ACR–SPR PRACTICE PARAMETER FOR THE PERFORMANCE OF A CONTRAST SMALL BOWEL EXAMINATION

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The American College of Radiology will periodically define new practice parameters and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice parameters and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice parameter and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review and approval. The practice parameters and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice parameter and technical standard by those entities not providing these services is not authorized.

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care[1]. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner considering all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The purpose of this document is to assist practitioners in achieving this objective.

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1 *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (Iowa 2013) Iowa Supreme Court refuses to find that the "ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures (Revised 2008)" sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, Stanley v. McCarver, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.*

I. INTRODUCTION

This practice parameter was revised by the American College of Radiology (ACR) in collaboration with the Society for Pediatric Radiology (SPR).

Radiographic examination of the small bowel after oral ingestion of contrast (eg, small bowel follow-through) is a proven and useful procedure. The purpose is to establish the presence or absence of a disease and its nature by opacifying the small bowel with contrast and taking sequential images. The goal is to obtain a diagnostic-quality study visualizing the small bowel with the minimum radiation dose necessary. Peroral pneumocolon is an adjunct technique that involves retrograde insufflation of air into the terminal ileum via a rectal tube.

Computed Tomography (CT) is often selected as the imaging examination of choice for patients with suspected small bowel obstruction because it does not rely on contrast reaching the site of obstruction to allow identification of its location [1,2].

A small bowel examination with water-soluble contrast, a "water-soluble contrast challenge," (or "gastrografin challenge") can be used as a potential predictor of nonoperative resolution of small bowel obstruction (SBO) [3], especially in the setting of SBO due to adhesive disease [4-6]. The water-soluble contrast challenge involves administration of water-soluble enteric contrast orally or via an enteric tube followed by serial abdominal radiographs at intervals over a period of time, most often a 24-hour period, to evaluate for transit of contrast into the colon. A functional study such as a contrast small bowel examination with dynamic monitoring may be beneficial to determine which patients will require surgical intervention. There is some debate in the literature about the best endpoint for the challenge; however, a commonly used endpoint is 24 hours [2,6,10]. Surgery is rarely required if contrast reaches the colon within 24 hours (a passed challenge), whereas if contrast has not reached the colon in 24 hours, surgery is usually necessary (a failed challenge) [5,7,8]. Despite high technical adequacy and high diagnostic performance of the water-soluble challenge, this should be undertaken only for selected patients.

Although there is a strong consensus regarding the diagnostic utility of a water-soluble contrast challenge, especially in SBO due to adhesive disease, a therapeutic role for this "challenge" remains controversial [3,4,7,9,11]. There may be benefit in terms of shorter duration of hospital stay, complications, and mortality in nonoperative patients [2,4,11]. Although advocated by some surgeons, water-soluble contrast small bowel examinations are not effective in treating prolonged postoperative ileus [12].

For some indications of a contrast small bowel examination such as inflammatory bowel disease and suspected (formerly known as obscure) bleeding [13], the contrast small bowel examination has been largely supplanted by CT enterography or MR enterography [14-18] and is no longer the examination of choice.

In very rare situations, enteroclysis may also be chosen over the contrast small bowel examination to provide better bowel distention and mucosal detail. However, enteroclysis is more invasive than other contrast small bowel exams and requires specific expertise. Advances in endoscopic as well as cross-sectional small bowel imaging techniques have led to enteroclysis being largely supplanted by those techniques.

II. INDICATIONS<u>AND CONTRAINDICATIONS</u>

A. Indications for contrast small bowel examinations include, but are not limited to:

1. Diverticula
2. Evaluation for presence of primary or secondary neoplasm(s)
3. Evaluation of congenital bowel anomaly
4. Evaluation of postsurgical anatomy
5. Evaluation of suspected or known enteric fistula
6. History of small bowel disease
7. Inflammatory bowel disease
8. Known or suspected small bowel stricture, tethering or obstruction (see above regarding CT)

9. Malabsorption
10. Polyposis syndrome such as Cowden or Peutz-Jeghers
11. Protein-losing enteropathy
12. Suspected small bowel bleeding or iron deficiency anemia
13. Possible small bowel stricture or obstruction (see above regarding CT)
14. Possible intermittent low grade small bowel obstruction
15. Possible internal hernia
16. Possible postoperative leak
17. Evaluation for an asymptomatic stricture prior to capsule enteroscopy

B. Pertinent symptoms that may serve as indications for a contrast small bowel examination include, but are not limited to:

