frequent presentation that occurs due to either mechanical or functional obstruction of the small bowel. The management of SBO depends upon a fast and accurate diagnosis. It is often diagnosed late or even misdiagnosed, leading to increased mortality and morbidity. The dilemma in the management of SBO lies in deciding whether to do an early laparotomy or to go ahead with non-operative management [4].

The findings upon performing a clinical examination and assessing laboratory values are not very specific or reliable in differentiating simple mechanical obstruction from strangulated bowel. Imaging plays a very important role in acute conditions by revealing the location, degree, and cause of obstruction. It can also assess if there is ischemia present [4].

Aim of Work: The study aims to discuss various modalities of imaging for cases of small bowel obstruction.

Methodology: This review is a comprehensive research of PUBMED from the year 1985 to 2016.

Conclusion: Small bowel obstruction (SBO) is a common presentation that occurs due to either mechanical or functional obstruction of the small bowel. The management of SBO depends upon a fast and accurate diagnosis. The first imaging technique which is used most commonly is abdominal radiography due to its easy availability and low price. CT is helpful to determine the degree and site of obstruction, cause of obstruction and presence of ischemia.

Keywords: *Small Bowel Obstructions; CT Scan; Enteroclysis; Valvulae Conniventes*

Introduction

Small bowel obstruction (SBO) is a common presentation that occurs due to either mechanical or functional obstruction of the small bowel. The management of SBO depends upon a fast and accurate diagnosis. It is often diagnosed late or even misdiagnosed, leading to

increased mortality and morbidity. SBO is a very common cause of hospitalization, accounting for about 20% of all surgical admissions for acute abdominal pain [1,2]. In 70% of the cases, the cause of small bowel obstruction is postoperative adhesions [3]. Hernias, neoplasm and Crohn's disease are few of the other causes [3,4]. The dilemma in the management of SBO lies in deciding whether to do an early laparotomy or to go ahead with non-operative management. The findings upon performing a clinical examination and assessing laboratory values are not very specific or reliable in differentiating simple mechanical obstruction from strangulated bowel. Imaging plays a very important role in acute conditions by revealing the location, degree, and cause of obstruction. It can also assess if there is ischemia present [4].

Imaging workup: Algorithmic approach

The difficulty which is most often faced by most of the radiologists and surgeons when they see a possible SBO on the basis of the patient's signs and symptoms is which examination to use first to confirm the SBO and to help determine the best therapeutic approach [5].

