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ACR–SPR PRACTICE PARAMETER FOR THE PERFORMANCE OF GASTROINTESTINAL SCINTIGRAPHY

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 care¹. 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 in light of 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 the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also 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 sole purpose of this document is to assist practitioners in achieving this objective.

¹ *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing*, ___ N.W.2d ___ (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).

This practice parameter is intended to guide physicians performing and interpreting gastrointestinal scintigraphy in adult and pediatric patients. Properly performed imaging with radiopharmaceuticals that localize in or are introduced into the gastrointestinal tract or peritoneum is a sensitive means for detecting, evaluating, and quantifying numerous conditions affecting the gastrointestinal tract and peritoneum. As with all scintigraphic studies, correlation of findings with the results of other imaging and nonimaging procedures, as well as clinical information, is necessary to achieve maximum diagnostic yield.

Application of this practice parameter should be in accordance with the [ACR–SNM Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals](#) [1].

II. DEFINITION

Gastrointestinal scintigraphy involves the intravenous, oral, transcatheter (to include enteric tubes), or intraperitoneal administration of a radiopharmaceutical that localizes in or transits the salivary glands, gastrointestinal tract, or peritoneal cavity, followed by gamma camera imaging with digital acquisition [2]. (For scintigraphy of the hepatobiliary tract or liver and spleen, see the [ACR–SPR Practice Parameter for the Performance of Hepatobiliary Scintigraphy](#) [3] and the [ACR–SPR Practice Parameter for the Performance of Liver and Spleen Scintigraphy](#) [4].)

III. GOAL

The goal of gastrointestinal scintigraphy is to enable the interpreting physician to identify and/or quantify anatomic or physiologic disturbances of the salivary glands, gastrointestinal tract, or peritoneum.

IV. INDICATIONS

Clinical indications are varied and include, but are not limited to, the following:

1. Demonstration of salivary gland function and tumors
2. Verification of suspected aspiration
3. Evaluation and quantification of transit through and reflux into the esophagus
4. Quantification of the rate of emptying of liquid and/or solid meals from the stomach
5. Demonstration of transit through the small and large intestine
6. Detection of ectopic functioning gastric mucosa
7. Demonstration of the presence and site of acute gastrointestinal bleeding
8. Assessment of peritoneovenous shunt patency
9. Detection of congenital or acquired perforation of the pleuroperitoneal diaphragm
10. Demonstration of the presence or absence of peritoneal loculations prior to intraperitoneal chemotherapy or radiopharmaceutical therapy

For information on radiation risks to the fetus, see the [ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#) [5].

V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See the [ACR–SNM Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals](#) [1].

VI. RADIOPHARMACEUTICALS AND TECHNIQUE

Several radiopharmaceuticals are currently available. The radiopharmaceutical used should be chosen based on the clinical indications and circumstances. Administered activity for children should be based on body weight and should be as low as reasonably achievable for diagnostic image quality [6,7].

A. Technetium-99m Sodium Pertechnetate

During the first 1 or 2 minutes after intravenous administration, technetium-99m pertechnetate may be used as a blood flow and “blood pool” marker. Within minutes after injection, this radiopharmaceutical begins to concentrate in the salivary glands and gastric mucosa, making it a suitable radiopharmaceutical for evaluation of the salivary glands and for detection of ectopic gastric mucosa. The usual adult administered activity is 296 to 444 MBq (8 to 12 mCi) intravenously. Lower administered activity (111 to 185 MBq [3 to 5 mCi]) may be used if flow imaging is not performed. For pediatric patients, 1.85 MBq/kg (0.05 mCi/kg) is recommended. Physiologic renal excretion results in visualization of the kidneys and bladder. Rapid absorption by the stomach and peritoneum makes technetium-99m pertechnetate unsuitable for oral or intraperitoneal administration.