1. Abdominal pain
2. Diarrhea
3. Abdominal masses
4. Unexplained fever
5. Vomiting
6. Failure to thrive or weight loss

C. Contraindications for contrast small bowel examinations using barium may include, but are not limited to:
1. High-grade distal small bowel obstruction
2. Suspected perforation
3. Barium contrast media allergy

D. Contraindications for contrast small bowel examinations using water-soluble, iodinated contrast may include, but are not limited to:

1. iodinated contrast media allergy

- Pediatric Patients Special Considerations:

1. Some indications for contrast small bowel examinations are unique to the pediatric population. Examples
   a. Failure to
   thrive
2. Ischemic stricture secondary to necrotizing enterocolitis
3. Pseudoobstruction

- Patient preparation protocols differ for children.

Guidance is provided in IV.B

- Examination Technique related to contrast selections and administration differs for children. Guidance is provided in IV.D.1.b
- Examination Technique related to the fluoroscopy procedure may differ children. Additional considerations include:
  1. Pulsed fluoroscopy at the lowest applicable rate without magnification and last image hold and save techniques are recommended.
  2. If compression of bowel loops is needed, smaller paddles may be needed, particularly for neonates
  3. Inpatients are frequently transferred to their unit with routine radiographs performed as a portable study
  4. Neonates should be kept warm throughout the procedure, and should be transferred back to their isolette and inpatient unit when possible

In determining the appropriateness of a contrast small bowel examination for a specific pediatric patient,

alternate methods might be considered that may not require ionizing radiation, such as ultrasound and MRI.

For the pregnant or potentially pregnant patient, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [19].

III. QUALIFICATIONS AND RESPONSIBILITES OF PERSONNEL

For physician, qualified medical physicist, registered radiologist assistant, and radiologic technologist qualifications, see the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [20].

In addition, personnel participating in the care of pediatric patients should have knowledge and experience in dealing with the pediatric patient population, including methods of safe effective physical immobilization when needed, and in the use of enteric catheters in performing contrast small bowel examinations. Physicians, registered radiologist assistants, and technologists should also be cognizant of the specific methods of radiation reduction appropriate to pediatric patients of various ages and sizes.

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for a contrast small bowel examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis is helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state scope of practice requirements. (ACR Resolution 35, adopted in 2006 – revised in 2016, Resolution 12-b)

IV. SPECIFICATIONS OF THE EXAMINATION

A. Patient Selection

A qualified radiologist should be available to help the clinician decide which test is best to evaluate the clinical problem(s). The radiologist and the patient's health care provider should consult when necessary to determine the examination and examination technique appropriate for the individual patient

IV. SPECIFICATIONS OF THE EXAMINATION

B. Patient Preparation

The adult patient should be instructed to refrain from taking anything by mouth after midnight the night before the procedure. Some institutions require a bowel preparation in order to reduce excessive right-sided colonic feces that can impair normal small bowel motility. Patients may generally take scheduled medications on the morning of the examination. Examinations may be performed with shorter fasting times as clinically indicated.

The pediatric patient should have nothing by mouth or via nasogastric, gastrostomy, or other enterostomy tube before the examination. The length of the fast depends on the patient's age, the examination, and the clinical circumstances. The specific regimen is often institution dependent. Suggested regimens are as follows:

1. Two to three hours for neonates and infants under 3 months of age
2. Three to four hours for infants 3 to 12 months of age
3. Four hours or more for all other children

These regimens may be modified depending on the needs of the patient as assessed by the performing

radiologist. For emergent indications or in the setting of SBO, fasting may not be required.

IV. SPECIFICATIONS OF THE EXAMINATION

C. Examination Preliminaries

Upright, decubitus, or cross-table lateral abdominal radiograph(s) should be performed if there is any suspicion of pneumoperitoneum or if the patient has an underlying condition that might predispose to bowel perforation.

Pertinent prior studies and/or reports, if available, should be reviewed when appropriate.

Medical history should be reviewed to determine whether the study technique should be modified to meet specific needs. Concurrent medical conditions as well as allergies should be considered in patient scheduling and study design.

IV. SPECIFICATIONS OF THE EXAMINATION

D. Examination Technique

To produce a diagnostic-quality examination, the physician should tailor the contrast small bowel examination procedure to the individual patient, as warranted by clinical circumstances and the condition of the patient.

