

Frequency and Relevance of the “Small-Bowel Feces” Sign on CT in Patients with Small-Bowel Obstruction

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OBJECTIVE. We sought to determine the incidence of the “small-bowel feces” sign (SBFS) in patients with small-bowel obstruction (SBO) and whether it can be used to accurately locate the point of obstruction.

SUBJECTS AND METHODS. From November 2002 until March 2003, 34 consecutive adult patients with CT findings of small-bowel obstruction were prospectively evaluated. The CT findings used to diagnose small-bowel obstruction were a dilated proximal small bowel and a collapsed distal small bowel and colon. CT scans were evaluated to determine the degree of obstruction (mild, moderate, or high-grade), the presence or absence of the SBFS (defined as particulate-type material in the dilated small bowel), the location of the SBFS in relation to the transition zone, and the cause of the obstruction. Mild obstruction was defined as a slight discrepancy between the caliber of the proximal and that of the distal small bowel; moderate SBO was defined as a discrepancy of 50% or more between the calibers of the proximal and the distal small bowel; and high-grade SBO was considered to be present if the distal small bowel and the colon had collapsed. The cause of the obstruction was determined from surgical findings or a combination of CT findings, follow-up barium studies, and clinical assessment.

RESULTS. The SBFS was present in 19 (55.9%) of 34 patients with SBO. The degree of SBO was mild in six, moderate in 11, and high-grade in 17 of the patients. The SBFS was present in one of the six patients (16.6%) with mild, eight (72.7%) of the 11 with moderate, and 10 (58.8%) of the 17 with high-grade SBO. In all patients in whom the SBFS was present, the particulate material could be traced to the point of transition and was most conspicuous in the transition zone. The length of fecalike material ranged from 2 to 25 cm and was longer in moderate and high-grade SBO than in mild SBO. The cause of the SBO was an adhesion in 20 patients, a hernia in four patients, Crohn’s disease in four patients, a tumor in three patients, and other miscellaneous causes in three patients.

CONCLUSION. When present on CT, the SBFS can be used to help locate the transition zone in patients with SBO. The sign is present more frequently in patients with moderate and high degrees of SBO.

Small-bowel obstruction (SBO) is a common clinical problem [1]. CT has become an important tool in the workup and treatment of patients with SBO; CT findings frequently alter clinical decisions. In the setting of SBO, CT can be used to confirm the diagnosis, determine the cause, and diagnose complications such as a closed loop and intestinal ischemia [2–6]. The diagnosis of SBO is made when there is a discrepancy between the calibers of proximal and distal small bowel loops [2]. In cases of SBO, the proximal loops are distended and the distal loops are collapsed. A secondary sign that has been reported to be helpful in

confirming SBO is the “small-bowel feces” sign (SBFS) [3]. The SBFS is present when intraluminal particulate material is identified in the dilated small bowel.

On CT, determining the cause of SBO is facilitated by locating the transition zone. Most cases of SBO are due to postoperative adhesions. The diagnosis of adhesions is made by locating the point of obstruction and determining that a neoplasm, hernia, or other inflammatory condition is absent [6]. Thus, it is a diagnosis of exclusion. Rarely, internal hernias or strictures resulting from prior ischemia or inflammation may mimic the appearance of an adhesion on CT. Simple mechanical obstruc-

Received December 22, 2003; accepted after revision March 19, 2004.

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AJR 2004;183:1361–1366

0361–803X/04/1835–1361

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tion due to an adhesion is usually treated with an initial trial of nasogastric tube decompression and hydration. Detecting the point of transition helps to determine the cause of the SBO, but the point is often difficult to find, especially in patients with a paucity of intraperitoneal adipose tissue. Scrolling through the data at a workstation or PACS or using coronal and sagittal multiplanar reformatted images may be helpful in locating the point or zone of transition [7]. We have observed that the SBFS is frequently located at the point of transition

from dilated to collapsed bowel, aiding in the identification of the cause of the obstruction by revealing the transition zone.

The purpose of our study was to determine the frequency of the SBFS in patients with SBO and to determine if this sign can be used to accurately locate the point of obstruction.

