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# ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF ADULT AND PEDIATRIC HEPATOBILIARY SCINTIGRAPHY

## PREAMBLE

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines 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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, 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 the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines 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. It should be recognized; therefore, that adherence to these guidelines 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 these guidelines is to assist practitioners in achieving this objective.

## I. INTRODUCTION

This guideline has been developed by the American College of Radiology (ACR) to guide physicians performing hepatobiliary scintigraphy in adult and pediatric patients. Hepatobiliary scintigraphy involves the intravenous injection of a technetium-99m labeled hepatobiliary radiopharmaceutical and subsequent imaging with a gamma camera.

Properly performed hepatobiliary imaging is a very sensitive method for detecting numerous conditions involving the liver and biliary system. Although certain patterns may suggest specific disease states (e.g., nonvisualization of the gallbladder in patients with acute cholecystitis), correlation of abnormal patterns with clinical information, with the physiologic state of the patient, and with other imaging techniques is imperative for arriving at a correct diagnosis. Pharmacologic

adjunctive agents and quantitative assessment may enhance diagnostic utility.

Application of this standard should be in accordance with the ACR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals.

(For pediatric considerations see Sections IV.A, IV.B, and IV.C. 2.)

## II. GOAL

The goal of hepatobiliary scintigraphy is to detect physiologic and anatomic abnormalities of the hepatobiliary system by producing diagnostic quality images obtained under physiologic conditions and, if indicated, after pharmacologic intervention.

## III. INDICATIONS

Clinical indications include, but are not limited to, evaluation of acute cholecystitis, evaluation of common bile duct obstruction, evaluation of right upper quadrant pain or mass, detection of enterogastric reflux, demonstration of leakage of bile, postoperative assessment of biliary enteric bypass (e.g., Kasai procedure), evaluation of hepatic transplant function, evaluation of neonatal hyperbilirubinemia (biliary atresia vs. neonatal hepatitis "syndrome"), evaluation of choledochal cyst, assessment of chronic biliary tract disorders, and assessment of gallbladder ejection fraction.

## IV. SPECIFICATIONS OF THE EXAMINATION

### A. Radiopharmaceutical

Technetium-99m labeled disopropyl iminodiacetic acid, trimethylbromo iminodiacetic acid, or a comparable agent is administered intravenously in dosages of 3-15 millicuries (111-555 MBq) for adults. Higher dosages may be needed if the patient's bilirubin is elevated or hepatic function is reduced. For children, the usual dosage is 0.05-0.07 millicuries per kilogram (1.85-2.59 MBq/kg) or

$$5.0 \text{ millicuries (185 MBq)} \times \frac{\text{patient body surface area}}{1.73 \text{ square meters}}$$

body surface area with a minimum dosage of 0.3 millicuries (1.11 MBq).

### B. Patient Preparation

Fasting for 2-6 hours prior to injection of the radiopharmaceutical is commonly required for adult patients. Administration of meperidine or morphine prior to testing does not contravene the study but may delay the entrance of radiotracer into the small bowel. When scheduling the patient, the time and dosage of these medications should be noted. Children should have fasted for 2-4 hours before radiopharmaceutical administration. Infants need to fast only 2 hours prior to administration of the agent. Clear liquids are permissible, if necessary.

### C. Pharmacologic Enhancement

A variety of pharmacologic or physiologic interventions may enhance the diagnostic quality of the exam. Appropriate precautions should be taken to promptly detect and treat any adverse reactions caused by these maneuvers.

1. Morphine sulfate
   In cases where acute cholecystitis is suspected and the gallbladder is not seen within 30-60 minutes, morphine sulfate, 0.04 mg/kg, may be administered intravenously. By causing a temporary spasm of the sphincter of Oddi, reflux of bile through a patent cystic duct may be demonstrated. The common bile duct must contain radioactive bile. Tracer activity in the small bowel is desirable at the time of morphine injection to confirm biliary-to-bowel transit. A second dosage of radiopharmaceutical may be used to accomplish this. Imaging may be completed by 30 minutes after morphine administration or may be extended. Increased intracranial pressure in children, severe respiratory depression (in nonventilated patients), morphine addiction, and morphine allergy are considered absolute contraindications to the use of morphine. Documented acute pancreatitis is a relative contraindication.

2. Phenobarbital
   In cases of neonatal hyperbilirubinemia, oral phenobarbital in a total dosage of 5 mg/kg/day (two divided dosages) for 3-5 days prior to the study may be used to stimulate the flow of bile and to improve the specificity of the test.

3. Fatty meal
   In patients for whom concern about common duct patency is raised, a fatty meal may cause emptying of the bile from the biliary system into the duodenum. This should be done only after the gallbladder is identified.

4. Cholecystokinin
   In patients who have been fasting or who are on total parenteral nutrition (TPN), maximal filling of the gallbladder with viscous bile may cause nonvisualization. Cholecystokinin may be given intravenously 15-30 minutes prior to the hepatobiliary agent in a dosage of 0.01-0.04 microgram/kg to facilitate gallbladder visual-

ization. Cholecystokinin should be given over a minimum of 3 minutes to avoid untoward symptoms such as flushing, vomiting, etc.

A "gallbladder ejection fraction study" may also be performed using an intravenous infusion of 0.01-0.04 microgram/kg of cholecystokinin. The study requires activity in the gallbladder and is usually begun 60 minutes after the administration of the hepatobiliary agent. Numerous protocols exist, and the ACR does not endorse any one over the others. When performing and interpreting this procedure, the physician should adhere to the technique and the normal values validated for the specific technique. The ejection fraction is calculated using the values from the time-activity curve:

$$\frac{\text{gallbladder counts (max) - gallbladder counts (min)} \times 100}{\text{gallbladder counts (max)}}$$

D. Images

Serial continuous anterior or left anterior oblique images obtained over a period of 60 minutes or until both the gallbladder and upper small bowel are clearly identifiable constitute the baseline exam. Dynamic acquisition of data (60-120 seconds per frame) is preferred since it may be useful for resolution of ambiguous findings. The study may be extended for as long as 24 hours for detection of tracer in the gallbladder (e.g., chronic cholecystitis) or bowel (e.g., biliary obstruction or atresia) or for detection of bile leaks. Oblique, lateral, posterior, or pinhole collimator views may be useful to clarify ambiguous findings, such as with renal excretion or duodenal activity. Ingestion of water with dynamic acquisition may help distinguish duodenal loop tracer.

## V. EQUIPMENT

For small crystal detectors, a low-energy, all-purpose/general all-purpose (LEAP/GAP), high resolution, or diverging collimator may be used and images of 300,000–500,000 counts obtained. For larger detectors, a LEAP/GAP or higher resolution collimator should be used and images obtained for 500,000–1,000,000 counts. If a larger detector is used in studying children, an appropriate electronic acquisition zoom should be used.

## VI. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Guidelines for Communication: Diagnostic Radiology.

## VII. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS

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 Concerns appearing elsewhere in the ACR Practice Guidelines and Technical Standards book.

Equipment performance monitoring should be in accordance with the ACR Technical Standard for Medical Nuclear Physics Performance Monitoring of Nuclear Medicine Imaging Equipment.


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