

YYYYYY Nuclear Medicine Laboratory

Bone Scan Procedure

78300 – LIMITED
78315 - THREE PHASE

78306 - WHOLE BODY
78320 - SPECT

APPROVED BY: _____
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A. THEORY

Diphosphonates are absorbed onto the surface of bone reflecting local osteoblastic activity and vascularity. Bone scans remain as most sensitive imaging modality to detect osteoblastic response, as seen with fractures and osteoblastic metastatic disease, infections and metabolic disease. (Ref 1,2)

B. CLINICAL INDICATIONS

- a. Neoplastic disease.
 - i. Detection of metastatic disease.
 - ii. Monitoring metastatic disease.
 - iii. Evaluation of primary bone tumors.
- b. Infectious Disease.
 - i. Detection of acute osteomyelitis.
 - ii. Detection of chronic osteomyelitis.
 - iii. Monitoring effects of therapy
- c. Trauma
 - i. Evaluation for fracture
 - ii. Evaluation of prosthetic joints
- d. Arthritis and related disorders
 - i. Evaluation for osteoarthritis, sacroiliitis, synovitis.
 - ii. Detection of Reflex Sympathetic Dystrophy.
- e. Detection of osteonecrosis.
- f. Evaluation of metabolic bone disease
- g. Evaluation of soft tissue calcification
- h. Evaluation of skeletal pain of unknown cause. (Ref 1,2)

C. RADIOPHARMACEUTICAL

- a. ^{99m}Tc MDP 15 - 25 mCi (740 MBq - 925 MBq)
- b. Dose: Adults 15- 25 mCi (740-925 MBq); Children - 200 $\mu\text{Ci/kg}$ (7.4 MBq/kg) (lower limits - 2 mCi) (74 MBq)

D. EQUIPMENT AND MATERIALS

- a. Standard I.V. tray.
- b. Prism 2000XP or Axis camera fitted with LEHR collimator and Odyssey computer.
- c. ^{57}Co marker

E. EQUIPMENT PREPARATION

- a. Perform Daily QC per established standards
- b. Put LEHR collimators on detectors.

- c. Attach pallet to pedestals. (Center and lock table on Axis)
- d. Place sheet and pillow on patient table.
- e. Attach left arm rest. (Right arm rest on Axis)
- f. Check camera PHA at Odyssey. ^{99m}Tc peak is 140 keV. Use 15% window. Assymetry should be less than 3%.

F. PATIENT PREPARATION

- a. No barium studies within previous 2 days
- b. Instruct patient to consume extra liquids during the 3 hours between injection and imaging and to empty bladder frequently
- c. The patient must empty bladder as completely as possible preceding the imaging procedure.

G. PRINCIPLE

Metastases, fractures, bone infections and other bone lesions cause increased osteoblastic response and can be easily imaged by skeletal scintigraphy. Methylene diphosphonate chemical adsorbs to the bone crystal, because it is a phosphate analog. This process takes several hours, so that imaging at 2-4 hours is optimal. If vascularity is to be imaged, i.e. with stress fracture, osteomyelitis, or RSD, a 3-phase scan should be performed which consists of rapid sequence scintiphotos, immediate and delayed static images over the region of interest. (Ref 1,2)

H. PROCEDURE

- a. The receptionist will track the Injection Procedure to Enter Department in the RMS system to notify technologists of patient's arrival
- b. Method of administration – intravenously
- c. Injection to imaging time – 2-4.5 hours.
- d. Do NOT track the Injection Procedure in the RMS system. The receptionist will cancel this procedure when the Patient returns for the Bone Scan. She will track the patient to Enter Department for the Bone Scan Procedure when the patient returns.
- e. Track the patient to Begin Procedure for the return scan in the RMS system.
- f. Routine whole body Imaging:
 - i. Have patient remove any attenuation producing articles (jewelry, belt buckles, coins, large metal buttons, etc). Position patient on pallet. Left arm rest should be in position for patient. Put right arm rest in place. Remind patient to keep arms at his sides. Secure patient's feet together, if possible. This places the legs and hips in a true anterior position. Adjust patient's head in a true anterior and posterior position. Secure head, if necessary. Observe that patient is lying as flat as possible on the table. Pelvis should not be rotated. Both arms should be at the patient's sides.
 - ii. Set up gantry for whole body imaging. Gantry moves to patient's feet.
 - iii. Set Head 1 height and linear travel position. Press Mark to locate end of scan.
 - iv. Move gantry to left. Adjust height of Head 1 as close as possible without touching the patient. Observe that the patient will not be touched by any part of the camera. Adjust the patient or camera as necessary staying as close as possible with the detectors
 - v. At start position press mark to locate start of scan.
 - vi. Set up computer using Acquire Macro with S&W Tc99m Wholebody Bone protocol. This can be defined from the USER macro list.
 - Value: 20 minutes.
 - Select both heads for wholebody mode
 - No magnification
 - Matrix: 256 x 1024