1. Contrast selection and administration
    a. For adult patients:
        i. The patient should ingest a minimum of 16 ounces (~475 mL) of a well-suspended barium preparation, with additional barium ingestion as needed to maintain uniform distension of all barium-opacified small bowel loops. This is best accomplished by maintaining a barium-filled stomach for the duration of the procedure. It is preferable for the patient to drink contrast if possible at least at the onset of the procedure. In patients with aspiration risk, the study may be performed via injection of a nasogastric or orogastric tube. In the case of gastric outlet obstruction, a naso- or orojejunal tube may be used for the study. A tube may be placed for the procedure, or an indwelling feeding tube may be used. Gastric contents should be aspirated before administration of oral contrast. If an indwelling feeding tube is used, it should be flushed with water following injection to prevent clogging.
        ii. Because of dilution and absorption, the use of water-soluble contrast media is not the preferred contrast agent for small bowel contrast examination. However, water-soluble contrast is sometimes preferred by referring physicians if there is suspicion of bowel leak or obstruction. If water-soluble contrast is used, an isosmotic water-soluble contrast such as iohexol will minimize the dilution effect caused by hyperosmolar contrast agents. Hyperosmolar water soluble contrast (diatrizoate meglumine and diatrizoate sodium solution [United States Pharmacopeia, USP]) may be useful to determine the need for surgery in the setting of SBO due to adhesive disease, ie, "water-soluble contrast challenge" (see above). Success has also been reported using iohexol for this indication.

    b. For children:
        i. Type of contrast: The type of contrast given is determined by the indications for the study. Barium is the preferred contrast medium for most studies. A barium sulfate suspension of 45% weight/weight (70% weight/volume) is commonly used. Barium should be avoided when there is a possible perforation of the gastrointestinal (GI) tract. When a small bowel study is performed with iodine-containing contrast media, low or iso-osmolar contrast is preferred. Use of iso-osmolar contrast media is particularly important in critically ill premature neonates and infants to avoid serum electrolyte shifts [21]. Hyperosmolar iodinated contrast media should not be given by mouth in patients who are at risk for aspiration.
        ii. Volume of contrast: The volume of contrast administered will vary based on patient

age, size, anatomy, and pathology. Typical volumes range from 30 to 75 mL in infants and to 480 mL in older teens and can be adjusted based on individual needs of the patient and the discretion of the performing radiologist. The radiologist may choose to administer additional contrast at any time during the study if images or fluoroscopy suggest that the quantity of contrast present in the GI tract is insufficient for diagnosis.

iii. Delivery of contrast: Contrast medium should be delivered in a manner that is appropriate for the patient's age [21]. Flavoring agents may be added. For neonates and infants, a device consisting of a feeding tube passed through a nipple may be used to deliver the contrast into the mouth [22]. Alternatively, the neonate or infant may be fed contrast from a baby bottle with a nipple. Older infants able to bottle feed themselves may be allowed to do so. The barium suspension may be given by straw or taken directly from a cup by an older child. A nasogastric tube, gastrostomy, or jejunostomy, if present, may be used as appropriate. If the infant or child does not voluntarily take contrast, administration of contrast into the mouth with a small syringe (or an infant feeding tube placed in the mouth and connected to the syringe) may be successful. The syringe should have a Luer lock-type or catheter-type tip to prevent accidental injury to the mouth. However, if the child of any age is unable to take sufficient contrast by mouth, an appropriately sized enteric tube may need to be placed for contrast administration.

