American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Suspected Small-Bowel Obstruction**

Variant 1: **Suspected complete or high-grade partial SBO.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast (routine)	8	Oral contrast should not be used. Positive enteric contrast may prevent detection of diminished bowel wall enhancement in ischemia and obscure abnormal mucosal enhancement in inflammatory and neoplastic conditions. Additional fluid from oral contrast is not well tolerated with bowel obstruction.	High
X-ray abdomen and pelvis	7		Med
CT abdomen and pelvis with contrast (CT enteroclysis)	4	A limited role if high-grade obstruction has been confirmed.	High
X-ray small bowel follow-through	4		Med
X-ray small bowel enteroclysis	4		Med
MRI abdomen and pelvis with or without contrast	4	See statement regarding contrast in text under "Anticipated Exceptions."	None
US abdomen and pelvis	2		None

Variant 2: **Suspected intermittent or low-grade SBO.**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with contrast (CT enteroclysis)	8	If other tests are negative.	High
MRI abdomen and pelvis with contrast (MR enteroclysis)	8	MR enterography may have sensitivity and specificity similar to CT enterography and avoids radiation risks. However, the choice of examination depends on institutional preferences and resources. See statement regarding contrast in text under "Anticipated Exceptions."	None
CT abdomen and pelvis with contrast (CT enterography)	7		High
MRI abdomen and pelvis with contrast (MR enterography)	7	See statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray small bowel enteroclysis	7		Med
CT abdomen and pelvis with contrast (routine)	5		High
X-ray small bowel follow-through	5		Med
MRI abdomen and pelvis with or without contrast (routine)	5	See statement regarding contrast in text under "Anticipated Exceptions."	None
X-ray abdomen and pelvis	4		Med
US abdomen and pelvis	2		None
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Summary of Literature Review

There is no single generally accepted approach to evaluate patients with suspected small-bowel obstruction (SBO). This, in part, reflects not only the differing perspectives of investigators who have written on the topic (surgeons and radiologists) but also the increasing application of sophisticated imaging studies. The diagnostic approach also depends on the clinical presentation (ie, acute high-grade vs. low-grade or intermittent SBO) [1].

Radiography has been the traditional starting point for imaging evaluation of suspected SBO. It must be conceded, however, that studies testing the utility of radiographs have yielded quite disparate results [2-5]. While some investigators report 80%-90% success in diagnosing SBO using radiographs [3], an overall accuracy equal to that of computed tomography (CT) [6], others have achieved rates only in the 30%-70% range [2,5,6]. In some even less encouraging studies, abdomen radiographs have proved to be of little to no help in assessing the site or cause of SBO [7,8], or even to be misleading in 20%-40% of patients [5].

In light of these inconsistent results, it is reasonable to expect that abdomen radiographs will not be definitive in many patients with suspected SBO. In such a setting, gastrointestinal contrast studies (small-bowel follow-through [SBFT], enteroclysis, and barium enema) or cross-sectional imaging studies (CT, ultrasound [US], and magnetic resonance imaging [MRI]) are options.

Contrast Enema

The single-contrast barium enema study with attempted reflux into the distal ileum can exclude colonic obstruction and may occasionally aid in distinguishing SBO from an adynamic ileus [9,10]. It is unreliable, however, for localizing and characterizing the site of SBO [10,11], as well as for identifying patients who will need surgery [11].

Small-Bowel Follow-Through

Opinion is divided on the usefulness of SBFT studies with orally administered barium. Some investigators have found this study useful for managing suspected SBO in 68%-100% of cases [9,11,12]. Because SBFT suffers from nonuniform small-bowel filling, inability to test distensibility, and limitations posed by intermittent fluoroscopy, some authorities argue that enteroclysis is the appropriate examination in problematic SBO cases [10,13,14].

CT Enteroclysis

Methods of examination that challenge the distensibility of the small bowel, such as standard or CT enteroclysis (CT-E), offer improved sensitivity and specificity over standard barium small-bowel and CT examinations in evaluating suspected intermittent or low-grade SBO [1,5,10,15,16]. Evidence is compelling that enteroclysis is highly reliable in pinpointing sites of low-grade and high-grade obstruction [13,17,18], as well as in distinguishing adhesions from obstructing neoplasms [13]. CT-E is generally favored over conventional enteroclysis because of its ability to avoid problems from overlapping bowel loops. CT-E should be considered as an alternative, especially in patients with a history of malignancy [1]. Enteroclysis has low patient acceptance and depends on the skill of the radiologist performing the examination.