Subjects and Methods

From November 2002 until March 2003, 34 consecutive adult patients (20 men and 14 women; mean age, 52 years; age range, 21–82 years) were

prospectively identified with CT findings of SBO. One of four abdominal radiologists who were prospectively interpreting routine abdominal–pelvic CT scans entered these cases of SBO into a database for future review.

All CT examinations were performed at a single institution using either a single-detector CT scanner (HiSpeed Advantage, GE Healthcare) or a 16-MDCT scanner (Sensation 16, Siemens Medical Solutions). Scans on the single-detector scanner were obtained with either 5- or 7-mm collimation and with a reconstruction interval every 4 or 6 mm, respectively. Scans on the 16-MDCT scanner were obtained with 16 × 1.5 mm-thick sections. Images were reconstructed as 2-mm-thick sections with 1-mm reconstruction intervals.

Oral administration of small increments of 800 mL of 2.1% weight/volume barium sulfate suspension (Readi-CAT 2, E-Z-EM) or dilute (2%) water-soluble contrast material (Gastrografin [meglumine diatrizoate mixed with sodium diatrizoate], Bristol-Myers Squibb) was begun 1 hr before scanning. If the patient could not tolerate oral contrast material, it was not administered. All patients received 150 mL of nonionic IV contrast material (Isovue [iopamidol, 300 mg I/mL], Berlex Laboratories) injected at a rate of 2–3 mL/sec using a power injector (Envision CT Injector, Medrad) beginning 70 sec before the initiation of scanning.

The CT findings used to diagnose the presence of SBO were dilated proximal small-bowel loops and a collapsed distal small bowel and colon. The degree of obstruction was rated as mild, moderate, or high-grade. Mild SBO was defined as a slight discrepancy (25–50%) between the calibers of the proximal and the distal small-bowel loops; moderate SBO was defined as a discrepancy of 50% or greater between the proximal and the distal small-bowel luminal calibers with residual gas or contrast material in the distal small bowel; and high-grade SBO was considered to be present if there was a discrepancy of 50% or greater between the proximal and distal small-bowel luminal calibers and if the distal small bowel and the colon were collapsed.

The presence or absence of the SBFS (particulate-type material in the dilated small bowel) was evaluated, and the location of the SBFS in relation to the transition zone was also examined. The location of the transition zone was determined by identifying a mass, hernia, or other cause of the SBO in the area in which a change in the caliber of the small bowel could be seen. For patients in whom an obvious mass or hernia was not present and in whom adhesions were believed to be the cause of the SBO, we used one of two workstations (Vitrea 2, Vital Images; Leonardo, Siemens Medical Solutions) that allow interactive axial, coronal, and sagittal scrolling functions to locate the point or zone of caliber change.

A single radiologist with 6 years' experience in abdominal imaging then evaluated the 34 cases from the database to confirm the presence of SBO and to determine the degree of obstruction, the

TABLE 1 Degree of Obstruction, Presence, and Location of "Small-Bowel Feces" Sign and Cause of Obstruction in 34 Patients				
Patient	Small-Bowel Obstruction	Small-Bowel Feces Sign	Location at Transition	Cause
1	Moderate	Yes	Yes	Stricture
2	Moderate	Yes	Yes	Crohn's disease
3	Mild	No	—	Adhesion
4	Moderate	Yes	Yes	Adhesion
5	Mild	No	—	Hernia
6	Mild	No	—	Adhesion
7	High	Yes	Yes	Adhesion
8	High	Yes	Yes	Adhesion
9	High	Yes	Yes	Adhesion
10	High	No	—	Crohn's disease
11	High	Yes	Yes	Hernia
12	Mild	No	—	Adhesion
13	High	No	—	Adhesion
14	Mild	Yes	Yes	Adhesion
15	High	No	—	Adhesion
16	High	Yes	Yes	Adhesion
17	High	Yes	Yes	Stricture
18	High	No	—	Adhesion
19	Moderate	Yes	No	Crohn's disease
20	Moderate	No	—	Hernia
21	High	No	—	Adhesion
22	Moderate	No	—	Gallstone
23	High	No	—	Adhesion
24	High	Yes	Yes	Tumor
25	High	Yes	Yes	Adhesion
26	High	Yes	Yes	Adhesion
27	Moderate	Yes	Yes	Adhesion
28	Moderate	Yes	Yes	Adhesion
29	High	Yes	Yes	Tumor
30	Moderate	Yes	Yes	Crohn's disease
31	Moderate	No	—	Adhesion
32	Mild	No	—	Tumor
33	High	No	—	Adhesion
34	Moderate	Yes	Yes	Hernia

Note.—Dash (—) indicates absence of small-bowel feces sign.