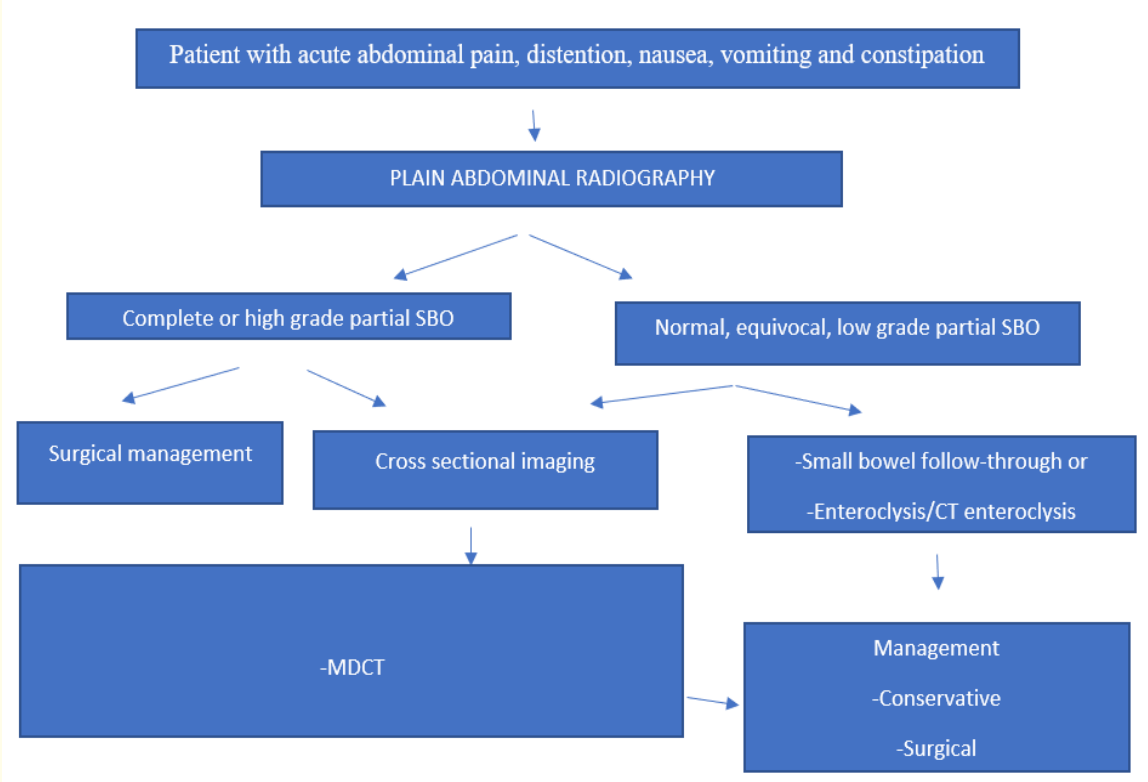


Figure 1: *Algorithm for imaging work-up of patients suspected to have SBO. MDCT = multidetector CT [5].*

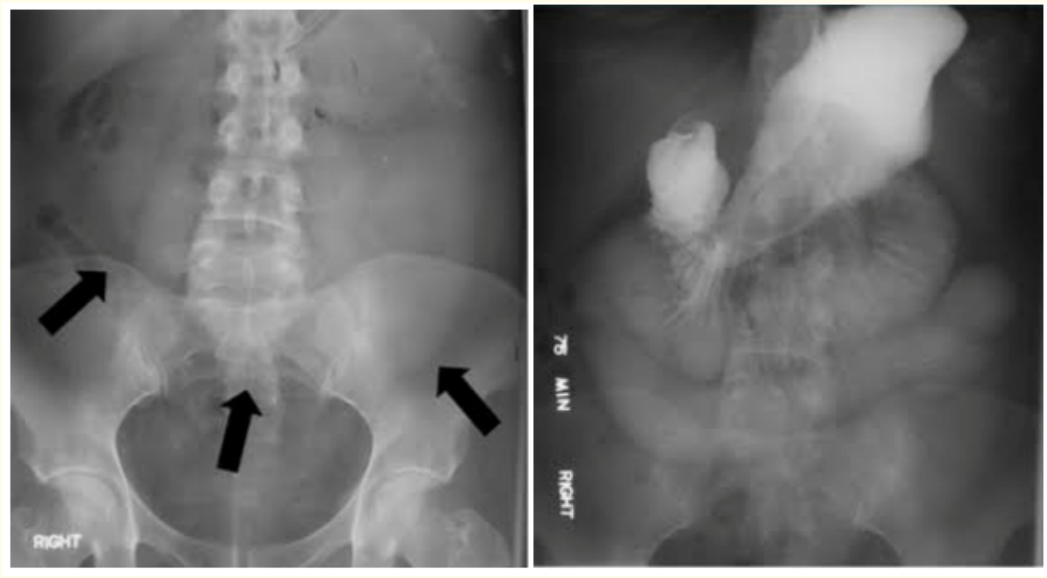
The various imaging modalities used in diagnosing acute small-bowel obstruction are listed below.

Conventional radiography

Most of the patients with symptoms of SBO undergo abdominal radiography because it is cheaper, accurate and easily available [6].

The radiographs are accurate in 50% to 86% of cases for the diagnosis of SBO [8-12].

