American College of Radiology
ACR Appropriateness Criteria®

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

Variant 1: **Suspected high-grade small-bowel obstruction (SBO), based on clinical evaluation or initial radiography (if performed).**

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with IV contrast	9	Oral contrast should not be used if high-grade SBO is known or suspected. Oral contrast will not reach the site of obstruction, wastes time, adds expense, can induce further patient discomfort, will not add to diagnostic accuracy, and can lead to complications, particularly vomiting and aspiration.	☢ ☢ ☢ ☢
CT abdomen and pelvis without IV contrast	7	Perform this procedure in patients who have known or suspected high-grade SBO when IV contrast is contraindicated.	☢ ☢ ☢ ☢
MRI abdomen and pelvis without and with IV contrast (routine)	6	MRI is most appropriate in children and younger adult patients who have had multiple prior CT examinations.	O
X-ray abdomen and pelvis	5	Perform this procedure if it has not already been performed.	☢ ☢ ☢
CT abdomen and pelvis without and with IV contrast	4		☢ ☢ ☢ ☢
MRI abdomen and pelvis without IV contrast (routine)	4	MRI is most appropriate for pregnant women, children, and younger adult patients who have had multiple prior CT examinations.	O
X-ray small bowel follow-through	4	This procedure has a limited role if a high-grade obstruction has been confirmed by radiography or CT/MRI. Perform the x-ray with water-soluble contrast material, and use iso- or low-osmolar contrast material if there is a risk of aspiration.	☢ ☢ ☢
CT enteroclysis	3	This procedure may not be readily available at most institutions or radiology practices. Generally, it is not indicated in the acute setting.	☢ ☢ ☢ ☢
CT enterography	3	This procedure has a limited role if radiography or routine CT/MR has confirmed a high-grade obstruction. The exact protocol depends on the patient's circumstances and the radiologist's preference. Generally, it is of little use in the acute setting due to lack of tolerance of the volume of fluid ingested if there is an obstruction.	☢ ☢ ☢ ☢
MR enteroclysis	3	This procedure may not be readily available at most institutions or radiology practices.	O
MR enterography	3	This procedure has a limited role if radiography or routine CT/MR has confirmed a high-grade obstruction. The exact protocol depends on the patient's circumstances and the radiologist's preference. Generally, it is not indicated in the acute setting.	O

X-ray small bowel enteroclysis	3	This procedure has a limited role if radiography or CT/MR has confirmed a high-grade obstruction by radiography or CT/MR.	☢ ☢ ☢
US abdomen and pelvis	2		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

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

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen and pelvis with IV contrast	8	In contrast to a high-grade obstruction, oral contrast is not necessarily contraindicated and may add functional information.	☢ ☢ ☢ ☢
CT enteroclysis	8	This procedure may not be readily available at most institutions or radiology practices. CT enteroclysis, MR enteroclysis, and x-ray enteroclysis are alternative examinations.	☢ ☢ ☢ ☢
MR enteroclysis	8	This procedure may not be readily available at most institutions or radiology practices. CT enteroclysis, MR enteroclysis, and x-ray enteroclysis are alternative examinations.	O
X-ray small bowel enteroclysis	7	This procedure may not be readily available at most institutions or radiology practices. CT enteroclysis, MR enteroclysis, and x-ray enteroclysis are alternative examinations.	☢ ☢ ☢
CT abdomen and pelvis without IV contrast	6	Perform this procedure when IV contrast is contraindicated. In contrast to a high-grade obstruction, oral contrast is not necessarily contraindicated and may add functional information.	☢ ☢ ☢ ☢
CT enterography	5	The exact protocol depends on the patient's circumstances and the radiologist's preference. There is no evidence that CT enterography can accurately identify the presence or site of obstruction in this population, other than to characterize known or suspected Crohn disease.	☢ ☢ ☢ ☢
MR enterography	5	The exact protocol depends on the patient's circumstances and the radiologist's preference. This procedure's role in SBO is not established, other than to characterize Crohn disease. MR enterography has no proven efficacy in intermittent or low-grade SBO; it is useful only if the suspected cause is a tumor (including concurrent obscure gastrointestinal bleeding), in which case a multiphase CT enterography may be preferable.	O

