

# A review of the Radiological Diagnosis of Small Bowel Obstruction using various Imaging Modalities.

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*Radiological investigation is an important tool in the diagnosis of small bowel obstruction (SBO). While plain abdominal radiograph remains the commonest investigation done in SBO contrast gastrointestinal radiography ultrasonography (US), computerised tomography (CT) scan with or without contrast enhancement are increasingly being advocated particularly in equivocal cases of SBO. We conducted manual, medicine and internet search for relevant literature on diagnosis of SBO using radiological investigations. Plain abdominal radiograph has a diagnostic accuracy for SBO that varies widely from 50-92%. Contrast gastrointestinal radiograph in equivocal cases of adhesive SBO can readily differentiate between complete and partial obstruction. Abdominal ultrasound is cheap and readily available. Accuracy of as high as 89% has been reported in experienced hands. CT scan has an added advantage of predicting the site and cause of obstruction. In developing countries like ours, plain abdominal radiography still remains an important diagnostic tool. The role of abdominal ultrasonography needs further evaluation since it is safe, readily available and affordable.*

**Key words:** small bowel obstruction, radiological diagnosis, developing countries.

Small bowel obstruction is a common surgical emergency in the tropics where it constitutes a major health problem. While obstructed external hernia, especially inguinal hernias, remain the leading cause of small bowel obstruction (SBO) in our environment, post operative adhesions is the main cause in the western world where it constitutes between 50-79% of the total number of SBO<sup>1</sup>.

The obstruction could be complete or partial; simple, closed-loop or strangulation obstruction.

Diagnosis of SBO is usually obtained by the triad of a good history, physical examination and radiological investigation<sup>2</sup>. Plain abdominal radiograph in supine and erect or lateral decubitus views has been the standard routine<sup>3</sup>. Recently, however, there seem to be a growing interest in the use of contrast radiography and modern imaging techniques in the pre-operative diagnosis and localisation of the level of obstruction.

This review attempts to discuss the place of some of the radiological techniques that have been utilized in the diagnosis of small bowel obstruction in the light of our environmental peculiarities.

## Plain Abdominal Radiograph

This is by far the commonest and oldest of all imaging techniques used in the diagnosis of SBO.

Features that indicate SBO include<sup>4,5</sup>,

- a.) Air-fluid levels: A minimum of three air-fluid levels in adults suggest obstruction. An exception is the double-double appearance observed in meconatal atresia or annular pancreas or proximal jejunal obstruction. In general proximal obstruction tends to produce air-fluid levels in the left upper quadrant, mid obstruction in the left upper quadrant extending to the right and distal obstruction in the upper and lower abdomen. The greater the number of air fluid levels the greater the proximity to the ileocaecal valve<sup>6</sup>. Sickie cell abdominal crisis and severe diarrhoea with electrolyte derangement are other causes of multiple air fluid levels that may simulate SBO.
- b.) Gaseous distension: Dilated loops of bowel that are centrally located suggest SBO. The character and not the diameter of such a loop distinguishes it

from large bowel e.g. ileum lacks character and is described as "unremarkable" or "characterless", the jejunum has valvulae conniventes that run from wall to wall regularly distributed giving rise to concertina effect. The colon, however has haustrations which are irregularly spaced indentations. Absence of colonic gas on plain abdominal roentgenography indicates that the SBO is complete whereas obvious evidence of colonic gas besides dilated loops of small bowel suggests partial obstruction.

Such information is vital not only in the pre-operative evaluation of the patients but also in predicting the ultimate treatment modality, especially when one is dealing with adhesive small bowel obstruction. For instance, Broliner *et al*<sup>10</sup> in a review of 342 cases of SBO, reported that 84% of patients with plain radiographic features of complete obstruction required surgery compared to only 19% of those with features suggestive of partial obstruction.