Figure 2a **Figure 2b**



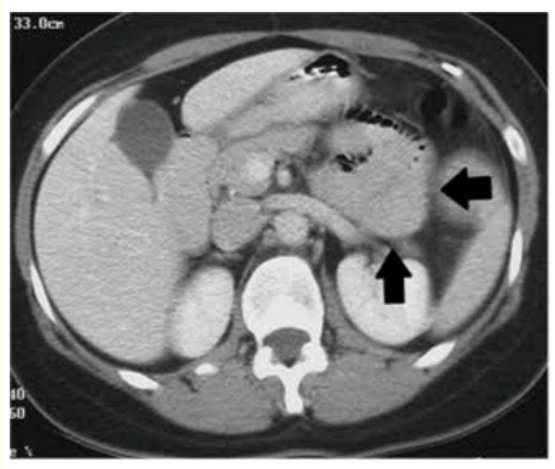


Figure 2c

Figure 2: *Images in a 60-year-old man with abdominal pain. (a) Supine abdominal radiograph demonstrates soft-tissue mass mid-abdomen (arrows). (b) Supine radiograph from upper gastrointestinal series demonstrates the soft-tissue mass is actually due to fluid-filled dilated small bowel secondary to SBO. (c) Intravenous contrast-enhanced axial CT scan through mid-abdomen demonstrates fluid-filled loops of the small bowel (arrows) responsible for the pseudotumor sign [7].*

Radiographs are sensitive in high-grade obstructions but not in low-grade obstructions.

Radiographic signs of small bowel obstruction include collapsed colon, distended loops of bowel greater than 3 cm, differential air-fluid levels, and thickened bowel wall [4].

Figure 3a: *Supine abdominal radiograph in 45 year old woman with adhesional small bowel obstruction shows multiple dilated loops of small bowel. Valvulae conniventes appear prominent. In appropriate clinical context, this would be diagnostic of small bowel obstruction [7].*

Figure 3b: *Upright abdominal radiograph in 56 year old woman with adhesional small bowel obstruction shows multiple air fluid levels (arrows) and string of pearls sign (arrowhead) [7].*

In some cases, a string-of-pearls sign may also be seen, which occurs due to slow resorption of intraluminal air, leaving small bubbles trapped between the folds of the valvulae conniventes [13].

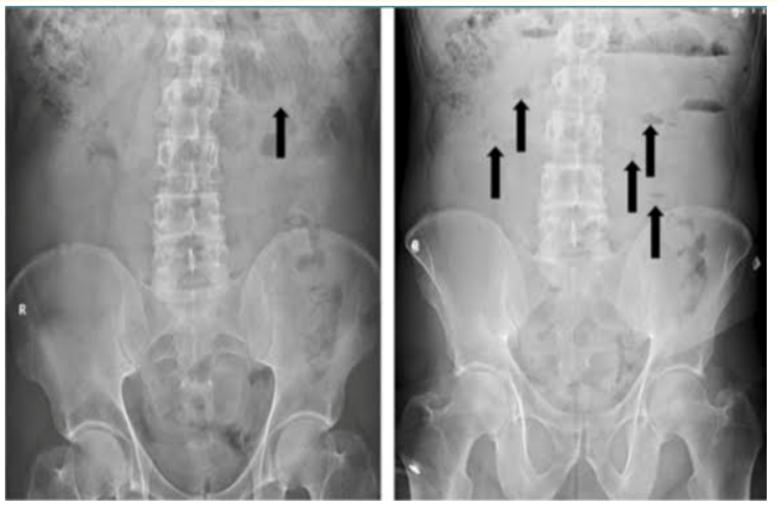


Figure 4a **Figure 4b**

Figure 4: *Images in a 70-year-old man with abdominal pain, nausea, and vomiting. (a) Supine abdominal radiograph demonstrates a paucity of small-bowel gas. Note the dilated small-bowel loop in the left upper abdomen (arrow). (b) Upright abdominal radiograph demonstrates multiple small fluid levels (arrows). Large fluid level seen in dilated small bowel left upper abdomen correlates with the same dilated small bowel loop seen on a supine radiograph [13].*

Some rarely seen features are edematous folds, pneumatosis intestinalis (Figure 5A) and gas in the portal vein (Figure 5B), which is indicative of strangulation [13].

