ACR–SPR PRACTICE PARAMETER FOR THE PERFORMANCE OF CONTRAST ESOPHAGRAMS AND UPPER GASTROINTESTINAL EXAMINATIONS IN INFANTS AND CHILDREN

The American College of Radiology, with more than 40,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

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 collaboratively by the American College of Radiology (ACR) and the Society for Pediatric Radiology (SPR).

Radiographic examination of the esophagus and the upper gastrointestinal (GI) tract by single-contrast or double-contrast technique is a proven method to establish the presence or absence of disease and to define the nature and extent of disease with a diagnostic-quality study using the minimum radiation dose necessary. The following outline indicates key elements in the performance of single-contrast and double-contrast (biphasic) esophagrams and upper GI examinations in infants and children. Typically, single-contrast technique isused in infants and children; occasionally, double-contrast technique is indicated.

II. INDICATIONS AND CONTRAINDICATIONS

A. Esophagram
   1. Pertinent history, signs, and symptoms including, but not limited to, the following:
      a. Dysphagia
      b. Odynophagia
      c. Noncardiac chest pain
      d. Recurrent pneumonia or chronic tracheobronchial inflammation
   2. Evaluation of suspected or known conditions, including, but not limited to, the following:
      a. Great-vessel anomalies
      b. H-type tracheoesophageal fistula
      c. Evaluation following repair of esophageal atresia and/or tracheoesophageal fistula
      d. Esophageal strictures
      e. Motility disorders
      f. Esophagitis
      g. Foreign bodies
      h. Pneumomediastinum with clinical/imaging findings of esophageal injury [1]
      i. Suspected esophageal perforation
      j. Neoplasm
      k. Varices

B. Upper GI Examinations
   1. Pertinent history, signs, and symptoms including, but not limited to, the following:
      a. Vomiting
      b. Abdominal pain
      c. Weight loss or failure to thrive
      d. Congenital syndromes or anomalies associated with intestinal malrotation
      e. Chronic or recurrent respiratory disease, including cough
      f. Preoperative evaluation prior to gastrostomy tube placement
      g. Postoperative evaluation such as to exclude leak or obstruction
   2. Evaluation of suspected or known conditions including, but not limited to, the following:
      a. Intestinal malrotation anomalies
      b. Hiatal hernia
      c. Gastritis or duodenitis
      d. Pyloric stenosis when ultrasound is not available
      e. Gastric outlet or upper intestinal obstruction
      f. Peptic ulcer disease
      g. Duodenal laceration or intramural hematoma
      h. Additional hernias (diaphragmatic, paraesophageal), including recurrent diaphragmatic hernia
      i. Neoplasms

In reviewing indications for a contrast study of the stomach and duodenum, alternative imaging and nonimaging

methods of examining these structures should be considered.
For the pregnant or potentially pregnant patient, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [2] and the ACR Manual on Contrast Media [3]

III. QUALIFICATIONS OF PERSONNEL

For qualifications of physicians, medical physicists, radiologist assistants, and radiologic technologists, see the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [4].

Physicians performing this procedure should have documented formal training in the performance and interpretation of GI fluoroscopy as part of an accredited residency training program.

Qualifications of technologists performing GI radiography should be in accordance with the current ACR policy statement on fluoroscopy[1] and with operating procedures or manuals at the imaging facility. Fluoroscopy technologists assisting in esophagrams or upper GI examinations should be thoroughly trained in GI radiography.

[1]The American College of Radiology approves of the practice of certified and/or licensed radiologic technologists performing fluoroscopy in a facility or department as a positioning or localizing procedure only, and then only if monitored by a supervising physician who is personally and immediately available*. There must be a written policy or process for the positioning or localizing procedure that is approved by the medical director of the facility or department/service and that includes written authority or policies and processes for designating radiologic technologists who may perform such procedures. (ACR Resolution 26, 1987 – revised in 2007, Resolution 12-m)

*For the purposes of this guideline, "personally and immediately available" is defined in manner of the "personal supervision" provision of CMS—a physician must be in attendance in the room during the performance of the procedure. Program Memorandum Carriers, DHHS, HCFA, Transmittal B-01-28, April 19, 2001.

IV. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for pediatric contrast esophagram or upper gastrointestinal examination should provide sufficient information to demonstrate the medical necessity of the examination and allow for the proper performance and interpretation of the examination.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). The provision of additional information regarding the specific reason for the examination or a provisional diagnosis would be 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)

A. Patient Selection
   For a routine esophagram, the patient should not have ingested anything by mouth for a minimum of 2 to 3 hours. For upper GI examinations, oral feeding should be withheld for a time period appropriate for the patient's age: approximately 2 to 3 hours for neonates and young infants and 4 hours for older infants and children. Adolescents should fast for at least 6 to 8 hours prior to the examination. Emergency examinations may be performed with shorter fasting times as determined by the radiologist in concert with the referring physician.

