Diagnostic Imaging Pathways - Bone Metastases

Population Covered By The Guidance

This pathway provides guidance for imaging cancer patients with suspected bony metastases.

Date reviewed: August 2013

Date of next review: 2017/2018

Published: August 2013

Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

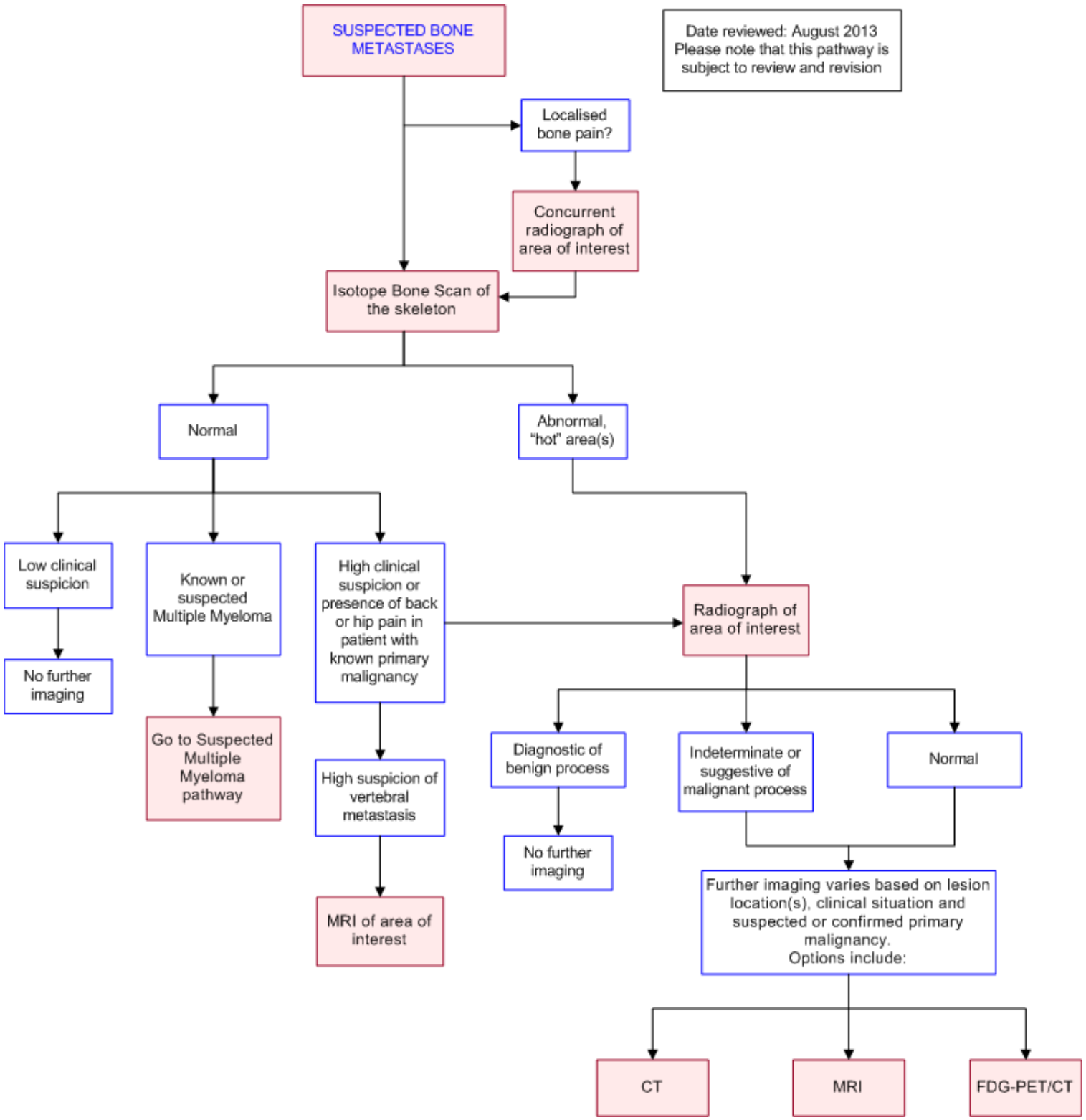

Image Gallery

Note: These images open in a new page

1a **Pathological Fracture Secondary to Metastatic Disease**

Image 1a (Plain Radiograph): Pathological fracture (arrow) secondary to a lytic bone metastasis (arrowhead) in the distal femoral shaft.