“Small-Bowel Feces” Sign on CT

presence or absence of the SBFS, and, if present, its location relative to the transition zone. The cause of the obstruction was determined using surgical findings or a combination of CT findings, follow-up barium studies, and clinical assessments.

Results

Twenty-five of the 34 patients were treated conservatively, and nine patients underwent surgery. The cause of the SBO was an adhesion in 20 patients, a hernia in four patients, Crohn's disease in four patients, a tumor in three patients, and other miscellaneous causes

in three patients (Table 1). The SBFS was present in 19 (55.9%) of 34 patients with SBO (Figs. 1 and 2). The SBFS was absent in 15 patients (44.1%) (Figs. 3 and 4). The degree of SBO was mild in six, moderate in 11, and high-grade in 17 patients. The SBFS was present in one (16.6%) of the six patients with mild, eight (72.7%) of the 11 patients with moderate, and 10 (58.8%) of the 17 patients with high-grade SBO.

In 18 (94.7%) of 19 patients in whom the SBFS was present, the particulate material could be traced to the point of transition and

was most conspicuous in the transition zone (Figs. 1 and 2). The length of fecalike material ranged from 2 to 25 cm and was longer in moderate and high-grade SBO than in mild SBO (Fig. 5). In a single case of SBO secondary to Crohn's disease, the SBFS was present; however, it was not located at the zone of transition.

The presence or absence of the SBFS was independent of the cause of the obstruction, occurring in 10 (50%) of 20 patients with an adhesion and in nine (64%) of 14 patients whose obstruction was due to causes other than an adhesion.