Although sometimes plain radiographic findings in small bowel obstruction are diagnostic in about 50-60%, equivocal in about 20-30% and normal, non-specific or misleading in about 10-20% of cases, hence the need for further investigations.<sup>11</sup>

However, in a retrospective study of 130 patients with clinical admission diagnosis of SBO, Ramos and Rizer<sup>12</sup> reported that plain abdominal radiograph diagnosed complete or partial obstruction in 119 patients and re-obstruction in 20 patients. Further small bowel examination confirmed the diagnosis in the 119 patients and refuted 16 out of the 20 patients in which plain abdominal radiograph showed no evidence of mechanical SBO. There may be difficulty differentiating between mechanical small bowel obstruction and paralytic ileus since both can produce multiple air fluid levels. Paralytic ileus is however known to cause gaseous distension that almost uniformly affects the stomach, small and large bowel.<sup>13</sup> In our environment where cost consideration is an important part of patient management, the surgeon could do without abdominal radiograph where the diagnosis is obvious, requiring emergency surgical intervention e.g. strangulated groin hernia. However, in cases where there is peritonitis complicating SBO base line preoperative abdominal radiograph is desirable so long as it does not constitute a delay in surgical intervention, since it is not unusual in the tropics for such investigation to be carried out in a different facility.

#### Gastrointestinal Contrast Radiography

The use of contrast radiography in the evaluation of patients with suspected small intestinal obstruction has been controversial. Proponents<sup>14-17</sup> posit that gastrointestinal contrast studies, when carefully performed in selected cases of SBO are safe and could provide useful additional information where plain radiographic features are equivocal. Opponents<sup>18</sup> argue that barium study delays surgery and carries the risk of

concretions within the bowel lumen. To this may be added the inconvenience and extra cost such an investigation poses on the patient. Suggested indications for contrast studies in SBO include<sup>19-22</sup>:

- i.) Equivocal clinical and plain radiographic features.
- ii.) Differentiating between mechanical and a dynamic SBO.
- iii.) When conservative management is desirable e.g. patients with adhesive bowel obstruction; abdominal carcinomatosis and those with early post-operative obstruction where prolonged tube decompression may be advocated.

In mechanical bowel obstruction the contrast usually reaches the point of obstruction within one hour of ingestion whereas in a dynamic ileus there is usually no identifiable mechanical cause of obstruction and the contrast transit time to the colon is prolonged taking about 4 to 6 hours.<sup>23</sup> SBO on contrast study is defined as either a discrete point of blockage or failure of contrast to reach the cecum/colon within 24 hours.<sup>24</sup> Contrast media commonly used include barium sulphate, indinated water-soluble contrast e.g. gastrografin and air. These are administered orally as in conventional upper gastrointestinal series e.g. barium (or gastrografin) meal and follow through or by enteroclysis. Enteroclysis<sup>25</sup> involves instillation of air and contrast medium into the duodenum via a naso-enteric gastrointestinal tube under fluoroscopic guidance. When compared with conventional upper gastrointestinal contrast studies, enteroclysis has the advantages of affording a better examination of the mucosal surfaces of the small bowel because of the double contrast medium used and easy evaluation of the ability of the small bowel to distend. The site of obstruction is shown on enteroclysis as a short segment of acute transition bounded proximally by distended intestines and distally by collapsed loops.<sup>26</sup> Occasionally, a sudden halt to the column of barium is the only indication of the site of obstruction.

Richards and Williams<sup>1</sup> reported on 32 patients who had enteroclysis for small bowel obstruction with only one false-positive and no false-negative compared to six patients who had barium meal and follow through with three false-positives and two false negative results. In a study<sup>27</sup> of 124 patients on conservative management for adhesive small bowel obstruction, thirty-five patients who showed no improvement within 48 hours were randomised to surgery (16 patients) and gastrografin meal and follow through (19 patients). Of the 19 who had gastrografin study, 14 were diagnosed as partial obstruction (presence of contrast in the colon within 24 hours) and were successfully managed without surgery while the remaining 5 had laparotomy for complete obstruction. In spite of the diagnostic and therapeutic uses, contrast radiograph of SBO has some disadvantages. These include<sup>28</sup>:

- i.) It is difficult to perform in critically ill patients.
- ii.) It is contraindicated in patients with clinically obvious complete bowel obstruction, strangulation or

suspected perforation.

Large bowel contrast studies deserve brief mention also. Although used mainly for large intestinal obstruction, it is useful in diagnosing intussusception presenting as SBO. In this case, a filling defect with a "coiled-spring appearance" from the contrast between the intussusciptions and intussusceptum suggest the diagnosis<sup>1</sup>. Barium enema could also be therapeutic as it could achieve hydrostatic reduction. Other indication of large bowel contrast studies is the rare syndrome of SBO masking a synchronous large bowel obstruction<sup>21</sup>. When intestinal perforation can not be ruled out, water soluble contrast such as gastroconray or gastrografin rather than barium sulphate may be used<sup>22,23</sup>.

