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The American College of Radiology will periodically define new practice guidelines 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 guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline 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, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines 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 guideline and technical standard by those entities not providing these services is not authorized.

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ACR PRACTICE GUIDELINE FOR THE PERFORMANCE OF ADULT AND PEDIATRIC RADIONUCLIDE CYSTOGRAPHY

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. Therefore, it should be recognized 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 interpreting physicians in performing radionuclide cystography (RNC) in adult and pediatric patients. Properly performed imaging of the bladder with radiopharmaceuticals provides a sensitive means of detecting, following, and evaluating certain conditions of the bladder. As with all scintigraphic studies, correlation of findings with the results of other imaging and nonimaging procedures, as well as clinical information, is necessary for maximum diagnostic yield.

Application of this guideline should be in accordance with the [ACR Technical Standard for Diagnostic Procedures Using Radiopharmaceuticals](#).

(For pediatric considerations see Sections VI and VII.)

II. DEFINITION

RNC involves filling the urinary bladder with a radiopharmaceutical, either by direct, retrograde administration via catheter or by indirect, antegrade drainage of an intravenously administered radiopharmaceutical that is excreted by the kidneys, and subsequent imaging with a gamma camera

III. GOAL

The goal of RNC is to enable the interpreting physician to detect and quantify physiologic and anatomic abnormalities of the genitourinary system by producing images of diagnostic quality.

IV. INDICATIONS

Clinical indications for RNC include, but are not limited to, detection and evaluation of vesicoureteral reflux and quantification of postvoid bladder residual.

V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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

VI. RADIOPHARMACEUTICALS

If the retrograde technique (see below) is employed, technetium-99m as sodium pertechnetate, sulfur colloid, or stannous diethylenetriamine pentaacetic acid (DTPA) is satisfactory. An administered activity of up to 1.0 millicuries (37.0 MBq) is introduced aseptically into the urinary bladder via a urethral catheter.

If the antegrade technique (see below) is employed, either technetium-99m DTPA or mercapto-acetyltriglycine (MAG-3[®]) must be used; technetium-99m MAG-3[®] is preferred. Administered activity is the same as for renal scintigraphy (see the [ACR Practice Guideline for the Performance of Renal Scintigraphy](#)), with which this technique can be combined. This technique should not be used if the patient is not toilet trained.

Administered activity in children should be reduced based on weight or body surface area, and should be as low as practically achievable for appropriate image quality.

VII. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for radionuclide cystography 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. 2006 (Res. 35)

A. Vesicoureteral Reflux

For infants and children refer to the [ACR Practice Guideline for the Performance of Voiding Cystourethrography in Children](#).

If the retrograde technique is used, the radiopharmaceutical is administered aseptically into the bladder via a urinary catheter and followed by an appropriate volume of sterile normal saline, until the bladder reaches capacity. Alternatively, in adults, the radiopharmaceutical may be added to and mixed with 500 ml of sterile normal saline with appropriate shielding of the container. Warming the saline solution to room or body temperature and infusing at a slow rate may improve the comfort of the patient. The saline container is typically placed no more than 100 cm above the tabletop. The pelvis and abdomen are imaged continuously in the posterior projection, with the patient lying supine. Computer data acquisition is recommended. If reflux occurs during filling of the bladder, the volume at which reflux occurred should be recorded.

When the patient reaches maximum capacity and is instructed to void or when the patient begins to void spontaneously, imaging is continued until the bladder is empty. In patients able to cooperate, voiding images may be obtained with the patient upright. Postvoid posterior images should be obtained in either the supine or upright position after bladder emptying is complete. If the patient cannot void upon request, emptying the bladder via the urinary catheter will reduce radiation exposure. The degree of reflux may be estimated using either a visual grading scale of 1-3 (mild, moderate, or marked), or a 1-5 scale analogous to that used for contrast cystography. For visual analysis of digital images, contrast enhancement or other brightening mode or cine mode should be used to detect the smallest amounts of reflux. Quantification of reflux during the bladder-filling phase and during the voiding phase may also be achieved using region-of-interest (ROI) analysis, with regions of interest placed over both the kidney regions and the ureters.

If the antegrade technique is used, computer acquisition is necessary. Data are obtained in the posterior projection during the act of voiding, and regions of interest are drawn over the kidneys and ureters. Antegrade cystography is not as accurate as the retrograde method for detecting reflux. Reported results vary with the specifics of the technique.

B. Residual Volume

For quantification of postvoid residual volumes, images of the bladder should be acquired anteriorly or posteriorly after voiding. Regions of interest are drawn over the bladder on both sets of images. The volume of voided urine is recorded. Residual volume (RV) can be estimated by the following formula:

$$RV (ml) = \frac{\text{voided vol [ml]} \times \text{postvoid bladder ROI count}}{\text{initial bladder ROI count} - \text{postvoid bladder ROI count}}$$

Residual volume may also be calculated if the volume to which the bladder was filled is known; the equation then becomes:

$$RV(ml) = \frac{\text{max bladder vol (ml)} \times \text{postvoid bladder ROI count}}{\text{full bladder ROI count}}$$

C. Instructions to Patient/Parent

The radiation exposure to the bladder lining and wall, although small and well within accepted diagnostic imaging levels, can be further reduced by a postexamination diuresis to eliminate residual radioactivity if the patient does not empty the bladder completely. Instruction to drink fluids by mouth for several hours following the examination should be given to the patient, parent, or caregiver.

VIII. EQUIPMENT SPECIFICATIONS

A gamma camera with a LEAP/GAP or high-resolution collimator is recommended. If the clinical question relates to vesicoureteral reflux, the field of view must be large enough to include both the bladder and kidneys. For infants and small children, magnification may be used if a large-field-of-view camera head (400 mm) is employed.

Digital acquisition may be desirable and is necessary if quantification is performed. A 64 x 64 acquisition matrix is sufficient for gamma camera heads up to 400 mm in diameter. For larger detectors, a 128 x 128 matrix is needed. A framing rate of 10-30 seconds per frame is suggested. The collimator face and the entire imaging field must be protected from radionuclide contamination using plastic-backed absorbent pads or other similar material. Plans for collection, disposal, storage, or

decontamination of radioactive urine and materials must be considered.

IX. DOCUMENTATION

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

X. RADIATION SAFETY IN IMAGING

Radiologists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This is the concept "As Low As Reasonably Achievable (ALARA)."

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active or manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate ACR Technical Standard. 2006 (Res. 17)

XI. 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 Guideline 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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