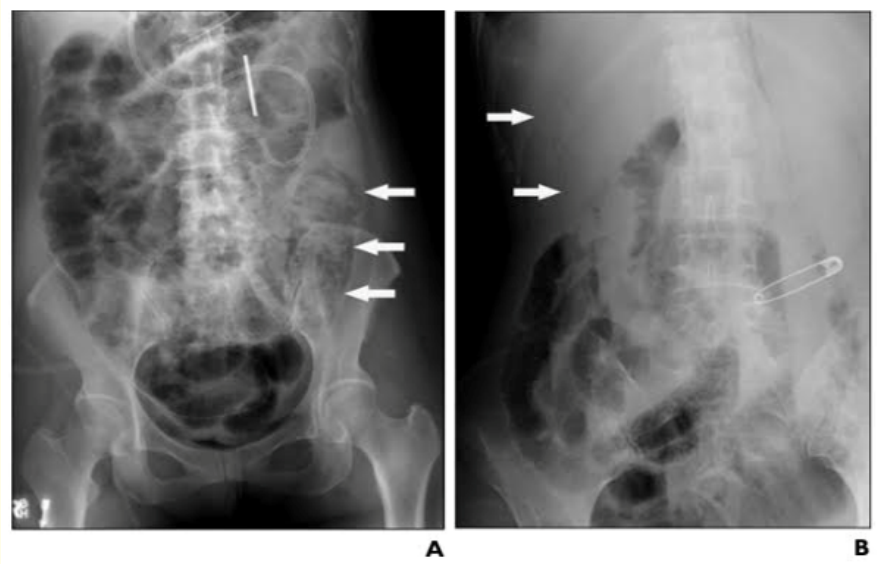


Figure 5

In cases where the radiographs show normal findings, additional imaging is always required for cases with high suspicion of obstruction.

Contrast radiography

Further information regarding the degree of obstruction can be obtained through contrast studies like small bowel follow-through. Any obstruction present would appear as dilated loops of the small bowel and a delayed transit time of barium through a transition point [14].

However, there are certain drawbacks of small bowel follow-through technique. These include the duration of the study, dilution of barium because of excess residual intraluminal fluid, and the patients being unable to drink the barium in an acute setting [14].

Certain parts of the small intestine that are non-distensible or fixed can be easily identified by Enteroclysis. Enteroclysis is done by intubating the small bowel and infusing contrast material, typically bypassing the stomach. Enteroclysis has proven to be very accurate in diagnosing low grade and intermittent obstructions in sub-acute cases [15].

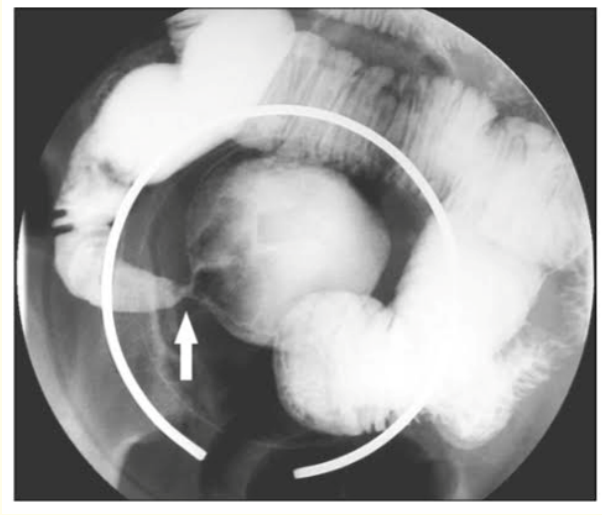


Figure 6: *Enteroclysis. A 54-year-old woman with adhesional small-bowel obstruction. Spot film from enteroclysis shows small-bowel loop narrowing (arrow) due to postoperative adhesion [14].*

Sonography

The use of sonography is limited in countries where computed tomography (CT) is readily available. Where CT is not widely available, sonography is frequently used. Although it is an operator-dependent procedure and has got constraints in the assessment of gas-containing structures, abdominal sonography can be quite helpful in demonstrating the presence of SBO, its level, and in some cases, the cause and severity of the obstruction [5]. Sonography has a sensitivity of 89% as compared to 71% for conventional abdominal radiography in diagnosing small bowel obstruction. It is also better in identifying features of strangulation and in predicting the cause and location of the obstruction [16]. If there are multiple dilated (> 3 cm), fluid-filled loops present on sonography, it is usually suggestive of SBO [13].

If the cause of obstruction is a tumor or a hernia, it is hardly seen with sonography.