B. Examination Preliminaries
   An appropriate medical history should be available, including results of laboratory tests and imaging, endoscopic, and surgical procedures as applicable.

   Use of a child life specialist and/or parent may be helpful in enabling young patients to cooperate for the

examination. Immobilization devices may be helpful in patient positioning. These devices may help limit repeat radiographic exposures and unnecessary radiation dose to patients, parents, technologists, and other personnel.

Routine scout imaging prior to upper GI series in the outpatient setting, unless specifically requested by the ordering physician, can be replaced by a brief, initial fluoroscopic assessment, as the risk of radiation outweighs the benefit because the addition of a clinically significant finding that would change management is unlikely in outpatients [5]. A scout image should be obtained for inpatients if there has been no recent radiograph as well as in postoperative patients and in those with an acute abdomen [5]. Preliminary images should be assessed for calcifications, skeletal abnormalities, anomalies of situs, bowel gas pattern, pneumoperitoneum, residual intraluminal contrast, evidence of prior surgery, catheters, and monitoring devices. A scout image of the chest should be assessed for pneumomediastinum and pleural effusion, especially in cases where an esophagram is performed [5]. A dependent image (upright or decubitus views) should be performed if the patient has an underlying condition that might predispose to GI tract perforation. In the absence of preceding abdominal imaging, scout images are especially helpful in the workup of neonatal bowel obstruction because they may influence the choice of initial fluoroscopic study and GI contrast (eg, upper GI for proximal bowel obstruction and contrast enema for distal small bowel or colonic obstruction).

C. Examination Technique

The examination procedure should be tailored by the radiologist to the individual patient to produce a diagnostic-quality examination as warranted by clinical circumstances and the condition of the patient. Preliminary findings during the examination may indicate a need to alter technique in subsequent portions of the examination.

The contrast medium should be delivered in a manner that is appropriate for the patient's age. Neonates and infants may be fed contrast from a baby bottle with a nipple. Alternatively, an orogastric tube passed through a nipple may be used to deliver the contrast into the mouth [6] or an enteric tube may be placed directly into the stomach tube placement should be performed under fluoroscopic control to ensure correct positionin. Older infants able to bottle feed themselves may be allowed to do so. In the older child, the contrast may be given by straw, taken directly from a cup, or administered by syringe; flavoring agents may be added. A gastrostomy tube or jejunostomy tube may be used as appropriate.

In neonates or young infants with a history of bilious emesis, a nasogastric tube can be placed with the tip in the distal stomach so that a controlled upper GI with a small amount of contrast and air can effectively evaluate for malrotation and/or volvulus using the least amount of contrast and fluoroscopic time.

The amount and type of contrast material given are determined by the child's age and the indications for the study. Barium is the preferred contrast medium for most studies [7]. Nonionic**,** isosmotic, or iodinated contrast media may be used to assess the integrity of an esophageal anastomosis, diagnose duodenal obstruction or perforation, or diagnose intestinal malrotation/volvulus in select critically ill patients. Isosmotic or near-isosmotic solutions are important in cases in which there is risk of aspiration [8], particularly in critically ill premature neonates and infants to avoid serum electrolyte shifts. Diatrizoic acid, a very highly osmotically active water-soluble contrast agent, should not be administered in neonates and young infants as this patient population has a higher risk of gastroesophageal reflux and aspiration. Diatrizoic acid may result in pulmonary edema and chemical pneumonitis.

Sufficient still images and/or fluoroscopic image clips should be recorded to adequately evaluate normal anatomy and characterize abnormalities. Anteroposterior and lateral projections of all anatomic structures should be obtained and complemented by oblique images when indicated for adequate assessment. Although fluoroscopic store/last image-hold images do not have the same resolution as spot images, they may be adequate for documentation, depending upon the study circumstances, and can markedly reduce patient dose compared with spot images.

1. Single-contrast esophagram
    a. The anatomic structure and motility of the entire esophagus should be evaluated fluoroscopically. Appropriate images should be obtained to document normal and abnormal findings. The examination is optimally performed in the lateral and anteroposterior projections, with visualization of the nasopharynx to the gastric fundus [9].
    b. Esophagrams performed in infants with a suspected H-type tracheoesophageal fistula are optimally performed with the infant in a left or right lateral position, with full distension of the esophagus, achieved with normal drinking in patients who drink contrast readily. In patients who do not drink sufficient contrast to distend the esophagus, the contrast can be administered in small amounts at various points in the esophagus from the level of the carina to the level of the thoracic inlet through a small feeding tube placed prior to the examination. This requires careful fluoroscopic monitoring of the contrast as it exits the tube to prevent aspiration. If no fistula is identified on the early images, the study may be completed with standard oral administration of contrast. Fluoroscopic observation from hypopharynx to carina in the lateral view throughout contrast instillation usually will allow differentiation of contrast in the trachea due to aspiration versus a fistula.
    c. Imaging of the esophagus should include an assessment of swallowing in the lateral view, especially if the patient has symptoms suggesting swallowing dysfunction, such as coughing and choking and/or gagging during feeding. This should include imaging from the base of the tongue through the lower esophageal sphincter. Modified barium swallow is a more detailed evaluation of the oral, pharyngeal, and upper esophageal phases of swallowing with variable consistency materials, usually performed in conjunction with a speech pathologist or occupational therapist. Please refer to the ACR-SPR Practice Parameter for the Performance of the Modified Barium Swallow [10] for additional information.