CT Enterography

CT enterography does not require intubation of the small bowel and therefore has greater patient acceptance and is less dependent on the technical skill of the radiologist. However, its clinical usefulness in diagnosing intermittent or low-grade SBO has not yet been convincingly established. CT enterography with neutral-density enteric contrast offers an advantage over CT-E, particularly where detection and characterization of bowel wall abnormalities are important (eg, Crohn's, neoplasms).

Oral Contrast

Evaluation of suspected SBO with oral water-soluble contrast agents is controversial. Some authors point out that this technique is disadvantageous because of the potential for intravascular volume depletion and electrolyte imbalance, plus its suboptimal imaging characteristics compared with studies using barium contrast [10,19]. Others have found both low-osmolar and high-osmolar water-soluble agents to be useful in diagnosis, amelioration, and management of SBO [20-23]. Their stance is bolstered by reports of admittedly rare complications with barium studies, such as conversion from partial to complete obstruction [24]. A randomized controlled study concluded that water-soluble contrast administration was not useful in the management of these patients [25].

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Computed Tomography

Convincing studies have confirmed the usefulness of the standard CT examination in suspected high-grade SBO. Diagnostic accuracy of more than 90% has been reported [2,3,26], with success in distinguishing SBO from ileus [27] and in identifying the cause of obstruction [5,26]. Patients with suspected high-grade obstruction do not require additional oral contrast medium since the fluid in the bowel provides adequate contrast. Low-grade obstruction is a relative "blind spot" for standard CT. One study demonstrated correct diagnosis in fewer than half of such cases [16]. Newer multidetector (MDCT) scanners with multiplanar reconstruction capabilities have been noticeably more effective in evaluating SBO and other abdominal pathology, particularly when coronal reconstructions are added [28].

CT may be useful for detecting complications of bowel obstruction such as ischemia and strangulation [29-33]. CT signs of ischemic complications, when present, are highly specific [34]. When combined with clinical findings, the sensitivity of CT for detecting strangulation can be improved [35].

Ultrasound

Largely because of the success of enteroclysis and CT in diagnosing and characterizing SBO, US has been used rarely for this purpose in the United States; therefore data are scanty. In skilled hands, US has been reported to have a nearly 90% success rate in diagnosing SBO [8,36-38]. In the pediatric age group, US has proven useful in evaluating intussusception [17], midgut volvulus [39], and other causes of SBO [40]. CT proved superior to US in one study [41].

Magnetic Resonance Imaging

Increasing evidence supports MRI's capability to detect and characterize SBO [42-45]. Because of its higher cost and convincing lack of incremental diagnostic gain compared with CT, MRI should not be used routinely for evaluating suspected high-grade SBO. MR enteroclysis appears to compare favorably with CT enteroclysis in evaluating low-grade obstruction. Children and pregnant patients are a particularly good population to be offered MRI for SBO.

Summary

- Standard CT has emerged as the pre-eminent imaging modality for evaluating SBO and should be considered in the initial evaluation of patients with suspected high-grade SBO.
- The barium enema and small-bowel examination play a less significant role and should not be used as a primary modality in diagnosing acute SBO.
- If intermittent or low-grade SBO is a chief diagnostic concern, either CT or MR enteroclysis [15] is preferred.
- CT and MR enterography are likely superior to routine CT and MRI examinations and enjoy better patient acceptance than enteroclysis. However, there are no studies comparing enterography with enteroclysis techniques in low-grade SBO.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [46].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations	
Relative Radiation Level	**Effective Dose Estimate Range**
None	0
Minimal	< 0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

Supporting Document(s)

- ACR Appropriateness Criteria® Overview
- Evidence Table

References

1. Walsh D, Bender G, Timmons J. Comparison of computed tomography-enteroclysis and traditional computed tomography in the setting of suspected partial small-bowel obstruction. *Emerg Radiol* 1998; 5:29-37.
2. Frager D, Medwid SW, Baer JW, Mollinelli B, Friedman M. CT of small-bowel obstruction: value in establishing the diagnosis and determining the degree and cause. *AJR* 1994; 162(1):37-41.
3. Fukuya T, Hawes DR, Lu CC, Chang PJ, Barloon TJ. CT diagnosis of small-bowel obstruction: efficacy in 60 patients. *AJR* 1992; 158(4):765-769; discussion 771-762.