B. Technetium-99m Sulfur Colloid

Technetium-99m sulfur colloid, when administered orally, is not absorbed and is an excellent radiopharmaceutical for imaging and quantification of numerous parameters of swallowing and gastrointestinal motility and transit. A small volume (up to 1 mL) of technetium-99m sulfur colloid containing no more than 18.5 MBq (0.5 mCi) can be used for pharyngeal aspiration imaging. Administered activity of 18.5 to 74 MBq (0.5 to 2 mCi) is generally used as a radiolabel for liquid and solid meals in adults. There is no weight-based dosage for children, but 9.25 to 37 MBq (0.25 to 1.0 mCi) of administered activity can be used to label a liquid meal, and 9.25 to 18.5 MBq (0.25 to 0.5 mCi) can be used to label a solid meal. The affinity of this radiopharmaceutical for the protein matrix of egg whites makes it easy to use to label egg as a solid-phase radiopharmaceutical [8]. The administered activity of the radiopharmaceutical and the volume to be fed to the patient should be based on patient factors such as age, body weight, and the usual feeding volume.

Administered intraperitoneally, it is not absorbed and becomes a qualitative marker of movement of ascitic fluid through congenital or traumatic diaphragmatic fenestrations and peritoneovenous shunts. For this purpose, the administered activity of 18.5 to 185 MBq (0.5 to 5.0 mCi) technetium-99m sulfur colloid is used.

C. Technetium-99m (Stannous - Sn) Diethylenetriamine-Pentaacetic Acid (DTPA)

Given orally, technetium-99m (Sn) DTPA may be used as a liquid-phase marker of gastric emptying or of small-bowel transit when only a single liquid meal transit examination is performed. It cannot be used simultaneously for a combined liquid-phase and solid-phase gastric emptying examination when a technetium-99m solid-phase radiopharmaceutical is also used. When dual-phase (solid and liquid) gastrointestinal examinations are performed, indium-111 DTPA or gallium-67 citrate is used to measure the liquid phase, and technetium-99m sulfur colloid is used for the solid phase.

The administered activity for technetium-99m DTPA is 18.5 to 37 MBq (0.5 to 1.0 mCi) for adults. The administered activity of the radiopharmaceutical and the volume to be fed to the patient should be based on patient factors such as age, body weight, and the usual feeding volume.

D. Indium-111 DTPA

Given orally, with an administered activity of 5.55 to 18.5 MBq (0.15 to 0.50 mCi), indium-111 DTPA may be used as a liquid-phase marker of gastric emptying when a concomitant solid meal labeled with a technetium-99m radiopharmaceutical is used. Due to the longer half-life of indium-111, additional imaging of the abdomen is possible up to 72 hours and allows measurement of small bowel or colon transit [9,10]. Administered activity of

indium-111 DTPA for colon transit is 3.7 to 37 MBq (0.1 to 1.0 mCi). For a liquid-only gastric examination, technetium-99m sulfur colloid should be used instead of indium-111 DTPA to reduce radiation exposure.

E. Gallium-67 Citrate

Given orally, gallium-67 is not absorbed from the gastrointestinal tract and may be used as a liquid-phase marker of gastric emptying. Like indium-111 DTPA, this radiopharmaceutical can be used with concomitant solid meal labeled with technetium-99m for gastric imaging and measurement of small bowel or colon transit. Its long half-life allows extended imaging of the abdomen up to 96 hours or longer. Administered activity is typically 0.056 kBq/kg body weight (0.0015 mCi/kg) for dual-phase gastric emptying examinations in pediatric patients. For adults needing evaluation of colonic transit, a dosage of 3 to 7 MBq (0.08 to 0.2 mCi) can be used [11,12].

For a liquid-only gastric emptying examination, technetium-99m sulfur colloid should be used instead of gallium-67 to reduce radiation exposure.

F. Technetium-99m Autologous Red Blood Cells (RBCs)

Technetium-99m RBCs remain intravascular and are commonly used for detecting and localizing active gastrointestinal bleeding. The usual adult intravenous administered activity for gastrointestinal blood loss detection is 740 to 1,010 MBq (20 to 30 mCi). The highest RBC-labeling efficiency is achieved with the in vitro method, which is recommended and widely used.