2. Double-contrast (biphasic) esophagram
   Double-contrast esophagrams are seldom performed in pediatric patients, but they may help to evaluate mucosal integrity in adolescents. (See the ACR Practice Parameter for the Performance of Esophagrams and Upper Gastrointestinal Examinations in Adults [11], section IV.C.)

3. Single-contrast upper GI examination
    a. Fluoroscopic assessment of swallowing and the anatomic structure and motility of the entire esophagus, stomach, and duodenum should be performed, and appropriate images should be obtained to document normal and abnormal findings. Suggested images include frontal and lateral views of the barium-distended esophagus, stomach, and duodenum and images of the partially filled esophagus. Initial passage of contrast through the duodenum should be observed directly with fluoroscopy to confirm the position of the duodenojejunal junction (DJJ) [12]. This can be documented with serial multiple fluorocapture images or fluoroscopy video capture where available [13]. On the first upper GI examination in an infant or child, the position of the DJJ should be documented on both frontal and lateral positions to diagnose or exclude malrotation [12,14]. The lateral view is important to ensure the retroperitoneal position of the normally rotated duodenum and the normal height of the DJJ at the level of the duodenal bulb; additionally, the straight anteroposterior (AP), nonobliqued frontal view ensures the normal position of the DJJ at or to the left of the left pedicle of the vertebral bodies and at a height approximately at the level of the duodenal bulb [15-17].
    b. Images of gastroesophageal reflux should be recorded by last image-hold if reflux occurs during the examination. However, because reflux is a physiologic phenomenon and more sensitive tests exist, neither provocation of reflux nor prolonged fluoroscopic monitoring for detection is recommended [18].
    c. A final image documenting gastric emptying and the progress of contrast through small-bowel loops may be obtained at the conclusion of the examination.

4. Double-contrast (biphasic) upper GI examination
   Double-contrast upper GI examinations are seldom performed in pediatric patients, but they may

help to evaluate mucosal integrity in adolescents and to detect subtle strictures because of the better esophageal distention that can often be achieved with the gas produced by swallowing Sodium Bicarbonate, Citric Acid, and Simethicone Effervescent Granule Pkt (eg, EZ gas crystals). (See the ACR Practice Parameter for the Performance of Esophagrams and Upper Gastrointestinal Examinations in Adults [11], section IV.C.)

5. Quality control indicators
   The following quality control indicators should be applied to all esophagram and upper GI examinations:

   a. When examinations are completed, patients should be held in the fluoroscopic area until the physician has reviewed the images.
   b. An attempt should be made to resolve questionable radiologic findings before the patient leaves. Repeat fluoroscopy should be performed as necessary.
   c. Correlation of radiologic, endoscopic, surgical, and pathologic findings is valuable for quality improvement whenever feasible.

V. DOCUMENTATION

An official interpretation (final report) of the examination should be included in the patient's medical record.

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [19].

VI. EQUIPMENT SPECIFICATIONS

Examinations must be performed with fluoroscopic and radiographic equipment meeting all applicable federal, state, and local radiation standards. Fluoroscopy units with settings for pediatric technique are recommended. If possible, a pulsed fluoroscopic technique and equipment should be used to reduce the radiation exposure. The equipment should provide diagnostic fluoroscopic image quality and recording capability (radiographs, video, or digital). The equipment should be capable of producing kilovoltage greater than 100 kVp. Equipment necessary to compress and isolate accessible regions of the small bowel should be readily available. Digital equipment with fluorohold and/or fluorocapture capability is desirable.

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 that may accompany aspiration, allergic reaction to contrast agents, or reflux.

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiographic Equipment [20] and the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Fluoroscopic Equipment [21].

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).

The lowest possible radiation dose consistent with acceptable diagnostic image quality should be used. Radiation doses should be determined periodically based on a reasonable sample of pediatric examinations. Technical factors should be appropriate for the size and the age of the child and should be determined with consideration of parameters such as characteristics of the imaging system, organs in the radiation field, lead shielding, etc. Guidelines concerning effective pediatric technical factors are published in the radiologic literature and at websites such as www.imagegently.org.

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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