2. The procedure in adult and pediatric patients should include:
    a. Preliminary (scout) supine radiograph of abdomen as indicated.
    b. After obtaining a preliminary radiograph of the abdomen or reviewing available prior abdominal imaging studies, contrast material is administered orally or by tube injection (ideally with the benefit of fluoroscopy). Intermittent, serial large-format overhead radiographs of the abdomen are obtained in the supine or prone position (when possible), each labeled with its individual time of acquisition. These overhead images are obtained as the contrast progresses through the small bowel to the colon and allow for the documentation of transit time. Subsequent timing of the overhead images should be dependent upon the examination indication, patient condition, and estimated speed of transit. Each timed overhead image should be viewed to ensure that some contrast remains present in the stomach. If no contrast is seen in the stomach, additional contrast may be administered. Maintaining a steady flow of contrast, if possible, will help ensure the diagnostic quality of the study, with contrast present throughout the small bowel.
    c. At intervals during the examination and depending upon findings on the overhead images, intermittent fluoroscopy can be used to further evaluate small bowel loops with patient rotation and palpation or compression (known as rotation and palpation) of all accessible small bowel loops, including the terminal ileum. Sufficient images are obtained to demonstrate any abnormality. The timing of fluoroscopy depends upon the examination indication, patient condition, and transit time. Intermittent overhead radiographs also help to determine fluoroscopy timing. Palpation is performed with a lead-gloved hand, compression paddle, or compression Even with rotation and palpation, separation of small bowel loops in the pelvis may not be possible. Sometimes these loops can be separated when the patient is placed in the prone position and a paddle with an inflatable balloon is placed under the patient's pelvis. When the balloon is inflated, the loops are displaced superiorly out of the pelvis. In addition to obtaining compression images after the distal small bowel is opacified, in certain cases, images using compression may be obtained before the contrast reaches the colon in order to better assess any small bowel abnormalities.
    d. The study is most often terminated when contrast reaches the colon. Alternatively, the study may be terminated when contrast reaches an ostomy or a point of complete obstruction, or if the study demonstrates a perforation, or other finding requiring surgical intervention [23,24].
    e. If peroral pneumocolon is needed to better visualize the terminal ileum, once contrast has opacified the terminal ileum in antegrade fashion, the patient is placed in the lateral decubitus position on the fluoroscopy table. Pneumocolon is achieved by introducing a flexible catheter tip connected to a hand-held bulb insufflator into the rectum and insufflating room air. Room air is introduced in a retrograde manner under intermittent fluoroscopic guidance until the right colon is filled with air. Air

should be insufflated until it fills the terminal ileum or to patient tolerance. The patient can be placed in the prone position to encourage reflux of gas into the terminal ileum [25]. If air does not enter the terminal ileum despite right colonic distension, postevacuation examinations may show that it has entered the ileum. This technique is usually not performed on children.

3. The following quality control indicators should be applied to all contrast small bowel examinations:

    a. When examinations are completed, patients should be held in the fluoroscopic area until the physician has reviewed all images.
    b. An attempt should be made to resolve questionable radiographic findings before the patient leaves. Repeat fluoroscopy of segments in question or special maneuvers, such as per oral pneumocolon, should be performed as necessary, but again, should not be performed in children.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [26].

VI. EQUIPMENT SPECIFICATIONS

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Fluoroscopic Equipment and the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiographic Equipment [27,28].

Examinations should be performed with fluoroscopic image intensification and radiographic equipment that meets all applicable federal and state radiation standards.

The equipment should be appropriately calibrated for low dose/adequate image quality. The equipment should be subject to a quality management and quality control (QM/C) program under the advice of qualified staff, such as a medical physicist. The QM/C program should include an annual survey of the equipment by a medical physicist. The equipment should be able to optimally image a full range of patients, extending from a preterm infant to a very large adult. The equipment should provide diagnostic fluoroscopic image quality and recording capability. The equipment ideally should be capable of pulsed fluoroscopy, and this should be used throughout the examination, with adjustment of frame rate as required during the procedure. Other dose-reduction techniques, such as last image hold/capture, saving of fluoroscopy clips, and video recording, are also recommended. Technical parameters such as air KERMA (mGy) or dose-area product (mGy-cm^2) and fluoroscopic time should be recorded so as to allow monitoring and review of radiation dose for the procedure [29,30]. One should use these dose-saving techniques as appropriate, remembering that low dose comes at the cost of reduced image quality. Last image hold/capture images and fluoroscopy clips are of lower resolution, with higher quantum mottle; if one requires higher resolution, such as to exclude subtle leak or other more subtle abnormalities, digital spot images or an overhead radiograph should be used as needed.

Equipment necessary to compress and isolate accessible regions of the small bowel should be readily available.

Facilities should have the ability to deliver supplemental oxygen to suction the oral cavity and the upper respiratory tract and to respond to life-threatening emergencies, including those that may accompany aspiration or allergic reaction to contrast agents. If examinations of children are performed, available resuscitation equipment should be adequate to meet the needs of the full range of patients, extending from a preterm infant to a very large adult.

VII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, non-physician radiology providers**,** radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, "as low as reasonably

achievable" (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.

Facilities should have and adhere to policies and procedures that require ionizing radiation examination protocols (radiography, fluoroscopy, interventional radiology, CT) to vary according to diagnostic requirements and patient body habitus to optimize the relationship between appropriate radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used, except when inappropriate for a specific exam. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

VIII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement).

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