#### Abdominal Ultrasonography

The use of abdominal ultrasonography (US) in the evaluation of various abdominal diseases is a common practice in our environment but its use in SBO is generally unpopular. The reason for this is not far fetched especially when one considers the frequent presence of abundant bowel gas interfering with satisfactory examination of the abdomen<sup>24</sup>. Also, besides large abdominal tumours, most causes of SBO are not visible on sonogram. US is however, able to diagnose the presence of SBO<sup>25</sup> and is relatively readily available and affordable. A CT-scan examination costs on the average between 50 – 100 times the cost of US in our environment. Ultrasonographic criteria for the diagnosis of SBO include<sup>26,27</sup>

- i) Fluid-filled distended, small bowel loops more than 3 cm in diameter.
- ii) A segment of the dilated small bowel more than 10cm in length. Variable peristalsis viz: increased peristalsis of dilated segment manifesting as rapid progression or waiving movement of bowel content, retrograde peristalsis or aperistaltic segment immediately proximal to the site of obstruction
- iii) Collapsed large bowel

When there is no peristaltic movement in the presence of small bowel dilation, paralytic ileus rather than acute mechanical bowel obstruction is the likely sonographic diagnosis. Bisset and Khan<sup>28</sup> added loss of prominence and definition of valvulae conniventes as part of the diagnostic features of SBO, but KO *et al*<sup>29</sup> in a retrospective study of 54 patients who had sonographic examination for suspected or diagnosed SBO reported that the valvulae conniventes can be easily visualised. They reported an overall accuracy of US in the diagnosis of SBO to be 89% compared to 70% accuracy obtained with plain abdominal radiograph and utilised the pattern and number of valvulae conniventes in predicting the level of obstruction on sonogram with 76% accuracy. The experience of the sonologist is in no doubt an important determinant. Recently, pre-operative ultrasound diagnosis of the rare case of an incarcerated sciatic hernia has been

reported<sup>30</sup>.

#### Computerised Tomographic (CT) Scan

CT scan of the abdomen in patients with SBO has been shown to be useful in diagnosis and prediction of the site, level, cause of obstruction and bowel viability<sup>31,32,33,34</sup>. CT scan examination is becoming more readily available in our environment<sup>35</sup>. It is about 90–95% accurate in diagnosing SBO<sup>32,35</sup>.

Maglinte *et al*<sup>36</sup>, however, reported 65% overall accuracy of CT diagnosis of SBO with the sensitivity increasing with the degree of obstruction e.g. the diagnostic accuracy was 48% with low-grade bowel obstruction and 81% with high grade bowel obstruction. The grading here relates to the severity of luminal obstruction.

Diagnostic feature<sup>32,37</sup> of obstruction on CT scan is a definite transition zone with dilated fluid and/or air-filled loops proximal to and collapsed loops distal to the site of obstruction. The more marked the transition zone is, the easier the diagnosis. With the exception of adhesion, the diagnosis of which is that of exclusion, other causes of SBO like tumours, intussusception, abscesses, and herniation are easily identified in CT scan. The CT findings in complicated SBO are summarised below<sup>38,39,40</sup>.

#### Closed-loop Obstruction

- i. U-shaped or C-shaped fluid filled dilated loops with associated mesenteric vascular convergence towards the point of obstruction.
- ii. A "whirl" sign, "beak" sign, triangular loop; or two adjacent collapsed loops at the site of obstruction.

#### Strangulation Obstruction

- i. Circumferential thickening of the wall with high attenuation.
- ii. Target sign or pneumatosis intestinalis.
- iii. Congestive changes or haemorrhages in the associated mesentery.

Contrast enhanced CT-scan using either 20% iodinated water soluble contrast medium or 1.2% barium sulphate are sometimes used to improve the diagnostic yield.

#### Conclusion

The essence of supportive radiological investigations in small bowel obstruction, is to aid diagnosis, the choice of treatment modality and timing of surgical intervention. In spite of the recent feat in establishing CT scans nationwide, it is still not readily available. In addition, the shortage of trained personnel and the cost of CT scan coupled with the emergency presentation of patients with SBO, make the routine use of CT scan doubtful. In our environment, abdominal x-ray still remains an important diagnostic tool but the role of abdominal ultrasonography in the management of patients with SBO needs further evaluation since it is readily available and affordable.

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