Contouring: On

- vii. Start scan. Mark RT side using ^{57}Co marker
- viii. At completion of scan, evaluate for replacement of counts.

All patients will have a Lightbox created using the following technique: (Replace Counts) (Light box is display procedure)

1. Put study on Workbench. Go to Display A.
2. Format should be 512 x 512 with a zoom x1.
3. Select Elliptical Region. Size = 10 Shape = 60
4. Look at Max Value number of anterior sternum and posterior L- spine. Exclude any hot spots from ROI. Average the two values. Record number on order requisition.
5. Click on Done
6. Go to Planar Processing, Planar Tools, Image Algebra
7. Choose Count Manipulation, Replace Counts
8. Click on Image ID box. After ReC enter averaged number determined in step 4 above.
9. Click on Counts Above box. Hit F3 to clear. Enter number determined in step 4 above.
10. Click on or tab to Become box. Hit F3 to clear. Enter number determined in step 4 above. Click on Done.
11. Set Window to 100 Base at 0.
12. Click on Display: Wholebody Display. Yes to see Clinical Index. You will have to select the patient.
13. Select the ReC Anterior and Posterior images. Click on Done.
14. Click on Wholebody Menu and select Dual Display Menu.
15. Click on Lock A stripe.
16. Adjust Window to 80
17. Cancel this menu.
18. Label RT side marker
19. Store Lightbox. Label as Rec and number of counts replaced.

If there are lesions in the scan, the physician may ask for a second technique using half of the lesion counts. If so, create a second Lightbox.

20. Track the patient to End Procedure for the return scan in the RMS system.
21. If spot images are to be made (extra views or 3 phase), static images are made on 256 x 256 matrix. Magnification may or may not be needed depending upon size of area of interest. Image for 500-1000k or 10 minutes. Create Lightbox.

g. Alternate procedure

i. Axis camera

1. Place patient supine on imaging table with feet toward gantry, positioning as described above.
2. At Odyssey:
 - a. Select Acquisition
 - b. Select Acquire
 - c. Enter Patient name, MRN, DOB, Sex, Operator ID, and Accession number
 - d. Click on Done. Screen goes to protocol list
 - e. Click on User
 - f. Double click on S&W 99Tc Wholebody Bone.

Parameters:

Mode: Wholebody

Heads: 12 (both)

Mag: 1.0

Window:

Matrix: 256 x 102

Value: 20 minutes

Isotope: ^{99m}Tc (140 keV) 15% window

Contouring: On

3. At gantry:

- a. Position patient supine on table as described above
- b. Click Done on Acquisition page of Odyssey.
- c. Press Resume on Hand Control to initiate wholebody setup sequence. Head 2 moves up and pallet moves in to catcher.
- d. Set table height, detector radius at end point (feet)
- e. Press M on hand control to continue set up
- f. Define Contour by moving Head 1 up or down and moving table translate in to start (head) point.
- g. Press M on hand control to set scan start point

4. At Odyssey:

- a. Select left foot flood table.
- b. Click on Done
- c. Enable gantry with resume button
- d. Start scan at Odyssey

h. Special Procedures:

i. Three phase (flow study).

1. Select A_3Ph_Bone protocol to acquire and display flow study.

Parameters:

Mode: Planar Dynamic

Heads (1 or 2 depending upon area of interest)

Mag: 1.0 (children may require mag)

Matrix: 128 x 128

Value: 5 seconds

Number of Images: 20 (more at discretion of physician)

Isotope: ^{99m}Tc (140 keV) 15% window

View: Anterior, Posterior, Plantar, etc.