G. Technetium-99m Macroaggregated Albumin (MAA)

Given intraperitoneally, technetium-99m MAA is not absorbed and is used as a qualitative marker of the movement of ascitic fluid through peritoneovenous shunt devices or congenital/traumatic diaphragmatic fenestrations. The usual adult administered activity is 0.5 to 5.0 mCi (18.5 to 185 MBq).

VII. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for gastrointestinal scintigraphy 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 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's scope of practice requirements. (ACR Resolution 35, adopted in 2006)

A. Salivary Gland Imaging

The collimator surface should be protected from contamination by using a plastic-backed pad or other similar material. The patient's face is positioned in front of a gamma camera in the Water's (nose-chin) position. Technetium-99m pertechnetate is given intravenously. Serial anterior images of the face are obtained over a period of 30 minutes. If needed, these views may be supplemented by oblique or lateral static images of the head and neck.

A sialogogue, such as lemon juice, may be given to stimulate salivary gland emptying in cases of salivary duct obstruction or ligation, sialadenitis, or suspected Warthin's tumor. The position of palpable nodules should be identified using a radioactive source marker.

B. Aspiration of Gastric or Pharyngeal Contents

These examinations are usually limited to pediatric patients or as a preoperative pulmonary evaluation prior to lung transplantation. The patient should have nothing by mouth or by tube feeding prior to the examination. The length of time that the patient should refrain from intake depends on the patient's age and the clinical circumstances, but in most cases 4 hours should be sufficient.

1. Aspiration of pharyngeal contents

A small volume of appropriate administered activity of technetium-99m sulfur colloid is placed on the dorsal surface of the posterior portion of the tongue or in the buccal fossa. Images of the chest are obtained in the posterior projection over the course of 30 to 60 minutes. Radioactivity detected in the bronchi or lungs confirms aspiration.

2. Aspiration of gastric contents

Radioactive source markers are placed for anatomic reference (eg, shoulder markers as reference of the relative location of the lungs). Appropriate administered activity of technetium-99m sulfur colloid is placed in a small amount of the patient's feeding, administered orally, by nasogastric tube, or by gastrostomy tube depending on the clinical situation and in consultation with the referring provider. If the material is administered orally, once the feeding is completed, an additional nonradioactive liquid feeding is given to clear any remaining radioactivity from the esophagus. Images of the thorax are obtained immediately after ingestion (as a baseline) and serially for 60 minutes thereafter. Additional planar imaging at 4 hours or 24 hours may be helpful. In infants and children, evaluation for aspiration of gastric contents is included as a routine component of the radiopharmaceutical gastric emptying and gastroesophageal reflux examinations (see VII.D and VII.E). Radioactivity seen in the lungs confirms the diagnosis of aspiration. Imaging is terminated after the radioactivity has cleared from the stomach.

C. Esophageal Transit

Scintigraphy of esophageal transit may yield unique and useful physiologic information about esophageal motility in patients with conditions (eg, scleroderma, stricture, achalasia) that cause impaired transit of esophageal contents from the pharynx to the stomach or following therapy for these conditions [13]. The patient should have nothing by mouth or by tube-feeding prior to the examination. The length of time that the patient should refrain from intake depends on the patient's age and the clinical circumstances, but in most cases 4 hours would be sufficient.

Data are collected in the posterior projection. As with barium esophagography, use of multiple (up to 5) dry swallows can increase the sensitivity of the examination in detecting an abnormal swallow. Comparison of at least one upright and one supine swallow can be helpful to differentiate disorders such as achalasia from scleroderma. The examination involves the patient swallowing the appropriate administered activity of technetium-99m sulfur colloid in 10 to 15 mL of water or a semisolid as a bolus. The initial rapid bolus transit should be recorded in a dynamic mode of 0.25 to 1 second per frame and reviewed using a cinematic (movie) display to evaluate the bolus transit. Additional data acquisition for up to 10 minutes is also helpful, during which time the patient may be asked to dry swallow to measure clearance from the esophagus and to look for possible gastroesophageal reflux.

The normal value for esophageal bolus transit time is generally under 5 seconds, although each facility should validate its own normal range for its specific technique, or it should closely follow a validated technique and normal range from the literature.