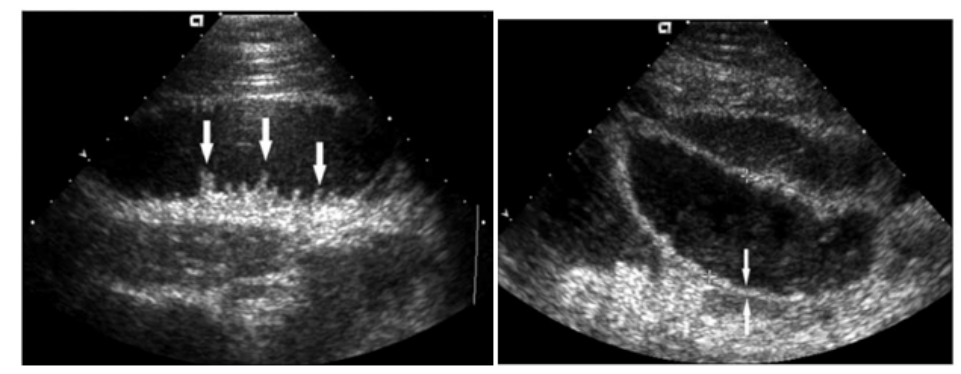


Figure 7a **Figure 7b**

Figure 7: *Sonography features of small-bowel obstruction. Both cases are due to postoperative adhesions. An Abdominal sonogram in a 40-year-old woman shows a dilated, fluid-filled loop of small bowel with prominent valvulae conniventes (arrows). B, Abdominal sonogram in a 62-year-old man shows thickened small-bowel wall (arrows). Real-time scanning showed small bowel to be hyperperistaltic [16].*

CT

CT is the preferred technique in cases where an acute obstruction is suspected because of the following reasons:

1. It does not require any oral contrast media because the retained intraluminal fluid acts as a natural negative contrast agent.
2. As compared to enteroclysis, CT is rapid, noninvasive and easily available.
3. It also allows extramural areas that would not be visible in contrast to studies to be assessed.

Multidetector CT is the best imaging tool for suspected SBO. It has a sensitivity and specificity of 95% for the diagnosis of high-grade SBO and is less accurate in partial obstruction [4,7-9]. The hallmark in CT, as in radiography, is dilated (> 2.5 cm) proximal small bowel with decompressed distal small bowel and colon (Figure 8). A string of beads sign may be seen, and air-fluid levels will be present [14].

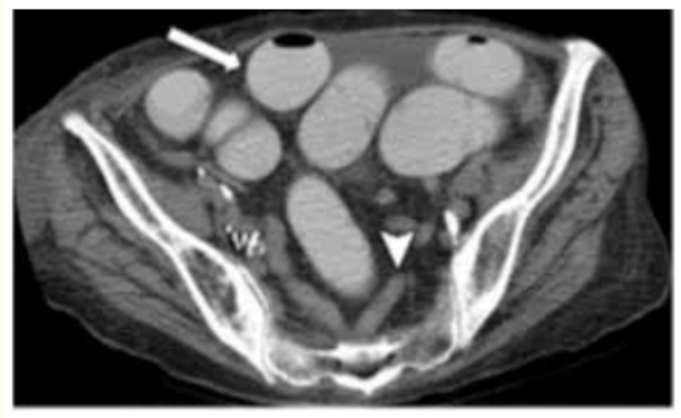


Figure 8a: *Axial unenhanced CT scan shows dilated loops of ileum filled with contrast material (arrow). Note the contrast material does not pass into decompressed distal loops of small bowel (arrowhead).*

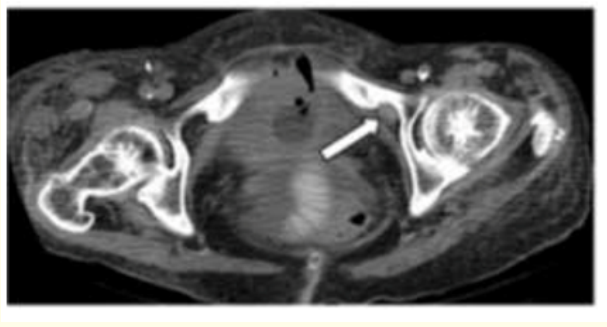


Figure 8b: *Unenhanced axial CT scan at the level of the pubic symphysis shows protrusion of ileum (arrow) into the obturator canal.*