4. Matsuo Y. Degree of bowel distension on plain-radiographs--a surgical-radiological study of new criteria in mechanical intestinal obstruction. *Jpn J Surg* 1978; 8(3):222-227.
5. Shrake PD, Rex DK, Lappas JC, Maglinte DD. Radiographic evaluation of suspected small bowel obstruction. *Am J Gastroenterol* 1991; 86(2):175-178.
6. Maglinte DD, Reyes BL, Harmon BH, et al. Reliability and role of plain film radiography and CT in the diagnosis of small-bowel obstruction. *AJR* 1996; 167(6):1451-1455.
7. Heinberg EM, Finan MA, Chambers RB, Bazzett LB, Kline RC. Postoperative ileus on a gynecologic oncology service--do abdominal X-rays have a role? *Gynecol Oncol* 2003; 90(1):158-162.
8. Ko YT, Lim JH, Lee DH, Lee HW, Lim JW. Small bowel obstruction: sonographic evaluation. *Radiology* 1993; 188(3):649-653.
9. Dunn JT, Halls JM, Berne TV. Roentgenographic contrast studies in acute small-bowel obstruction. *Arch Surg* 1984; 119(11):1305-1308.
10. Maglinte D, Herlinger H, Turner W, Kelvin F. Radiologic management of small bowel obstruction: a practical approach. *Emerg Radiol* 1994; 1994(1):138-149.
11. Ericksen AS, Krasna MJ, Mast BA, Nosher JL, Brolin RE. Use of gastrointestinal contrast studies in obstruction of the small and large bowel. *Dis Colon Rectum* 1990; 33(1):56-64.
12. Anderson CA, Humphrey WT. Contrast radiography in small bowel obstruction: a prospective, randomized trial. *Mil Med* 1997; 162(11):749-752.
13. Caroline DF, Herlinger H, Laufer I, Kressel HY, Levine MS. Small-bowel enema in the diagnosis of adhesive obstructions. *AJR* 1984; 142(6):1133-1139.
14. Maglinte DD, Burney BT, Miller RE. Lesions missed on small-bowel follow-through: analysis and recommendations. *Radiology* 1982; 144(4):737-739.
15. Boudiaf M, Jaff A, Soyer P, Bouhnik Y, Hamzi L, Rymer R. Small-bowel diseases: prospective evaluation of multi-detector row helical CT enteroclysis in 107 consecutive patients. *Radiology* 2004; 233(2):338-344.
16. Maglinte DD, Gage SN, Harmon BH, et al. Obstruction of the small intestine: accuracy and role of CT in diagnosis. *Radiology* 1993; 188(1):61-64.
17. Makanjuola D. Computed tomography compared with small bowel enema in clinically equivocal intestinal obstruction. *Clin Radiol* 1998; 53(3):203-208.
18. Roediger WE, Marshall VC, Roberts S. Value of small bowel enema in incomplete intestinal obstruction. *Aust N Z J Surg* 1982; 52(5):507-509.
19. Bhisitkul DM, Listernick R, Shkolnik A, et al. Clinical application of ultrasonography in the diagnosis of intussusception. *J Pediatr* 1992; 121(2):182-186.
20. Assalia A, Schein M, Kopelman D, Hirshberg A, Hashmonai M. Therapeutic effect of oral Gastrografin in adhesive, partial small-bowel obstruction: a prospective randomized trial. *Surgery* 1994; 115(4):433-437.
21. Chung CC, Meng WC, Yu SC, Leung KL, Lau WY, Li AK. A prospective study on the use of water-soluble contrast follow-through radiology in the management of small bowel obstruction. *Aust N Z J Surg* 1996; 66(9):598-601.
22. Joyce WP, Delaney PV, Gorey TF, Fitzpatrick JM. The value of water-soluble contrast radiology in the management of acute small bowel obstruction. *Ann R Coll Surg Engl* 1992; 74(6):422-425.
23. Stordahl A. Water-soluble contrast media in obstructed in ischemic small intestine. A clinical and experimental study. *J Oslo City Hosp* 1989; 39(1-2):3-22.
24. Assalia A, Schein M, Hashmonai M. Barium contrast study converts partial small-bowel obstruction into a complete one. Report of 2 cases. *S Afr J Surg* 1993; 31(3):102-103.
25. Fevang BT, Jensen D, Fevang J, et al. Upper gastrointestinal contrast study in the management of small bowel obstruction--a prospective randomised study. *Eur J Surg* 2000; 166(1):39-43.
26. Megibow AJ, Balthazar EJ, Cho KC, Medwid SW, Birnbaum BA, Noz ME. Bowel obstruction: evaluation with CT. *Radiology* 1991; 180(2):313-318.