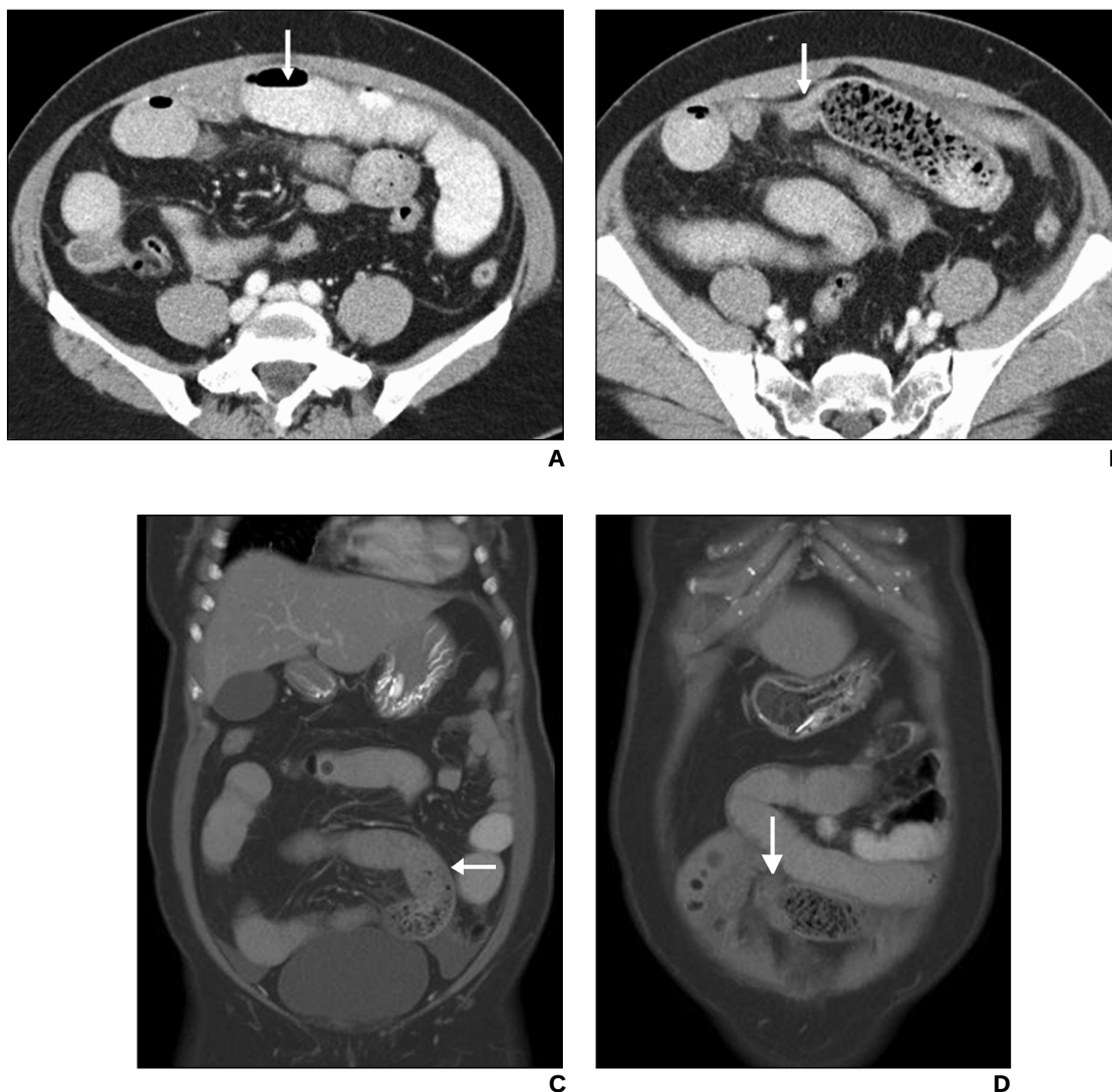


Fig. 1.—Small-bowel obstruction due to adhesion in 54-year-old woman (patient 4 in Table 1).

A, Axial CT scan obtained with IV and oral contrast material at level of upper pelvis shows dilated loops of small bowel that are filled with contrast material (*arrow*).

B, Axial CT scan obtained 5 cm caudal to **A** shows “small-bowel feces” sign (SBFS) (*arrow*) at point of transition.

C, Coronal reformatted image shows dilated loop (*arrow*) of small bowel filled with fluid.

D, Coronal reformatted image obtained several centimeters ventral to **C** shows intraluminal SBFS (*arrow*) at point of transition. Patient had remote history of prior surgery and improved with nasogastric tube decompression. Cause of obstruction was believed to be adhesion.

