Austin Radiological Association

Nuclear Medicine Procedure

BONE MINERAL STUDY
(Tc-99m-MDP, Tc-99m-HMDP)

Overview

- The Bone Mineral Study, with either Tc-99m-MDP or Tc-99m-HMDP, depicts the distribution of bone mineral metabolism throughout the skeleton. In addition, rapid serial images during the first pass of the radiopharmaceutical through the circulation may be obtained to demonstrate regional perfusion.

Indications

- Detection of bone metastases.
- Diagnosis of osteomyelitis.
- Evaluation of musculoskeletal trauma.
- Assessment of low back pain.
- Evaluation of primary benign and malignant bone lesions.
- Diagnosis of reflex sympathetic dystrophy (RSD).
- Evaluation of the response of Paget's disease to treatment.
- Evaluation of heterotopic ossification.

Examination Time

- Initially: 15 minutes for injection of the radiopharmaceutical; 30 minutes for the perfusion and blood pool components of a three-phase study.
- 3 hours later: 30 – 45 minutes for image acquisition with MDP

Patient Preparation

- None pre-exam:
  - > Hydration post injection with 2-3 16oz glasses of water
  - > Obtain PSA level if prostate cancer history
  - > Empty bladder often

Equipment & Energy Windows

- Gamma camera: Large field of view, preferably with dual heads.
- Collimator: Low energy, high resolution, parallel hole.
- Energy window: 15-20% window centered at 140 keV.

Radiopharmaceutical, Dose, & Technique of Administration

- Radiopharmaceutical:
  > Tc-99m-methylene diphosphonate (MDP).
  > Tc-99m-hydroxymethylene diphosphonate (HMDP).
- Dose: 20-30 mCi (740 - 1110 MBq). Pedi dose by NACG chart.
- Technique of administration:
  > Routine study: Standard intravenous injection.

Patient Position & Imaging Field

- Patient position: Supine (prone position can be used if patient cannot lie supine).
- Imaging field: Entire body (include arms as possible).

Acquisition Protocol - Routine Study

- Have the patient empty his/her bladder immediately before image acquisition.
- Begin image acquisition 3 hours following injection of the radiopharmaceutical.
- Moving acquisition protocol:
  1. Use a camera/table motion of approximately 10-20 cm/min.
     a. Average speed is 12cm/min with standard software, 16 -18 cm/min with ½ time (planar processing) resolution recovery software.
  2. Acquire ANT and POST images from the vertex of the head to the bottom of the feet.
  3. Acquire static "spot" images as indicated.
- Static acquisition protocol:
  1. Acquire an ANT image of the chest for approximately 500-750 K counts, note the time required for acquisition.
  2. Using the same acquisition time used for the ANT chest image acquire ANT and POST images of the rest of the torso and head, and ANT images of the extremities (include arms as possible).

- Limited study protocol:
  1. Acquire Anterior and Posterior Images was well as orthogonal views.
     a. Acquire for 300 - 600 secs/image standard software, 200 - 300 secs/image with ½ time (planar processing) resolution recovery software.

- SPECT tomographic images are routine for low back pain, and are used in other selected situations:
  1. Image acquisition parameters:
     a) degrees of rotation: 360°.
     b) number of images: 60 for single head, 120 for dual head camera
     c) time per image: 25-40 seconds, based on body habitus.
  2. Data processing:
     a) reconstruct transverse, sagittal, and coronal images.
     b) filter selection depends on computer software package – preference is iterative (Flash 3D) processing with Gaussian filter.

- Have the patient empty his/her bladder at the end of the study, and remind to hydrate and empty bladder often.

Protocol Summary Diagram

Data Processing

- Perform masked bladder Save Screen on all Total Body Bone scans

- SPECT imaging requires transverse, coronal, and sagittal reformations, utilizing Flash 3D (iterative) processing.

- Mask bladder

Optional Maneuvers

- Three-phase bone scan:

    1. Routinely used when the clinical question is infection in the extremities; frequently used for question of stress fracture, avascular necrosis, or primary bone tumor.
    2. The patient position and field of view depend on the area of interest; include both sides of the body, e.g. both legs or both hands, so that the unaffected side can be used for comparison.
    3. The radiopharmaceutical is administered as a bolus. Inject away from the area of interest, ex. feet/ankle for hands/wrists.
    4. Acquire serial analog images for 3-5 seconds each for 60 seconds starting at the time of injection.
    5. Flow knees anterior, hands palmer, feet plantar
    6. Immediately acquire a blood pool images for approximately 5 minutes. (The number of counts will depend on the body part being imaged and other factors.) Anterior/Posterior, Palmer/Posterior, Plantar/Anterior.
    7. Have the patient return in 3 hours for the delayed images; follow the acquisition protocol for delayed images given above.
    8. Complex regional pain syndrome UE or arthritis Hx, flow hands/wrists.

- Special views:

    1. Images of the scapula with the arms moved forward or up can be used to differentiate activity in the scapula and underlying ribs.
    2. The TOD view (tail on detector) is useful for separating otherwise superimposed structures around the pelvic ring. The view is obtained with the patient sitting over the head of the camera. Obtain on all pelvic indications.
    3. The skyline view of the elbow improves localization of elbow pathology.
    4. Small structures may be magnified with a 2 or 5 mm pinhole collimator, such as pediatric hips.
    5. For osteoid osteoma, radiologist may request pinhole views if exam is not ordered as SPECT/CT.

- Maximum intensity projection (MIP) display: May assist in lesion evaluation.

- SPECT-CT imaging: SPECT-CT imaging of the spine is useful in localizing metabolically active vertebral bodies prior to vertebroplasty.

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 - Tc-99m

- Physical half-life = 6.01 hours.

Radiation	Mean % per disintegration	Mean energy (keV)
Gamma-2	89.07	140.5

Dosimetry - Tc-99m-MDP/Tc-99m-HMDP

Organ	rads/25 mCi	mGy/925 MBq
Bladder wall		
2 hour void	3.25	32.5
4.8 hour void	7.75	77.5
Kidneys	1.00	10.0
Bone total	0.88	8.8
Red marrow	0.70	7.0
Testes		
2 hour void	0.20	2.0
4.8 hour void	0.28	2.8
Ovaries		
2 hour void	0.30	3.0
4.8 hour void	0.43	4.3
Total body	0.16	1.6