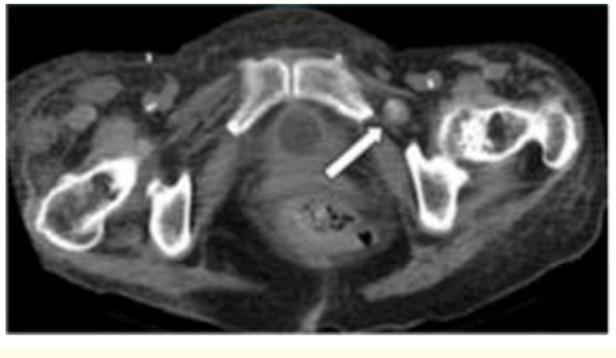


Figure 8c: *Unenhanced axial CT scan shows ileum trapped in the obturator canal between the obturator externus and pectineus muscles (arrow) [17].*

Figure 8d: *Coronal reformation shows the herniated and obstructed ileum protruding into the obturator canal (arrow) [17].*

The "small bowel feces" sign (Figure 9), which was first described by Mayo-Smith in 1995, occurs due to stasis and mixing of small bowel contents with gas and is seen in chronic obstruction or high-grade obstruction cases [12,17,18].

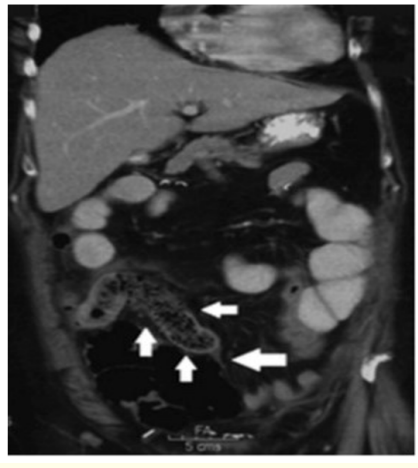


Figure 9: *Contrast-enhanced coronal CT scan in a 50-year-old man with abdominal distension, which demonstrates the small bowel feces sign (small arrows) just proximal to the transition point (large arrow) of small bowel obstruction due to adhesion.*

The transition zone is the site where dilated bowel transitions to decompressed bowel (Figure 9). This zone is more accurately identified with CT scans and can be helpful in determining the cause of obstruction. CT helps in the assessment of the bowel wall, its vessels and the adjacent mesentery, which allows for identification of co-existent ischemia and/or infarction. It also helps in ascertaining the presence of bowel perforation and free extraluminal gas.

MRI

MRI provides accurate and quick identification of small-bowel obstruction and helps in finding the cause without exposing the patient to radiation. MRI does not require the ingestion of barium before the procedure as it uses the intraluminal air as a natural contrast agent. Presence of dilated loops of bowel proximal to the obstruction, a distinct transition point, and normal-caliber or collapsed bowel distally are suggestive of small bowel obstruction on an MRI. It is possible to find the cause of small bowel obstruction due to the multi-planar capabilities of the MRI [19].

Figure 10a: *Transverse gadolinium enhanced T1-weighted image (TR/TE,400/10) obtained with fat saturation shows narrowing of large bowel (arrow) caused by mass (small arrowhead) with resultant proximal small bowel obstruction (large arrowhead).*

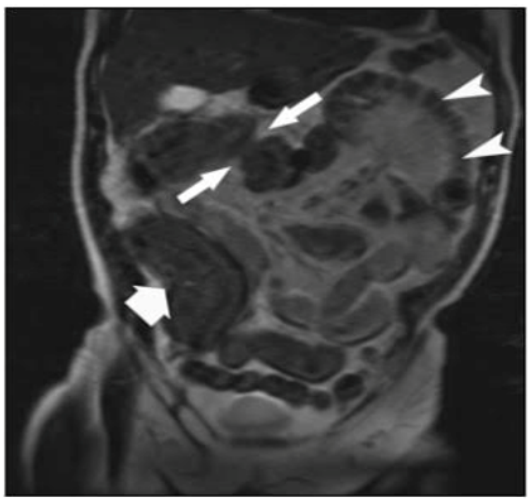


Figure 10b: *Coronal single shot fast spin-echo T2-weighted image (1800/103) reveals same constricting mass seen in A but with intermediate signal (thin arrows). Resultant proximal dilatation of large (thick arrow) and small (arrowheads) bowel is visualized.*