Time-activity curves may be generated for the proximal, middle, and distal portions of the esophagus, but visual inspection of the cine bolus transit is more important for differentiating the various primary esophageal motor disorders.

D. Gastroesophageal Reflux

Scintigraphy for gastroesophageal reflux may yield unique and useful physiologic information in patients whose history, signs, or symptoms suggest possible incompetence of the gastroesophageal sphincter associated with acute or chronic reflux of gastric contents into the esophagus [13]. Observation of gastroesophageal reflux, however, during an esophageal transit examination can be important as an etiology to reflux esophagitis and associated esophageal dysmotility.

In infants and children, a gastroesophageal reflux examination is often combined with a liquid gastric emptying examination. The patient should have nothing by mouth or by tube-feeding prior to the examination. The length of time that the patient should refrain from intake depends on the patient's age and the clinical circumstances, but in most cases 4 hours would be sufficient. A liquid meal consisting of formula, milk, or orange juice containing an appropriate concentration of technetium-99m sulfur colloid is administered orally, by nasogastric tube, or by gastrostomy tube. If feasible, when the meal is introduced via an orogastric or nasogastric tube, the tube should be removed prior to image acquisition. The patient is then positioned supine beneath the gamma camera detector, and serial 10-second to 30-second images of the esophagus and stomach are obtained. It is often appropriate to image small children in the supine position with the gamma camera detector under the imaging table. In adults, a Valsalva maneuver or an abdominal binder may be of benefit. Use of an abdominal binder is contraindicated in children.

The number of reflux events detected during the recording session, the duration, and the proximal extent of reflux are reported. The examination may be repeated to assess the effectiveness of medical therapy.

E. Gastric Emptying

Evaluation of gastric motility through a radiolabeled meal provides functional information that is indispensable in the management of patients presenting with various upper gastrointestinal signs and symptoms [10,14]. The patient should have nothing by mouth or by tube-feeding prior to the examination. The length of time that the patient should refrain from intake depends on the patient's age and the clinical circumstances, but in most cases 4 hours should be sufficient. Three approaches are used: liquid phase, solid phase, and combined liquid-solid phase.

In general, the liquid phase is preferred in infants and in neurologically impaired children, whereas the solid phase is used when the patient is capable of ingesting solid food. In both cases, the "meal" needs to be introduced into the stomach fairly quickly (ie, within 10 minutes). It is a good general practice to cover the camera detectors with protective wrap to prevent contamination. Digital acquisition is required to determine the half-time of emptying and/or percent of emptying and to generate gastric emptying time-activity curves. Given the oblique lie of the stomach in the abdomen, images should be acquired in both the anterior and posterior projection with gastric emptying determined based on the geometric mean. Posterior projection imaging only may be sufficient in children. Currently there are no published standardized protocols or normal values for pediatric examinations [15].

1. Solid-phase meal gastric emptying in adults

ACR supports the published consensus guideline on the scintigraphic measurement of gastric emptying in adults by the Society of Nuclear Medicine and Molecular Imaging (SNMMI) and the American Neurogastroenterology and Motility Society (ANMS) [16]. The ACR supports adoption of the recommendations of this consensus guideline and recommends adoption of its recommended normal

values, patient preparation, image acquisition, and data processing. Following ingestion of a radiolabeled low-fat, egg-white meal, 1-minute static imaging at 0, 1, 2, and 4 hours is performed with the patient upright, if possible [8]. The percentage remaining at each time point is compared with established normal ranges to determine the presence or absence of gastroparesis. Details can be found in the appendix to the consensus guideline [16].

2. Liquid-phase gastric emptying in adults and children

For some time liquid-phase gastric emptying examinations have not been used since it was believed that abnormal liquid gastric emptying was a late phenomenon and that a solid meal would detect abnormal gastric emptying better than a liquid meal. Recent studies suggest that liquids may detect some patients with abnormal gastric emptying when solid gastric emptying scintigraphy is normal [17]. There are, however, no consensus recommendations at present on the best liquid-phase gastric emptying meal or protocol.