27. Gazelle GS, Goldberg MA, Wittenberg J, Halpern EF, Pinkney L, Mueller PR. Efficacy of CT in distinguishing small-bowel obstruction from other causes of small-bowel dilatation. *AJR* 1994; 162(1):43-47.
28. Jaffe TA, Martin LC, Thomas J, Adamson AR, DeLong DM, Paulson EK. Small-bowel obstruction: coronal reformations from isotropic voxels at 16-section multi-detector row CT. *Radiology* 2006; 238(1):135-142.
29. Balthazar EJ, Liebeskind ME, Macari M. Intestinal ischemia in patients in whom small bowel obstruction is suspected: evaluation of accuracy, limitations, and clinical implications of CT in diagnosis. *Radiology* 1997; 205(2):519-522.
30. Donckier V, Closset J, Van Gansbeke D, et al. Contribution of computed tomography to decision making in the management of adhesive small bowel obstruction. *Br J Surg* 1998; 85(8):1071-1074.
31. Frager D, Baer JW, Medwid SW, Rothpearl A, Bossart P. Detection of intestinal ischemia in patients with acute small-bowel obstruction due to adhesions or hernia: efficacy of CT. *AJR* 1996; 166(1):67-71.
32. Ha HK, Kim JS, Lee MS, et al. Differentiation of simple and strangulated small-bowel obstructions: usefulness of known CT criteria. *Radiology* 1997; 204(2):507-512.
33. Zalcman M, Sy M, Donckier V, Closset J, Gansbeke DV. Helical CT signs in the diagnosis of intestinal ischemia in small-bowel obstruction. *AJR* 2000; 175(6):1601-1607.
34. Sheedy SP, Earnest Ft, Fletcher JG, Fidler JL, Hoskin TL. CT of small-bowel ischemia associated with obstruction in emergency department patients: diagnostic performance evaluation. *Radiology* 2006; 241(3):729-736.
35. Kim JH, Ha HK, Kim JK, et al. Usefulness of known computed tomography and clinical criteria for diagnosing strangulation in small-bowel obstruction: analysis of true and false interpretation groups in computed tomography. *World J Surg* 2004; 28(1):63-68.
36. Czechowski J. Conventional radiography and ultrasonography in the diagnosis of small bowel obstruction and strangulation. *Acta Radiol* 1996; 37(2):186-189.
37. Schmutz GR, Benko A, Fournier L, Peron JM, Morel E, Chiche L. Small bowel obstruction: role and contribution of sonography. *Eur Radiol* 1997; 7(7):1054-1058.
38. Wold PB, Fletcher JG, Johnson CD, Sandborn WJ. Assessment of small bowel Crohn disease: noninvasive peroral CT enterography compared with other imaging methods and endoscopy--feasibility study. *Radiology* 2003; 229(1):275-281.
39. Pracros JP, Sann L, Genin G, et al. Ultrasound diagnosis of midgut volvulus: the "whirlpool" sign. *Pediatr Radiol* 1992; 22(1):18-20.
40. Ikeda H, Matsuyama S, Suzuki N, Takahashi A, Kuroiwa M, Hatakeyama S. Small bowel obstruction in children: review of 10 years experience. *Acta Paediatr Jpn* 1993; 35(6):504-507.
41. Suri S, Gupta S, Sudhakar PJ, Venkataramu NK, Sood B, Wig JD. Comparative evaluation of plain films, ultrasound and CT in the diagnosis of intestinal obstruction. *Acta Radiol* 1999; 40(4):422-428.
42. Chou CK, Liu GC, Chen LT, Jaw TS. The use of MRI in bowel obstruction. *Abdom Imaging* 1993; 18(2):131-135.
43. Lee JK, Marcos HB, Semelka RC. MR imaging of the small bowel using the HASTE sequence. *AJR* 1998; 170(6):1457-1463.
44. Matsuoka H, Takahara T, Masaki T, Sugiyama M, Hachiya J, Atomi Y. Preoperative evaluation by magnetic resonance imaging in patients with bowel obstruction. *Am J Surg* 2002; 183(6):614-617.
45. Regan F, Beall DP, Bohlman ME, Khazan R, Sufi A, Schaefer DC. Fast MR imaging and the detection of small-bowel obstruction. *AJR* 1998; 170(6):1465-1469.
46. American College of Radiology. *Manual on Contrast Media*. Available at: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx.

The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.