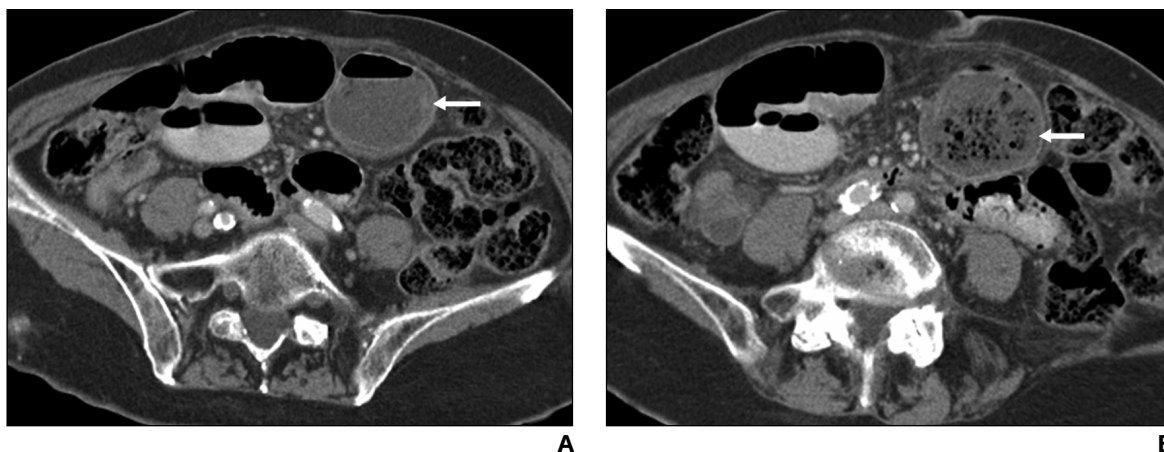


Fig. 2.—Small-bowel obstruction due to adhesion in 80-year-old woman (patient 7 in Table 1). **A**, Axial CT scan obtained with IV and oral contrast material at level of upper pelvis shows markedly dilated loop (arrow) of small bowel filled with fluid. **B**, Axial CT scan obtained 5 cm cephalad to **A** shows intraluminal “small-bowel feces” sign (SBFS) (arrow). **C**, Coronal reformatted image shows dilated loop of small bowel filled with fluid at transition zone (arrow). SBFS is seen within lumen of small bowel. Note totally collapsed loops of distal small bowel (arrowhead). Patient had history of prior surgery and improved with nasogastric tube decompression. Cause of obstruction was believed to be adhesion.

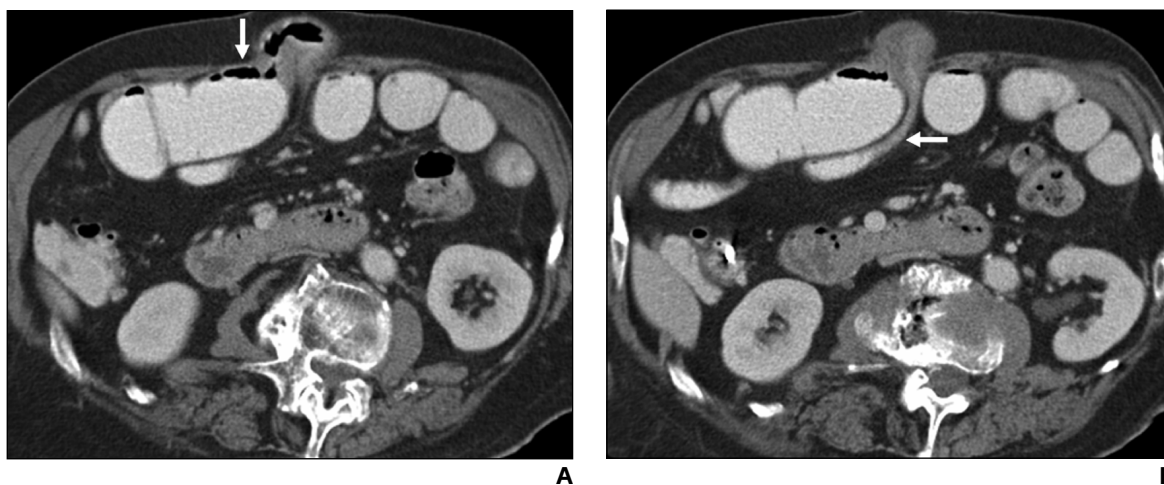


Fig. 3.—Small-bowel obstruction due to hernia in 70-year-old man (patient 20 in Table 1). **A**, Axial CT scan obtained with IV and oral contrast material at level of kidneys shows dilated loop (arrow) of small bowel entering ventral hernia. No “small-bowel feces” sign is present. **B**, Axial CT scan obtained 2 cm cephalad to **A** shows exiting collapsed loop (arrow).

