Overview

The radionuclide Cystogram allows the diagnosis and follow-up of vesicoureteral reflux. In general, the study is more sensitive than radiographic methods because of the high contrast between instilled radioactivity in the bladder and the lack of radioactivity outside of the bladder. The study is also able to evaluate the post void residual volume.

Indications

Evaluation of vesicoureteral reflux (1-3).
Suspicion of a large post void residual urine volume.

*Exams ordered for indications which are not listed above need to be discussed with the Nuclear Medicine Physician.

Examination Time

45 minutes.

Patient Instructions

a. No special scheduling is needed. However, do not schedule if the patient has, or has recently had, cystitis (not within 14 days of diagnosis; complete antibiotic therapy first).

b. In order to reduce anxiety in both the parent and the child, a nurse or technologist should explain the procedure in a sensitive and thorough manner to the patient, or parent, prior to scheduling. No sedation is used.

c. Be sure an RN is available to place the Foley catheter. The Department RN will normally do this. In children <1 yr and newborns, assistance from the neonatal-nursery staff may be required.

Lab / Image Correlation

No specific lab needed. Ask the referring physician's office if they want a "clean catch" urine specimen collected at the time of foley insertion.

If available, any previous radionuclide cystography or contrast cystography should be obtained for comparison.
**Patient Preparation** (1-3)

1. Inquire about latex allergy; if positive, use non-latex gloves, etc.

2. Patient should refrain from voiding immediately prior to procedure; no sedation.

3. Cover imaging table with absorbent pads.

4. A sterile Foley catheter is inserted (the largest size that comfortably passes the meatus), using sterile technique by a nurse (either nuclear medicine or pediatrics) with the patient supine and the gamma camera under the patient and scanning table. (lidocaine jelly, 3-5 ml, can be applied to the male urethra, 5 min. prior, directed by the nuclear medicine physician.) Inflate the balloon carefully after catheter is in the bladder (4). Drain bladder prior to connecting saline. (The physician may want a clean catch urine sample for culture, so preparation should be made for this.)

5. There is a small risk of catheter induced infection. Be sure the patient/parent know signs and symptoms.

**Equipment & Energy Windows**

1. Gamma camera: Large field of view (small field of view may be used for a small child).

2. Collimator: Low energy, high resolution, parallel hole.

3. Energy window: 20% window centered at 140 keV.


**Radiopharmaceutical, Dose, & Technique of Administration**

Radiopharmaceutical: Tc-99m-pertechnetate as sodium pertechnetate (6).

Dose: 1 mCi (37 MBq).

Technique of administration: Inject into rubber injection port of catheter.

**Patient Position & Imaging Field**

Patient position: Supine.

Imaging field: Base of bladder to top of kidneys.
Acquisition Protocol (1-3)

1. A 500-ml bag of sterile normal saline is attached to the catheter through the blue catheter adaptor, being sure the adapter is completely encased in the Foley. The bag should be at approximately 70-90 cm above table (normal resting bladder pressure 30 mm H2O) (1,5). A 1-mCi dose of Na99m Tc04 is sterilley injected into the IV tubing and the saline drip is begun. Only a small amount is infused at this time. Reposition the patient with the upper half to upper one-third of the bladder in the field of view so the ureters will be visualized. (In children, place full bladder at bottom of FOV; in adults, position with only 1/2-1/3 full bladder.)

2. The saline filling phase is begun with computer and formatter set to accumulate images 5 sec/frame x 1200 sec.128x128. Saline infusion should be administered slowly to avoid bladder spasm. One nuclear medicine technologist will control and watch the volume of saline and fill in work-sheet; another nuclear medicine technologist will run the computer and the gamma camera while watching the persistence scope for a reflux. If reflux occurs, the volume of saline infused is recorded on the data sheet -- "right or left reflux at _____ ml/saline".

3. Maximum bladder capacity will be approximately 200 to 300 ml. For children, use the following formula: (age in years + 2) x 30 = ______ cc. (The total volume of saline infused is noted from the plastic bag and recorded in the "Total Saline Instilled" column of the Data Sheet.) No more should be instilled. (At this point, if possible, i.e. the patient is fully continent.) Do not jeopardize dynamic voiding phase in order to obtain this static image.

4. When bladder capacity has been reached, proceed to dynamic voiding: quickly have patient sit up on bed pan; rotate camera to posterior view. Empty the Foley balloon, remove the catheter, and encourage the patient to void into the empty bedpan while dynamic images are obtained at 10 sec/frame for a total of 18 frames. Start camera when voiding is initiated. All the urine must be saved and the volume measured. This volume is recorded in the "Total Voided Volume of Urine" column on the data sheet.

Data Processing

None.

Optional Maneuvers

Quantitation of residual volume (8):

1. Measure the volume of urine which was voided (This measurement must be accurate.).
2. Place regions of interest over the bladder in the digital images corresponding to maximum filling and maximum emptying (postvoid).
3. Determine the counts per minute in each region of interest.

\[
\text{Residual volume (mL)} = \frac{B \times V}{A - B}
\]

Where:
- \(A\) = radioactivity in bladder when full (cts per min)
- \(B\) = radioactivity in bladder post void (cts per min)
- \(V\) = voided urine volume (mL)

**Principle Radiation Emission Data - Tc-99m (11)**

Physical half-life = 6.01 hours.

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma-2</td>
<td>89.07</td>
<td>140.5</td>
</tr>
</tbody>
</table>

**Dosimetry - Tc-99m-Pertechnetate as Sodium Pertechnetate (3,12)**

<table>
<thead>
<tr>
<th>Organ</th>
<th>rads/1 mCi</th>
<th>mGy/37 MBq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder</td>
<td>0.025</td>
<td>0.25</td>
</tr>
<tr>
<td>Ovaries</td>
<td>0.002</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**References**


Normal Findings


JSM
PROTOCOL\06-1
Rev. 4/8/2014

Note: This protocol is in agreement with the Society of Nuclear Medicine Procedure Guidelines Manual, 1997.
Cystogram Worksheet

Patient’s Name

Date
Hospital #
Age ________

Expected bladder vol. _______ (age+2)x30
Did child void before catheterization? Y N

Initial IV bottle volume ____________
Catheter used ____________

IV bottle volume after study is complete ____________ cc
Residual volume after cath. ____________ cc

Urine sent for culture? Y N

Rate of infusion:

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>250</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>350</td>
</tr>
<tr>
<td>400</td>
</tr>
<tr>
<td>450</td>
</tr>
<tr>
<td>500</td>
</tr>
</tbody>
</table>

Reflex (Y/N) | Right/Left |
-------------|------------|

Right kidney refluxed at ______________ ml/saline
Pre-void counts ____________ 2 min.

Left kidney refluxed at ______________ ml/saline
Post-void counts ____________ 2 min.

Total saline of urine ______________ ml
Total voided volume of urine ______________ ml
CALCULATIONS

\[
\text{Residual volume (mL)} = \frac{B \times V}{A - B}
\]

Where:
- \( A \) = radioactivity in bladder when full (cts per min)
- \( B \) = radioactivity in bladder post void (cts per min)
- \( V \) = voided urine volume (mL)

• The total volume of saline is noted from the plastic bag and recorded in the “Total Saline Instilled” column on the data sheet.