



Austin Radiological Association
Nuclear Medicine Procedure
CISTERNOGRAPHY
(In-111-DTPA)

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.
- Evaluation of lumboperitoneal shunts.
- Evaluate Ommaya reservoir patency

Examination Time

- Initial lumbar puncture: 30 minutes.
- Delayed images at 2, 4, 24, 48, and 72 hours (if needed): 60 minutes for each set of images.

Patient Preparation

- Informed consent must be obtained for the lumbar puncture.

Equipment & Energy Windows

- Camera: Large field of view gamma camera.
- 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: 0.5 - 2 mCi (18.5 - 74 MBq). Pedi dose by NACG chart.

- 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 that 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.

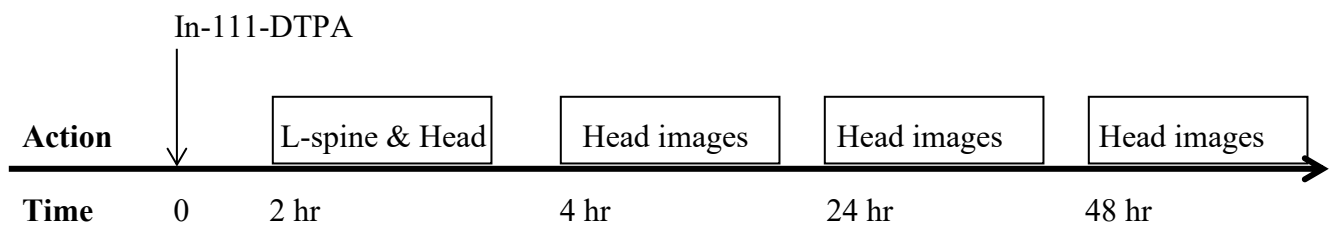
Patient Position & Imaging Field

- Patient position:
 1. Supine for ANT/POS and R & L LAT images.
 2. Prone for 2 hour POST image of lumbar spine.
- Imaging field:
 1. Entire head for all sets of images.
 2. Lumbar spine is added to the 2-hour set of images.

Acquisition Protocol

- Acquire a POST lumbar spine image at 2 hours, for 8 minutes
- Acquire ANT/POST and both LATERAL images at 2, 4, 24 and 48 hours.
 1. For the ANT image the orbitomeatal line should be perpendicular to the collimator face.
 2. For the LAT images the head may be slightly rotated so that the side of the head is flush with the collimator.
- Acquire each image for approximately 10 –12 minutes or 200k counts.
- 64x64 Matrix
- If at 2 hours there are very few counts coming from the head, show the 2-hour image to the nuclear medicine physician to determine if the injection extravasated outside of the subarachnoid space. If there has been extravasation, the study is usually terminated.

Protocol Summary Diagram



Data Processing

- None (unless nasal pledgets are used, see “Optional Maneuvers”).

Optional Maneuvers

- Quantitative diagnosis of CSF rhinorrhea:
 1. 2 hours after intrathecal injection of the radiopharmaceutical, anterior and posterior pledgets are placed in each nostril by an ear, nose, & throat physician.
 2. Each pledget is approximately 1 cm square, has an absorptive capacity of 0.5 mL of water, has a string attached to it for retrieval, and has a label on the protruding portion of the string indicating its position, e.g. left-anterior.
 3. 4 hours after placement (6 hours after injection of the radiopharmaceutical), the pledgets are removed.
 4. 5 mL of venous blood is withdrawn into a heparinized tube both at time of placement and at the time of removal of the pledgets.
 5. 0.5 mL of plasma is withdrawn from each blood sample following centrifugation.
 6. The radioactivity in each pledget and each 0.5 mL plasma sample is measured in a well counter using a 150-250 keV energy window.
 7. The results are expressed as the ratio of pledget radioactivity over the average plasma radioactivity (See CSF Leak Worksheet).
 8. Normal pledget to plasma radioactivity ratios do not exceed 1.3.
- When imaging for CSF leaks:
 1. Obtain ANT, POST, L LAT, and R LAT images.
 2. Position the patient in the position that maximizes the leak:
 - a) an absorbent sheet of paper should be placed underneath the patient’s nose to catch any radioactive rhinorrhea.
 3. An ANT image of the abdomen may be added to look for swallowed radioactive CSF in the intestine.
 4. Tomography may increase the sensitivity of imaging for CSF leaks.
- Cisternography may be used to assess the patency of lumboperitoneal shunts:
 1. Acquire serial 1 minute digital images of the abdomen in the R LAT projection for the first 20 minutes after injection.
 2. At 2 hours acquire ANT and R LAT images of the abdomen.
 3. At 4 and 24 hours acquire ANT and R LAT images of the abdomen and head.
- Dual isotope SPECT for anatomic localization of leak:
 1. Perform routine cisternography with In-111-DTPA.
 2. At 24 hours inject 25 mCi of Tc-99m-MDP.
 3. Acquire SPECT images of the head.

