NUCLEAR MEDICINE SERVICES

SUBJECT: CISTERNOGRAPHY (CSF Leaks & Shunts)

Overview
- Cisternography depicts the flow of cerebrospinal fluid along normal and abnormal pathways following injection of the tracer into the lumbar intrathecal space.

Indications
- Diagnosis of normal pressure hydrocephalus
- Identification of cerebrospinal fluid (CSF) leaks (Use protocol at end of this protocol)
- Evaluation of lumboperitoneal shunts

Examination Time
- Initial lumbar puncture: 30 minutes. Immediate image post injection of injection site.
- Delayed images at 6 and 24 hours: 30 minutes for each set of images. (Delayed images may be needed at 48 hours and 72 hours.)

Patient Preparation
- Informed consent must be obtained for the lumbar puncture.

Equipment & Energy Windows
- Camera: Dual Head, Large field of view.
- Collimator: Medium energy, parallel hole.
- Energy windows: 20% windows centered at 171 and 245 keV.

Radiopharmaceutical, Dose, & Technique of Administration
- Radiopharmaceutical: In-111-DTPA (diethylenetriaminepentaacetic acid).
- Dose: 0.5mCi.
- Technique of administration:
  1. Intrathecal via lumbar puncture (performed by physician).
  2. 22 gauge or smaller needle preferred to minimize CSF leakage.
  3. May use 3 way stopcock so injection of radiopharmaceutical can be followed by 1-2 mL saline flush.
  4. Keep patient horizontal for 2 hours following lumbar puncture to minimize chances of headache from CSF leakage.

Patient Position & Imaging Field
- Patient position:
  1. Supine for ANTERIOR and LATERAL images.
- Imaging field:
  1. Entire head for all sets of images.
  2. Lumbar spine is added to the immediate post injection set of images.
Acquisition Protocol

- Acquire a POST lumbar spine image immediate post injection.
- Acquire ANTERIOR, POSTERIOR and LATERAL images at 6, 24hrs. Delayed images may be needed 48 and 72 hours.
  1. For the ANTERIOR / POSTERIOR image the orbitomeatal line should be perpendicular to the collimator face.
  2. For the LATERAL images the head may be slightly rotated so that the side of the head is flush with the collimator.
- Acquire each image for 600 seconds.

Data Processing

- Static image display.

Optional Maneuvers

- When imaging for CSF leaks: See CSF leak protocol (this is only a synopsis)
  - Protocol at end of this protocol
  1. PLEDGET PLACEMENT
    - The patient will be instructed to report to the ENT Clinic where one of the ENT physicians will place 6 pledgets in the nasal and facial sinuses.
    - The patient will be given 1 dry pledget to bring back to Radiology. This pledget should be cut by the ENT physician such that its size and weight match those actually inserted, as precisely as possible (to be used as a bkg).
  2. Obtain ANTERIOR, POSTERIOR, LATERAL, images.
  3. Position the patient in the position that maximizes the leak:
    - an absorbent sheet of paper should be placed underneath the patient's nose to catch any radioactive rhinorrhea.
    - An ANT image of the abdomen may be added to look for swallowed radioactive CSF in the intestine.
  4. SPECT/CT may increase the sensitivity of imaging for CSF leaks.

- Cisternography may be used to assess the patency of lumboperitoneal shunts:
  - Acquire serial 1 minute digital images of the abdomen in the R LATERAL projection for the first 20 minutes after injection.
  - At 2 hours acquire ANTERIOR and R LATERAL images of the abdomen.
  - At 4 and 24 hours acquire ANTERIOR and R LATERAL images of the abdomen and head.

Principle Radiation Emission Data - In-111 (9)

- Physical half-life = 2.83 days.