X-ray small bowel follow-through	5	This procedure may add functional information. It should be performed with a water-soluble contrast, which can be helpful in predicting whether the patient should go to surgery. Use iso- or low-osmolar contrast material, if there is a risk of aspiration.	☢ ☢ ☢
MRI abdomen and pelvis without IV contrast (routine)	4		O
MRI abdomen and pelvis without and with IV contrast (routine)	4		O
X-ray abdomen and pelvis	4		☢ ☢ ☢
CT abdomen and pelvis without and with IV contrast	3		☢ ☢ ☢ ☢
US abdomen and pelvis	2		O
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

SUSPECTED SMALL-BOWEL OBSTRUCTION

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Summary of Literature Review

Abdominal Radiography

Abdominal radiography has been the traditional starting point for the imaging evaluation of suspected small-bowel obstruction (SBO) [1]. However, studies testing the use of abdominal radiographs have yielded disparate results [2-5]. Although some investigators have reported an 80%–90% success rate in diagnosing SBO using radiographs [3], an overall accuracy somewhat approaching that of computed tomography (CT) [6], others have achieved rates only in the 30%–70% range [2,5,6]. In other studies, abdominal radiographs proved to be of little or no help in assessing the site or cause of SBO [7,8] and were even misleading in 20%–40% of patients [5]. A relatively recent study, however, found that abdominal radiographs were accurate for detecting acute SBO. This study showed that by using 3 patterns of air-fluid levels senior radiologists achieved more accuracy than less experienced radiologists [9]. It should be stressed, however, that it is impossible to differentiate a SBO from a postoperative ileus in the perioperative period based on a single examination. Serial examinations showing persistent dilated small-bowel loops with air-fluid levels and relative or complete paucity of gas in the colon favor SBO.

Despite the relatively high accuracy of abdominal radiographs in detecting SBO, CT provides much more information, including the site and cause of the obstruction and complications of SBO. As a result, CT findings generally influence patient management much more than do abdominal radiographs.

In light of these inconsistent results, it is reasonable to expect that abdominal radiographs will not be definitive in many patients with a suspected SBO. It could prolong the evaluation period and add radiation exposure while often not obviating the need for additional examinations, particularly CT. Therefore, in patients with a known or suspected SBO, fluoroscopic-contrast examinations (small-bowel follow-through [SBFT], conventional enteroclysis), and, particularly, cross-sectional imaging examinations (CT, magnetic resonance imaging [MRI], ultrasound [US]), as well as specialized cross-sectional imaging examinations (CT enterography, CT enteroclysis, MR enterography, and MR enteroclysis), may be more appropriate options.

Small-Bowel Follow-Through

Opinions remain divided on the usefulness of SBFT examinations with an orally administered barium contrast. Some investigators have found this examination useful for managing suspected SBO in 68%–100% of cases [10]. Because SBFT is limited by nonuniform small-bowel filling, cannot test distensibility, and has limitations posed by intermittent fluoroscopy, some authorities argue that enteroclysis is the more appropriate imaging examination in problematic SBO cases [11,12]. The SBFT should, therefore, be considered a problem-solving examination following an equivocal CT, particularly with low-grade or intermittent/partial obstruction [13].

Water-Soluble Contrast Agent Use in Small-Bowel Follow-Through

One of the major issues with SBO is whether to conservatively manage it or to operate, even after CT confirms the diagnosis of SBO and excludes complications of ischemia and a closed loop. This is especially true in the perioperative period, when distinguishing an ileus from an obstruction is often impossible and when, within the first 10 days, a reoperation can lead to multiple, inadvertent enterotomies and other potential complications. In these cases, many surgeons use a water-soluble contrast small-bowel series, either orally or via a nasogastric tube, because the results of the examination are highly prognostic of whether a patient will require surgery.

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The use of oral water-soluble contrast agents in patients with a SBO is very controversial, particularly its therapeutic role (a subject not in the purview of this Appropriateness Criteria) [13-21]. However, a recent systematic review and meta-analysis of the diagnostic role of water-soluble contrast agents in adhesive SBO (including 14 prospective studies) concluded that if contrast reached the colon within 4–24 hours (often within 8 hours), there was 96% sensitivity and 98% specificity in predicting resolution of the SBO [22]. Therefore, it seems reasonable that in the proper clinical setting, in which a SBO is known, and signs, symptoms, laboratory values, and a CT have been used to exclude reasons for immediate operative management, a water-soluble contrast small-bowel study can assist management decisions [22].