- Ommaya reservoir patency – see appendix

Method for timely correction of Data Analysis and reporting errors and notification of referring parties

- Data Analysis and reporting errors are reported to the interpreting physician and appropriate clinic manager for timely correction and notification of the referring physician via report addendum or STAT call if error is significant.

Principle Radiation Emission Data - In-111

- Physical half-life = 2.83 days.

Radiation	Mean % per disintegration	Mean energy (keV)
Gamma-2	90.2	171.3
Gamma-3	94.0	245.3

Dosimetry - In-111-DTPA

Organ	rads/1.5 mCi	mGy/55.5 MBq
Spinal cord		
Surface	5.0	50.0
Average	1.5	15.0
Brain		
Surface	4.1	41.0
Average	0.4	4.0
Kidneys	0.22	2.2
Bladder wall		
2 hour void	0.21	2.1
4.8 hour void	0.5	5.0
Ovaries		
2 hour void	0.06	0.6
4.8 hour void	0.06	0.6
Testes		
2 hour void	0.04	0.4
4.8 hour void	0.05	0.5
Total body	0.04	0.4

CSF LEAK WORKSHEET
Nuclear Medicine Department
Austin Radiological Association

Patient name _____ ID _____

Referring physician _____ Date _____

STEP 1 Determine net counts per 5 minutes (cp5m) for all specimens:

Specimen	Gross (cp5m)	Background (cp5m)	Net (cp5m)
R Ant	-	-	=
R Post	-	-	=
L Ant	-	-	=
L Post	-	-	=
2 hr Plasma	-	-	=
6 hr Plasma	-	-	=
Background	-	-	=

STEP 2 Calculate the average counts per 5 minutes for the 2 plasma aliquots:

$$\begin{aligned}
 & 2 \text{ hour plasma sample} = \text{_____ cp5m} \\
 & 6 \text{ hour plasma sample} = \text{_____ cp5m} \\
 \text{sum} & = \text{_____} \div 2 = \text{_____ cp5m (average)}
 \end{aligned}$$

STEP 3 Calculate the ratio of each pledget to the average plasma value:

Specimen	Net (cp5m)	Ave plasma (cp5m)	Ratio
R Ant	-	-	÷ =
R Post	-	-	÷ =
L Ant	-	-	÷ =
L Post	-	-	÷ =

• Normal ratio \leq 1.3 •

Technologist _____

Ommaya Reservoir Cisternogram Protocol:

Order 2 mCi In-111 DTPA dose from Cardinal Health (allow for 2 days prior to exam).

Coordinate with clinic manager/referring office to confirm authorization has been received and patient will be coming in.

There is no fasting for this exam. No contraindications. Empty bladder for patient comfort (not necessary for imaging). Sedation, if required – call patient to evaluate prior to injection.

The referring physician will send a representative to access the Ommaya reservoir (they will be accessing this for the patient's chemotherapy treatments). Patient should be upright in a chair. A place for sterile field set-up should be close by.

The technologist will inject the radiopharmaceutical, unless a nuclear radiologist is present, and will be responsible for contamination detection, clean-up, and documentation.

Use a stabilizing head holder and arm support for imaging. Patient goes in feet first. The FOV should start 1-1.5 inches from top of the head, with the detector as close as you can to the patient (ideally, 0.5-1 inch away from the nose). Be consistent with your parameter settings throughout the exam.

Imaging protocol:

Immediately post injection: 12min statics - Anterior and Posterior and Laterals

1 hour post injection: 12min statics - Anterior and Posterior and Laterals

4 hours post injection: 12min statics - Anterior and Posterior and Laterals

6 hours post injection: 12min statics - Anterior and Posterior and Laterals

24 hours post injection: 12min statics -Anterior and Posterior and Laterals

Processing protocol:

Create save screens of your acquisitions.

Circular/elliptical shaped ROI's should be drawn to include the brain and injection site. Include all activity on initial images. Use the same ROI for 1 through 24Hr images (anterior ROI for anterior images, posterior ROI for posterior images).



Much like our Gastric emptying protocol, geometric mean is calculated so that we can identify retention of the isotope throughout the exam. Use the spreadsheet calculator on the ARA Portal page.

Normal is less than 50% retention at 24 hours.

Decay factors for In-111:

1 hour - 0.9898 4 hours - 0.9600 6 hours - 0.9406 24 hours - 0.7828

Display – Screen saves of all images at each time point and Screen save of ROI's with statistics.

