99mTc Diphosphonate Bone Imaging for Metastases – British Nuclear Medicine Society

99mTc Diphosphonate Bone Imaging for Metastases

1. Purpose

The purpose of this guideline is to assist specialists in Nuclear Medicine and Radionuclide Radiology in recommending, performing, interpreting and reporting the results of bone scans. It should be read in conjunction with the generic guideline for the provision of radionuclide imaging services.

2. Background

Bone scintigraphy is a sensitive imaging method for detecting (or excluding) and monitoring bone metastases in malignant disease and may detect metastases before they are apparent radiologically. Imaging is achieved using 99Tcm-labelled diphosphonates (e.g. MDP) which become incorporated into the hydroxyapatite crystal matrix as new bone is formed. Uptake in bone is dependent on local blood flow and the degree of osteoblastic activity.

3. Common Indications

3.1 Staging of malignancies which are known to metastasize to bone - particularly prostate, lung, and any other primary (e.g. breast) with locally advanced disease at the time of presentation.

3.2 Investigation of bone pain in patients with known or suspected malignancy

3.3 Monitoring disease progression and response to chemo or radiotherapy (but see controversies below)

4. Procedure

4.1 Patient preparation

4.1.1 Unless contra-indicated, the patient should be well hydrated and given instructions, both written and verbal, prior to imaging about the need to drink at least one litre of fluid between injection and imaging.

4.1.2 The patient should be encouraged to void frequently, particularly immediately prior to imaging; if a catheter is present, the bag should be emptied before imaging.

4.1.3 A clinical history including trauma, surgery, fractures, prostheses, bone or joint pains, primary malignancy, radiotherapy or limitation of limb movement should be obtained. In addition, a note should be made of urinary diversion in procedures that have been performed.

5. Radiopharmaceutical

5.1 99Tcm-diphosphonates - 600MBq (DRL for adults) - scaled dose for paediatric patients (cf. generic guidelines for children). Up to 800MBq may be given for SPECT studies.

6. Image Acquisition

6.1 Camera

6.1.1 Either whole body scan (high data density) with scan speed 8-10 cm/min, or multiple overlapping spot images may be obtained. If spot views are chosen, the anterior and posterior pelvic images should be acquired first, in order to minimise bladder activity.

6.1.2 A collimator giving optimal resolution should be used.
6.2 Views
Images should be obtained no earlier than 2-3 hours after injection (depending on the specific agent used). A longer delay may be helpful in elderly patients with slower bone uptake. Images should be marked to indicate left and right sides, and SPECT images should include indicators for ant/post and sup/inf. Minimum technique should include anterior and posterior views of the axial skeleton and proximal limbs. Distal limbs should be included if clinically indicated.

If ant/post images are equivocal, additional spot views may be helpful (e.g. obliques of ribs, vertex view of skull).

Spot views with high data density (minimum 500k) may be helpful if whole-body images are equivocal. SPECT imaging of relevant area may be obtained if planar images do not resolve the clinical problem. Where bladder activity obscures pelvic structures, lateral or squat views may be obtained or a further post-void image undertaken. If the patient is unable to empty the bladder, masking the retained urinary activity with lead shielding will allow improved detail in the rest of the pelvis.

Infants and young children require specific technical variations - please refer to the EANM guideline for bone imaging in paediatrics, which is accessible through the BNMS website.

7. Data Analysis
For showing the overall distribution of activity in the skeleton in the output format, images may be normalised for counts across anterior and posterior views by scaling to a maximum count density in a normal area (lumbar spine if possible). Areas of low count density will also need to be scaled up in order to avoid losing low-grade abnormalities.

8. Interpretation
The following should be assessed:
* Distribution of tracer throughout the skeleton:
* Areas of increased uptake
* Areas of decreased uptake
* Anatomical location of abnormalities
* Whether abnormalities are focal or diffuse
* Shape of abnormality, e.g. round, linear, fusiform
* The presence of soft tissue uptake (e.g. breast, primary tumour, secondary tumours in the liver or lung)
* The target (bone) to soft tissue (background) ratio.
* The intensity/pattern of renal uptake and any tracer retention within the collecting systems.
* Residual tracer in the bladder following voiding.
* Any abnormalities should be correlated with appropriate radiographic imaging if available; ideally this should be available for direct comparison at the time of reporting. Further imaging should be advised if appropriate.
* In case of follow-up examinations, comparison should be made with previous studies.

9. Discussion
Pitfalls in interpretation include:
* Urine contamination, urinary diversion (e.g. caecocystoplasty, urine collection bags)
* Injection site artefacts.
* Homogeneous increased bone activity - `superscan' (probably more of a problem with older equipment, as with newer cameras it is more likely for uptake to appear as multiple focal lesions throughout the skeleton).
* Purely lytic lesions.
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* Pubic lesions obscured by residual bladder activity.
* Benign disease - old trauma (e.g. rib fractures), arthropathies, Paget's disease, etc

10. Controversies
There is no consensus on the appropriate timing of follow-up studies during and after treatment to assess disease response to chemotherapy. The "flare" response does not correlate with the eventual response to chemotherapy, so routine repeat studies are generally unhelpful before 6 months. (The flare response refers to the bone scan appearance of increased activity at metastatic sites soon after chemotherapy, in association with bone repair. It occurs at a mean time of 3.2 months after therapy and does not occur later than 6 months. Because it may unmask previously undetected lesions, it may cause an apparent worsening of disease activity.) The value of routine screening for skeletal metastases in the initial staging of some primary malignancies is arguable.

11. Auditable Points
Auditable points include:
* Was an appropriate amount of activity given? (para 5.1)
* Were the images correctly marked to indicate left/right etc? (para 6.2)
* Have appropriate views been taken? (para 6.2)
* Does the report correctly identify the presence and location of abnormalities? (para 8)

12. References

13. Date Agreed / Approved
July 2002

14. Date for Review / Update
April 2005

15. Last updated Feb 2003
These guidelines do not constitute a formal protocol but highlight the aspects of a study where variation in practice may significantly affect the quality of outcome the study.