Figure 10c: *Subsequent coronal image reveals numerous proximal dilated loops of small bowel (arrows), which is consistent with diagnosis of small bowel obstruction.*

Figure 10: *80-year-old man with small bowel obstruction secondary to adenocarcinoma of the large bowel [20]. MRI cannot take the place of CT in evaluating small-bowel obstruction because of prolonged scan time and inferior resolution [19].*

Conclusion

Small bowel obstruction (SBO) is a common presentation that occurs due to either mechanical or functional obstruction of the small bowel. The management of SBO depends upon a fast and accurate diagnosis. The first imaging technique which is used most commonly is abdominal radiography due to its easy availability and low price. CT is helpful to determine the degree and site of obstruction, cause of obstruction and presence of ischemia.

Bibliography

1. Foster NM., *et al*. "Small bowel obstruction: a population-based appraisal". *Journal of the American College of Surgeons* 203.2 (2006): 170-176.
2. Welch JP. "General consideration and mortality in bowel obstruction. Bowel obstruction: differential diagnosis and clinical management". Philadelphia, Pa: Saunders (1990): 59-95.
3. Burkill GJ., *et al*. "The utility of computed tomography in acute small bowel obstruction". *Clinical Radiology* 56.5 (2001): 350-359.
4. Maglinte DD., *et al*. "Current concepts in imaging of small bowel obstruction". *Radiologic Clinics* 41.2 (2003): 263-283.
5. Guimarães MD. "Small Bowel Obstruction: What to Look For1". *RadioGraphics* 29.2 (2009): 423-439.
6. Thompson WM., *et al*. "Accuracy of abdominal radiography in acute small-bowel obstruction: does reviewer experience matter?" *American Journal of Roentgenology* 188.3 (2007): W233-W238.
7. Paulson EK and Thompson WM. "Review of small-bowel obstruction: the diagnosis and when to worry". *Radiology* 275.2 (2015): 332-342.
8. Maglinte DD., *et al*. "Reliability and role of plain film radiography and CT in the diagnosis of small-bowel obstruction". *AJR: American Journal of Roentgenology* 167.6 (1996): 1451-1455.
9. Maglinte DD., *et al*. "Small-bowel obstruction: optimizing radiologic investigation and nonsurgical management". *Radiology* 218.1 (2001): 39-46.
10. Furukawa A., *et al*. "Helical CT in the diagnosis of small bowel obstruction". *Radiographics* 21.2 (2001): 341-355.
11. Furukawa A., *et al*. "CT diagnosis of small bowel obstruction: scanning technique, interpretation and role in the diagnosis". *Seminars in Ultrasound, CT and MRI* 24. 5 (2003): 336-352.
12. Sheedy SP., *et al*. "CT of small-bowel ischemia associated with obstruction in emergency department patients: diagnostic performance evaluation". *Radiology* 241.3 (2006): 729-736.
13. Nicolaou S., *et al*. "Imaging of acute small-bowel obstruction". *American Journal of Roentgenology* 185.4 (2005): 1036-1044.
14. Macari M and Megibow A. "Imaging of suspected acute small bowel obstruction". *Seminars in Roentgenology* 36.2 (2001): 108-117.
15. Maglinte DD., *et al*. "The role of radiology in the diagnosis of small-bowel obstruction". *AJR: American Journal of Roentgenology* 168.5 (1997): 1171-1180.
16. Schmutz GR., *et al*. "Small bowel obstruction: role and contribution of sonography". *European Radiology* 7.7 (1997): 1054-1058.
17. Mayo-Smith WW., *et al*. "The CT small bowel faeces sign: description and clinical significance". *Clinical Radiology* 50.11 (1995): 765-767.

18. Lazarus DE., *et al*. "Frequency and relevance of the "small-bowel feces" sign on CT in patients with small-bowel obstruction". *American Journal of Roentgenology* 183.5 (2004): 1361-1366.

19. Regan F., *et al*. "Fast MR imaging and the detection of small-bowel obstruction". *AJR: American Journal of Roentgenology* 170.6 (1998): 1465-1469.

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