Computed Tomography

Multiple publications have confirmed the use and accuracy of "standard" abdominal and pelvic CT examinations in patients with a suspected high-grade SBO. A diagnostic accuracy of more than 90% has been reported [2,3,21], with high accuracy for distinguishing SBO from an adynamic small-bowel ileus [17] and for identifying the cause of obstruction [5,14,15,21]. Patients with a suspected high-grade obstruction do not require any oral contrast medium because the nonopacified fluid in the bowel provides adequate intrinsic contrast. Additionally, oral contrast use in a known or suspected high-grade SBO does not add to diagnostic accuracy and can delay diagnosis, slightly increase cost, increase patient discomfort, and increase the risk of complications, particularly vomiting and aspiration. However, SBO may be identified in patients who have undergone CT with oral (with or without intravenous [IV]) contrast, when SBO is not specifically suspected. Alternatively, oral contrast may be purposefully given to selected patients when SBO is a consideration but a high-grade obstruction is not the primary clinical diagnosis. A low-grade/intermittent obstruction is less accurately diagnosed using CT. In 1 study, the correct diagnosis was made in less than half of such patients. Multidetector CT scanners with multiplanar reconstruction capabilities have been noticeably more effective for evaluating SBO and other abdominal pathology, particularly when coronal or 3-D reconstructions are added [16,18-20,23,24]. Multiplanar reformations have also been found to increase accuracy and confidence in locating the transition zone in SBO, which can be a useful adjunct if an operative intervention is planned [19,25]. An IV contrast is preferable for routine CT imaging of a suspected SBO, in part to demonstrate whether the bowel is perfusing normally or is potentially ischemic, and, in a minority of cases, to provide information about the potential etiology, such as Crohn disease and neoplasm. However, in patients who cannot receive IV contrast due to an allergy or renal dysfunction, noncontrast CT appears to have comparable accuracy for diagnosing or excluding SBO [26].

In addition to CT's high accuracy for detecting a SBO, CT has been shown to be very helpful in guiding management. CT is very useful for assessing SBO complications, namely ischemia and strangulation [27-31], as well as conditions that lead directly to both obstruction and ischemia if untreated (ie, closed-loop SBO) [32]. With CT, signs of ischemic complications, when present, are highly specific [33,34]. Unfortunately, CT is not very sensitive for identifying ischemia; in 1 study, the prospective sensitivity, based on the initial radiology report, was only 14.8% [32]. Even retrospectively, the sensitivity of 2 experienced radiologists was 29.6% and 40.7% (consensus review of a third radiologist was 51.9%). Another study found that using maximal attenuation of a region of interest when assessing bowel-wall enhancement was a reliable method for evaluating intestinal ischemia in a SBO, and it and showed good correlation with the pathology results [35]. When combined with clinical findings, CT's sensitivity for detecting strangulation and associated complications can be improved [35-40]. Ultimately, CT has been useful in effectively triaging patients into operative versus nonoperative treatment groups [25,41-47]. Signs such as intraperitoneal fluid, mesenteric edema, and the absence of small-bowel feces suggest that early surgical intervention should be considered.

Conventional Enteroclysis and CT Enteroclysis

Methods of examination that challenge the distensibility of the small bowel, including conventional (ie, fluoroscopic) enteroclysis and CT enteroclysis, offer improved sensitivity and specificity over standard barium small-bowel and CT examinations in evaluating suspected intermittent or low-grade SBO [1,5,48-51]. There is solid evidence that enteroclysis is highly reliable in revealing sites of low- and high-grade SBO [11,52,53], as well as for distinguishing adhesions from obstructing neoplasms or other etiologies [11]. CT enteroclysis is generally favored over conventional enteroclysis because it avoids the problem of overlapping small-bowel loops; it also has been shown to demonstrate a larger number of bowel abnormalities and more abnormalities outside the bowel [54]. To our knowledge, however, CT enteroclysis is not widely used in the United States at present. CT enteroclysis should be considered, especially for patients who have a history of malignancy [1]. Enteroclysis has low patient acceptance and depends on the skill of the radiologist performing the examination (the same problem

exists for CT enteroclysis). Additionally, in the acute setting, enteroclysis (using any modality) can be difficult to perform, has very limited availability, and is generally not indicated. Also, the radiation dose can be relatively high in enteroclysis, especially if there is difficulty in positioning the tube; however, the dose can be substantially reduced by using pulsed fluoroscopy.