“Small-Bowel Feces” Sign on CT

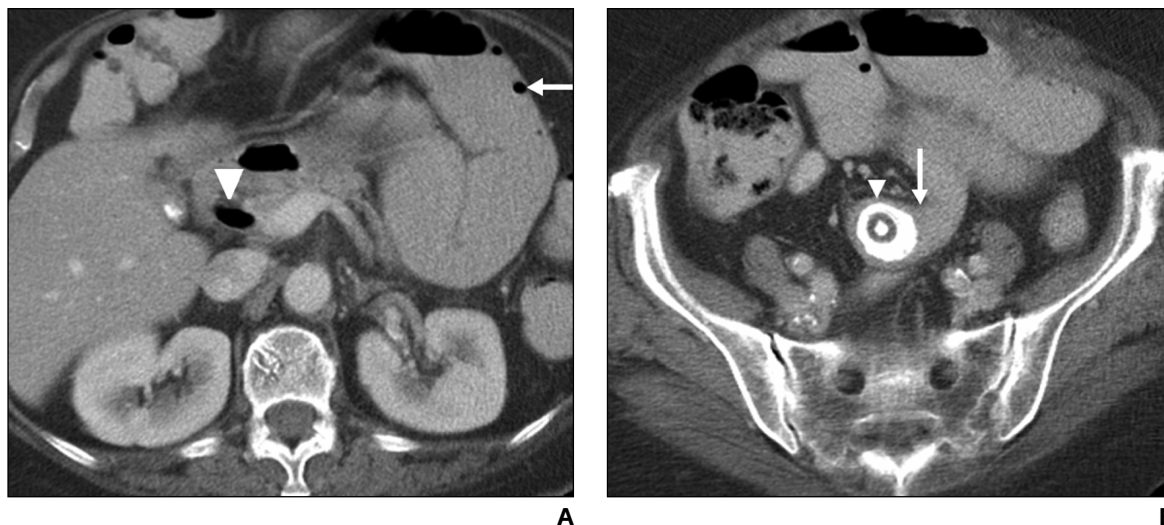


Fig. 4.—Small-bowel obstruction due to gallstone in 70-year-old man (patient 22 in Table 1).
A, Axial CT scan obtained with IV and oral contrast material at level of kidneys shows dilated loop (arrow) of small bowel. Note pneumobilia (arrowhead).
B, Axial CT scan obtained in mid pelvis show partially obstructing gallstone (arrowhead). No “small-bowel feces” sign is seen in bowel loop (arrow) proximal to gallstone.

Discussion

SBO is a common cause of abdominal pain. It accounts for approximately 4% of all patients presenting to emergency departments with an acute abdomen [8]. In the past, the condition was considered a surgical emergency because the cause was usually not apparent and complications such as closed loop and small-bowel ischemia were difficult to diagnose at clinical examination [1].

CT has become the primary imaging technique with which to evaluate and diagnose suspected cases of SBO. The diagnosis of SBO is made when a transition between a dilated small bowel to a collapsed distal small bowel and colon is visualized [2]. In addition to confirming the diagnosis of obstruction, CT is useful for determining the degree and the cause of obstruction and, perhaps most important, whether complications that prompt urgent surgical exploration (e.g., closed loop and ischemia) are present [9].

Adhesions are the most common cause of SBO, accounting for 60–80% of all cases [2]. Adhesions are the likely cause of SBO in patients in whom a smooth transition from dilated to collapsed small-bowel loops is noted. In cases of adhesions, mild bowel-wall edema may be present at the transition zone and minimal stranding of the adjacent perienteric fat may be seen. The adhesive band is rarely seen, and the differential diagnosis includes strictures secondary to inflam-

mation or prior irradiation as well as internal hernias. External hernias, tumors, and inflammatory processes account for most of the remaining cases of SBO.

Identifying the cause of the obstruction is facilitated by locating the transition point of the obstruction—the zone in which there is a change between the caliber of the dilated proximal loops and that of the collapsed distal loops of the bowel. The traditional way to determine the transition zone of an SBO is to use axial images. Although the transition zone of the obstruction may be readily apparent in cases of external hernia or large tumors, it is more difficult to discover in cases of adhesions, especially in patients with a paucity of intraperitoneal fat.

Several methods can be used to enhance detection of the transition zone on CT. First, scrolling through CT data in a cine mode at a workstation or PACS often allows one to track the course of the small bowel more easily than simply relying on static images. By scrolling back and forth through the data, the transition zone may become more apparent. Second, by acquiring thin-section CT data with near isotropic voxels, as are currently available with MDCT scanners, significantly improved multiplanar and 3D capabilities can be exploited using current workstation technology [7]. Finally, as has been previously reported, particulate fecallike material may be identified in the small bowel (SBFS) in patients with SBO [3, 10]. We have noticed that

this sign tends to be most prominent at the zone of transition from the dilated to the collapsed portions of the small bowel. We therefore undertook this study to determine if the SBFS could also be used to facilitate localization of the transition zone.