Acquisition ID: "Skeletal part" being imaged

2. Position patient and camera. Remove any attenuating material from patient, if needed.
3. If upper extremity is being imaged, inject on side opposite affected extremity.
4. Start acquisition when tourniquet is released. Mark RT side using ^{57}Co marker
5. Acquire immediate static images in same position and camera settings as flow, using 256 x 256 matrix and 500-1000k per image. Mark RT side using ^{57}Co marker
6. Upon completion of study, Create Lightbox, labeling all markers and views
 - a. Click on Dynamic Display. Select flow and static images
 - b. Display Planar Statics. Display 256 planars in bottom half of screen
 - c. Add labels and arrows.

- d. Enter time/image in label field.
 - e. Place label under flow images
 - f. Enter "RT" in label field
 - g. Place label next to RT side marker. Repeat for all RT side markers.
- ii. Four phase (24 hour): Duplicate static image acquisition from day before, changing image label to 24 hours.
 1. Static acquisition at 24 hours post injection.
 2. Matrix: 256 x 256
 3. Obtain as many counts as possible (50-100K). Create Lightbox.
 - iii. SPECT Acquisition (P2000).
 1. Position patient on pallet
 2. Select S&W Tc99m Bone SPECT protocol

Scan Parameters:
 Mode: SPECT non-circular
 Motion: Continuous
 Heads: 12 (Both)
 Window: 1 (99mTc 140 kev) 15% window
 Mag: 1.0 (may need mag for children)
 Step: 3 degrees
 Stops: 60 (120 images)
 Matrix: 128 x 128
 3. Select non-circular orbit set-up at gantry.
 4. Position gantry at correct linear travel.
 5. Adjust radius of heads 1 & 2 at two locations
 6. Start acquisition . A test orbit will be performed to check radius around patient.
 7. At completion of scan, reconstruct study using "A-Bone SPECT" Macro on Odyssey LX. Adjust filters as needed to prevent over-filtering of study. Small adults or children may need less filtering.

Default parameters:
 Reconstruction: Ramp Filter
 3D Post Filter: Low Pass Order 5, cutoff 0.4
 8. Align each plane in General SPECT Display using localizer. Create Lightbox.

I. DISPLAY AND LABELING

- a. See attached images for display and correct labeling
- b. Note: Lightbox is the Display Steps

J. STANDARDS OF PERFORMANCE

- a. Patient is positioned for wholebody imaging supine on table and is flat not rotated.
- b. All of skull is in field of view. Patients head is in correct anterior position (not rotated).
- c. Detector is contoured (automatically or manually) close as possible to patient's body.
- d. All images to be read are made into Lightboxes and saved on Odyssey for PACs to retrieve.
- e. Images are Lightboxed and all images are appropriately labeled.
- f. Static images are positioned correctly and acquired for at least 500k-1000k counts (or 10 minutes) at 256 matrix. Appropriate Lightboxes are made.
- g. Right side marker is used on wholebody, flow and all static images and is labeled on the Lightbox.

- h. If 3-phase study was performed, flow, immediate statics, and delayed statics are performed (may also have wholebody scan performed)
- i. If SPECT study was performed, proper positioning was used to acquire and reconstruct study. Proper reconstruction filters were used for study on LX (images are not over-filtered). Study is Lightboxed using Localizer.
- j. All paperwork is properly completed and turned in with study. Technologist initials and patient accession number were entered into Odyssey at patient set-up screen prior to imaging. If not, these fields are properly edited prior to turning in film.
- k. Patient is properly tracked to End Procedure in RMS system. Technologist has verified that order in RMS is the study that was performed. If nuclear physician changes original order, technologist makes corrections to RMS and prints new order.
- l. Charge document is properly marked with correct procedure performed.

K. REFERENCES

- a. Principles and Practices of Nuclear Medicine, Early and Sodee, Mosby Publishing, 1995, pp. 339-361.
- b. Nuclear Medicine Technology and Techniques, Bernier, Langan and Wells, Mosby Publishing, 1981, pp. 368-402.
- c. PRISM 3000 Operator's Guide 1993

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SAMPLE