Technetium-99m sulfur colloid or technetium-99m (Sn) DTPA is mixed with an appropriate volume (30 to 240 mL) of liquid carrier (eg, orange juice, formula, milk) and is introduced into the stomach by swallowing, nasogastric tube, orogastric tube, or gastric tube depending on the clinical situation, in consultation with the referring clinician. Sequential imaging and computer data acquisition are performed over the course of 30 to 60 minutes. A region of interest (ROI) is drawn over the stomach, and a decay-corrected time-activity curve is generated. In adult patients, the radiopharmaceutical exits from the stomach in an approximately monoexponential fashion for liquid meals. In children, imaging is usually performed during the first hour, and the percent of emptying is obtained at 60 minutes and later, if indicated. Unfortunately, there are currently no well-defined normal values for the various liquid meals used. Each facility must validate its own normal range for its specific meal and technique.

3. Liquid-phase gastric emptying (“milk scan”) in infants

Liquid-phase gastric emptying may be combined with evaluation of esophageal motility, gastroesophageal reflux, and aspiration. The radiopharmaceutical esophagram may be performed initially or following the completion of the gastric emptying portion of the examination. For the esophagram, the patient is placed in the supine position with the gamma camera posteriorly positioned. Dynamic images of the esophagus at 5 seconds/frame for 2 to 3 minutes are obtained for evaluating esophageal motility and possible aspiration. If the patient is normally fed by mouth, this may be accomplished as the initial part of the gastric emptying procedure, which is then followed by continuous imaging of the chest and abdomen for 60 minutes for evaluation of the presence and severity of gastroesophageal reflux. Gastric emptying at 60 minutes and at 2 or 3 hours after completion of feeding is calculated. If the patient is not orally fed, the esophagram should be performed at the end of the gastric emptying examination using a small volume of radiolabeled sterile water or saline.

4. Combined liquid-phase and solid-phase gastric emptying and small bowel and colon transit studies

A solid-phase examination (see section VII.E.1 above) may be combined with the liquid-phase examination (see section VII.E.2 above), using technetium-99m sulfur colloid for the solid phase and indium-111 DTPA or gallium-67 for the liquid phase. With the use of proper administered activity of dual radiopharmaceuticals and availability of simultaneous dual-isotope image acquisition and processing capability, it is possible to acquire data simultaneously using photopeaks of both radiopharmaceuticals. An added advantage provided by this combined solid-phase and liquid-phase technique includes the ability to follow the liquid phase to measure small bowel and colon transit resulting in evaluation of the whole gut [9]. There are increasing reports on the utility of whole-gut scintigraphy using simultaneous dual radiopharmaceutical solid-liquid meal in patients with various abdominal symptoms but no consensus recommendations on its use exist to date [18,19].

F. Ectopic Gastric Mucosa (Meckel's scan)

The radiopharmaceutical technetium-99m pertechnetate is given intravenously. A rapid sequence of images (blood flow/angiographic phase) taken at 1 to 3 seconds per frame, over 1 minute, may be obtained in the anterior projection to evaluate the presence of hypervascular abdominal lesions that could be mistaken for ectopic gastric mucosa. Immediate serial imaging for 30 to 45 minutes can then be acquired as serial static views (300,000 to 500,000 counts per image) or continuous dynamic imaging (30 to 60 seconds per image). Continuous dynamic imaging is preferred to better visually discriminate normal physiologic activity (such as renal activity) from ectopic gastric mucosa. A lateral view can be useful to distinguish renal activity and identify retrovesical ectopic gastric mucosa. The examination may be supplemented with oblique, postvoid single photon emission computed tomography (SPECT) imaging or delayed views of the abdomen, as indicated. Pharmacologic enhancement prior to administration of the radiopharmaceutical with H₂ blockers (cimetidine, famotidine, or ranitidine) to enhance free pertechnetate retention and/or glucagon to decrease gastrointestinal peristalsis can be used. Prone or right anterior oblique positioning can be used to delay gastric emptying into the small bowel if the patient has not been pretreated with H₂ blockers.

G. Gastrointestinal Blood Loss

All methods for diagnosing and localizing an active bleeding site require that the patient be actively bleeding and imaged during the time the radiopharmaceutical is present in the blood pool. Although this procedure is generally used for gastrointestinal bleeding, it can be useful for other sites of active bleeding.