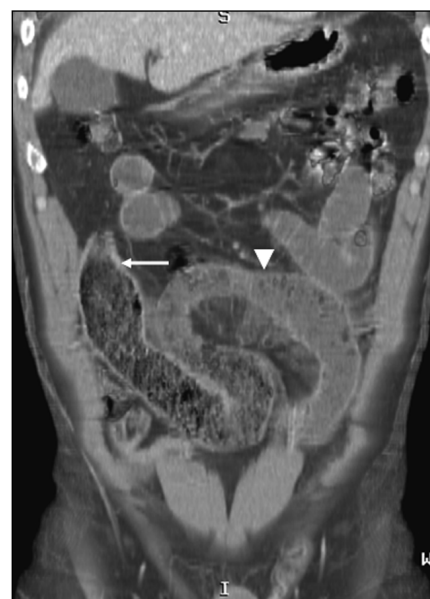


Fig. 5.—Small-bowel obstruction due to adhesion in 58-year-old man (patient 26 in Table 1). Coronal reformatted image shows progressive increase in density of particulate material (“small-bowel feces” sign) within obstructed small-bowel loop up to point of transition (arrow). In more proximal small bowel, intraluminal content is fluid (arrowhead).

The SBFS has been defined as gas and particulate material within a dilated small-bowel loop that simulates the appearance of feces [11]. It is likely caused by stasis within the obstructed loop, allowing more time for fluid absorption across the bowel wall and accumulation of undigested food particles [3, 10]. The SBFS is neither sensitive nor specific for the diagnosis of SBO. One retrospective study recognized the SBFS in only seven (7.4%) of 94 consecutive cases of SBO [10]. In our series, the SBFS was noted in 55.9% of consecutive patients with CT findings of SBO. A retrospective study found SBO in 18 (82%) of 22 patients who exhibited the SBFS on CT [3]. Therefore, the SBFS may be seen in the small bowel in patients without obstruction. This finding may be due to dietary intake with undigested vegetable matter in the lumen of the small bowel or reflux of fecal material across an incompetent ileocecal valve, producing a false-positive finding of SBFS.

However, we have found that the SBFS, when present in patients with SBO, is very useful for determining the location of the transition zone. In our series of 34 patients, the SBFS was located at or just proximal to the transition point in 18 of 19 patients. In some patients, the SBFS was not focal but was present in up to 25 cm of the small bowel. However, in these cases, the particulate material became more dense and fecal-like closer to the transition zone. The explanation is likely due to the accumulation of solid food particles and material at the point of obstruction.

In addition, we found that the SBFS was present more often in moderate and high-

grade SBO than in low-grade SBO. A prior study reported the presence of the SBFS in predominantly low-grade subacute obstruction [10]. The cause of this discrepancy in findings is unclear. One reason may be that it is not the degree of obstruction, but the chronicity of the process that is important. More chronic cases of obstruction may allow time for secretions and undigested material to accumulate within the obstructed bowel loop.

There are several limitations to our study. First, most patients in this study did not undergo surgery to confirm the presence and cause of SBO. However, all patients who did not undergo surgery had an initial clinical diagnosis of SBO, with CT findings confirming the diagnosis. Moreover, the current treatment of SBO due to adhesions without clinical or imaging signs of closed loop or ischemia is nonsurgical. We did not determine the length of time that the patients had been having symptoms before undergoing CT. As stated earlier, the presence of the SBFS may in part be due to the chronicity of the obstructing process. Finally, although SBFS has been observed in patients without intestinal obstruction, we did not evaluate the incidence of the SBFS in these patients. However, the aim in our study was to determine if SBFS when present could be used to help locate the transition zone.

In conclusion, our study has shown that when the SBFS is present in patients with SBO, it is located at or is most conspicuous at the point of transition. The SBFS is more often present in patients with moderate or high-grade SBO. Recognizing the SBFS in patients with

SBO is important because the sign usually is seen at the zone of transition, thus facilitating identification of the cause of the obstruction and thereby guiding appropriate treatment.

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