CT Enterography

CT enterography does not require intubation of the small bowel and, therefore, has greater patient acceptance and is less dependent on the radiologist's technical skill [55]. To our knowledge, however, its clinical usefulness for diagnosing intermittent or low-grade SBO has not been convincingly established. Additionally, patients may lack the tolerance to ingest a relatively large volume of fluid, if the bowel is obstructed. Because there is little evidence that CT enterography can be used reliably to identify intermittent- or low-grade SBO we cannot recommend this examination for these patients unless neoplasm is suspected as a cause (ie, no prior surgery and no known hernia and/or concomittent obscure gastrointestinal bleeding).

Ultrasound

Because of CT's high accuracy for diagnosing and characterizing SBO and because of the inherent limitation of US in adults in this situation, US has rarely been used for this purpose. Compared with sonography, CT (or MRI) generally provides more information as to the status of the entire gastrointestinal tract, the 3-D anatomy, and the underlying causes and complications of SBO, and it is preferred by surgeons for adult patient management. In skilled hands, US was reported to have a nearly 90% success rate for diagnosing SBO [8,56-58], with a sensitivity of 91% and a specificity of 84%, in a prospective study of 76 patients with suspected SBO who underwent bedside US [59]. In an older study [60], CT proved superior to US in diagnosing intestinal obstructions. In the pediatric age group, US has proven useful in evaluating intussusception [52], midgut volvulus [61], and other causes of SBO [62].

Magnetic Resonance Imaging

Increasing evidence supports the role of MRI for detecting and characterizing SBO, particularly in patients for whom ionizing radiation exposure should be avoided [63-67]. Because of its relatively high cost and absent evidence of any incremental diagnostic gain, compared with CT, *in most patients* MRI should not be used routinely to evaluate suspected high-grade SBO [68]. MR enteroclysis appears to compare favorably with CT enteroclysis in evaluating a low-grade obstruction [69], although neither MR enteroclysis nor CT enteroclysis are in wide use. Children and, particularly, pregnant patients with known or suspected SBO, as well as younger patients with repetitive episodes of obstruction, are the ideal population to undergo MRI. In pregnant patients, only noncontrast sequences are obtained. In nonpregnant individuals, noncontrast sequences, with or without IV gadolinium-enhanced sequences, can be performed [70]. MR enterography may be superior to routine MR examinations and is better accepted by patients than MR enteroclysis. To our knowledge, however, little data are available on comparing MR enterography with other imaging examinations in patients with a suspected SBO.

Summary

- Radiographs have relatively limited use for the imaging confirmation and characterization of a SBO. In patients for whom a strong clinical suspicion is present, consideration should be given to immediate cross-sectional imaging, particularly CT.
- Standard CT, performed with an IV contrast if possible, but generally without oral contrast, is the primary imaging modality for evaluating SBO and should be strongly considered in the initial evaluation of patients with a suspected high-grade SBO. CT also has use in evaluating lower grades of SBO and can be used to identify an obstruction, when obstruction is not the primary clinical consideration.
- Fluoroscopic small-bowel examinations play a much less substantial role and should not be used as a primary imaging modality in diagnosing an acute SBO.
- If intermittent, recurrent, or low-grade SBO is a primary concern, an enteroclysis is likely the next best test, although it may not be readily available at most institutions or radiology practices.
- In the proper clinical setting, a water-soluble contrast small-bowel series can be helpful in determining whether conservative or operative management is appropriate.
- Children and, particularly, pregnant patients with known or suspected SBO, as well as younger patients with repetitive episodes of obstruction, are the ideal population to undergo MRI. In pregnant patients, only

noncontrast sequences are obtained. In nonpregnant individuals, noncontrast sequences with or without IV gadolinium-enhanced sequences can be performed.

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. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). 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*	**Adult Effective Dose Estimate Range**	**Pediatric Effective Dose Estimate Range**
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢ ☢	0.1-1 mSv	0.03-0.3 mSv
☢ ☢ ☢	1-10 mSv	0.3-3 mSv
☢ ☢ ☢ ☢	10-30 mSv	3-10 mSv
☢ ☢ ☢ ☢ ☢	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".		

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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