<table>
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<tr>
<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
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<tr>
<td>Gamma-2</td>
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<td>171.3</td>
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<tr>
<td>Gamma-3</td>
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# Dosimetry - In-111-DTPA (10)

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<th>rads/1.5 mCi</th>
<th>mGy/55.5 MBq</th>
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<tr>
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<tr>
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<tr>
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<td>4.8 hour void</td>
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<td>Total body</td>
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<td>0.4</td>
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## References


## Normal Findings

CSF LEAK PROTOCOL

CSF LEAK-PATIENT POSITIONING:

Supine (The patient should not move during acquisition.)

ACQUISITION PROTOCOL:

1. PLEDGET PLACEMENT

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The patient will be given 1 dry pledget to bring back to Radiology. This pledget should be cut by the ENT physician such that its size and weight match those actually inserted, as precisely as possible.

2. NEURO CT PROCEDURE # 1:

The patient comes to radiology for the non-contrast CT procedure.
• Axial slices are obtained with 5 mm thickness through the sinuses or mastoids/ear.
• Coronal slices are obtained with the patient in the prone position, with 3 mm thickness through the sinuses or 1.5 mm through the temporal bone.

3. FLUOROSCOPY & LUMBAR PUNCTURE:

The patient is escorted to the fluoroscopy suite for the LP procedure.
The Nuclear Medicine Tech will bring the radiopharmaceutical dose containing the In-111 DTPA
• Under fluoroscopic guidance, the LP is performed and the intrathecal contrast is placed into the subarachnoid space.
• After the correct needle position has been verified with contrast, the radiopharmaceutical is injected.
• The Nuclear Medicine Technologist will take the dry pledget and the empty dose syringe back to Nuclear Medicine.
• The patient is placed in the prone, head down position for 2 minutes and then stays trendelenburg for at least 10 minutes.
• The patient is escorted to the Radiology PPCA Area and remains there until ready for the second part of the CT study.

4. NEURO CT PROCEDURE #2:

At 1 hour post LP, the patient returns to the CT Scanner for the CT study with contrast.
• The CT study is repeated per the above protocol. The patient is then escorted to Nuclear Medicine

5. NUCLEAR MEDICINE PROCEDURE, PART #1:

The patient comes to Nuclear Medicine 4 hours post LP.
• If possible, the patient should be imaged in the sitting position; otherwise supine will be acceptable.
• Acquire 4 PLANAR images, for 5MIN/VIEW: ANTERIOR, POSTERIOR, RIGHT LATERAL & LEFT LATERAL, using medium energy collimation.
• Review these images with the Reading Room Physician.
• The patient will return to Nuclear Medicine the next day for additional images.

6. NUCLEAR MEDICINE PROCEDURE, PART #2:

The patient returns to Nuclear Medicine on the morning following the LP procedure.
• Ask the patient if there is an optimal position which causes the CSF leak. If possible, place the patient in that position for imaging.
• At 24 hours post injection, Acquire 4 PLANAR images, for 5 MIN/VIEW: ANTERIOR, POSTERIOR, RIGHT LATERAL & LEFT LATERAL.
• Perform a 360 degree SPECT study with medium energy collimation & dual head camera.
• An attending or resident will carefully remove the pledgets, avoiding cross-contamination, and set them aside in separate containers for further analysis. The pledget location labels should not be removed.

**BLOOD SAMPLE:**
1. Draw a 5 cc blood sample.
2. Separate the 5 cc blood sample, via centrifugation. Obtain 1 cc of blood plasma, and count for 1 minute in the well counter.
3. Count each pledget, including the dry, unused one, for 1 minute in the well counter & record counts along side pledget labels, on the attached Worksheet.
4. Weigh each pledget, including the dry, unused one, using an accurate gravimetric balance.
5. Record these weights along side count data and pledget labels.

**DATA PROCESSING:** Calculate ratio of blood plasma to pledget corrected to one gram.

**PACS:** Gray scale screen capture of static images.

**OPTIONAL MANEUVERS:**
1. For normal pressure hydrocephalus: No need for pledget placement. Imaging is done at 48 and 72 hours.
2. For shunt evaluation: Depending on the type of shunt –
   a. VP shunt – inject thru the reservoir and see proximal and distal fluid patency.
   b. LP shunt – inject thru LP