The use of technetium-99m labeled autologous RBCs is the recommended method because they remain intravascular and permit a longer imaging time. The radiolabeled cells are injected intravenously. Blood flow/angiographic phase and continuous cine or images of the abdomen are obtained for 60 to 120 minutes. Cine images (maximum of 15 seconds per image) and display are preferred as these improve the initial detection and more accurate localization of subtle gastrointestinal bleeding sites. Oblique, lateral, or delayed static abdominal images may be obtained to supplement the basic examination. If the examination is negative, continued imaging may be appropriate. SPECT/CT, although not routinely performed, can be of value to more definitively localize sites and identify the cause of gastrointestinal hemorrhage.

H. Peritoneal Imaging

1. Evaluation of patency of peritoneovenous shunts

Technetium-99m sulfur colloid or technetium-99m MAA is directly administered into the peritoneal cavity, using aseptic technique. An immediate image of the abdomen may be helpful to determine that the radiopharmaceutical is free in the peritoneum and not loculated. On occasion, normal saline (50 to 200 mL) can be infused intraperitoneally to facilitate distribution. If the shunt is functioning correctly, serial images obtained over 1 or 2 hours will reveal radiopharmaceutical in the shunt tube, and radioactivity will eventually appear in the liver and spleen (with technetium-99m sulfur colloid) or lungs (with technetium-99m MAA).

2. Detection of congenital fenestrations or traumatic perforations of the diaphragm

Technetium-99m sulfur colloid or technetium-99m MAA is administered intraperitoneally as described in section VII.H.1. Occasionally, the radiopharmaceutical can be instilled with up to 500 mL of sterile normal saline in order to facilitate movement of the radiopharmaceutical into the pleural cavity. If activity appears in the pleural space, the diagnosis of perforated diaphragm is confirmed.

3. Demonstration of peritoneal loculation of fluid

Technetium-99m sulfur colloid or technetium-99m MAA is administered intraperitoneally as described in section VII.H.1. Immediate and delayed static images over the abdomen will reveal the pattern of distribution of the radiopharmaceutical in the peritoneal cavity.

VIII. DOCUMENTATION

Reporting should be in accordance with the [ACR Practice Parameter for Communication of Diagnostic Imaging Findings](#) [20].

The report should include the radiopharmaceutical used, the administered activity, and the route of administration, as well as any other pharmaceuticals administered, including their dose and route of administration.

IX. EQUIPMENT SPECIFICATIONS

A gamma camera with a low-energy all purpose (LEAP) or high-resolution collimator is used for technetium-99m labeled radiopharmaceuticals. A medium-energy collimator is needed for indium-111 and gallium-67. SPECT or SPECT/CT may also be useful in select cases.

X. RADIATION SAFETY

Radiologists, medical physicists, registered radiologist assistants, 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 that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels) http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.pdf.

Facilities and their responsible staff should consult with the radiation safety officer to ensure that there are policies and procedures for the safe handling and administration of radiopharmaceuticals and that they are adhered to in accordance with ALARA. These policies and procedures must comply with all applicable radiation safety regulations and conditions of licensure imposed by the Nuclear Regulatory Commission (NRC) and by state and/or other regulatory agencies. Quantities of radiopharmaceuticals should be tailored to the individual patient by prescription or protocol

Nationally developed guidelines, such as the [ACR’s Appropriateness Criteria®](#), should be used to help choose the most appropriate imaging procedures to prevent unwarranted radiation exposure.

Additional information regarding patient radiation safety in imaging is available at the Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org) websites. 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 measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR technical standards. Regular auditing of patient dose indices should be performed by comparing the facility’s dose information with national benchmarks, such as the ACR Dose Index Registry, the 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. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

XI. 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 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 (<http://www.acr.org/guidelines>).

Equipment performance monitoring should be in accordance with the [ACR–AAPM Technical Standard for Medical Nuclear Physics Performance Monitoring of Gamma Cameras](#) [21].

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Members represent their societies in the initial and final revision of this practice parameter.

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