2a

Metastatic breast cancer

Image 2a (Computed Tomography): Metastatic disease (from primary breast cancer) is present in the thoracic vertebral body (arrow).

2b

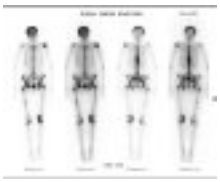

Image 2b (Isotope Bone Scan): Bone scan of the same patient demonstrating disseminated metastatic disease in the head of the left humerus, thoracic vertebral bodies, pelvic bones, femur and tibia bilaterally.

3

Bone Metastasis

Image 3: Metastatic deposits are present within the medullary cavity of the body and neck of the femur from a transitional cell carcinoma of the bladder.

4a

Bone Metastasis

Image 4a (H&E, x2.5) and 4b (H&E, x10): Core biopsy fragments showing bone with infiltrating sheets of malignant cells. The patient had a history of renal cell carcinoma and the features are consistent with metastatic carcinoma.

Teaching Points

- Initial investigation of choice in suspected metastatic disease is a nuclear medicine scan, with radiography of the area of interest
- Further diagnostic strategy depends on primary cancer type and clinical situation

Isotope Bone Scan

- Initial imaging modality of choice in detecting bone metastases, regardless of presence of symptoms
- Technetium-99 (99m Tc) accumulates at sites of elevated bone turnover. In a patient with foci of increased uptake and a known primary tumour, the scan strongly suggests metastases. Cortical involvement is the likely cause of positive findings on bone scan 1
- Advantages: allows total body survey 2
- Limitations
    - Non-specific. Radiographic correlation may be required to help identify benign processes. Lack of anatomic detail often requires further characterisation with MRI or CT
    - Some metastases may not show increased uptake on bone scan, particularly those that are lytic, 3,4 for example kidney, thyroid and melanoma. Lytic tumours are better detected by metabolic scans such as FDG-PET because they have a high glucose metabolism, 5 or anatomical assessment with CT or MRI

Computed Tomography (CT)

- Superior to MRI in revealing cortical integrity and extent of structural destruction 1,11
- Sensitivity for diagnosis of breast cancer metastasis to bone ranges from 71% to 100% 29
- Useful in guiding needle biopsy
- Multidetector CT is able to scan the whole body in a short period of time is often used in staging on discovery of a primary tumour and may have a role in screening

Magnetic Resonance Imaging (MRI)

- MRI can evaluate suspicious findings on bone scan, providing better spatial resolution, anatomical detail and soft tissue involvement 11
- MRI may detect small skeletal metastases not yet detectable on bone scan by revealing abnormal bone marrow 12-14
- More sensitive in detecting vertebral metastasis than bone scintigraphy. Where there is a high clinical suspicion of vertebral metastasis, MRI should be considered even if bone scintigraphy is negative or equivocal 15-18
- However there is overlap in the appearance of metastases and a variety of benign lesions (eg. degenerative disc disease, benign compression fracture, osteomyelitis and infarct) which affects specificity (usually less than 90%) 19,20
- A recent metaanalysis concluded MRI can help distinguish benign from malignant vertebral compression fractures 21,22
- May be used to guide biopsy in lesions not adequately visualised by CT 23
- Recent studies have investigated a role of whole-body MRI in the evaluation of bony metastases, 24-27 but it is questioned whether this feature is clinically beneficial compared to MRI of the axial skeleton, 28 or cost-effective

Positron Emission Tomography (PET)

- Can identify metabolically active skeletal metastases that may or may not have detectable structural destruction. Its use in staging and follow up evaluation is increasing for a number of malignancies. However, it is associated with high radiation and cost 11
- May be useful in differentiating malignant from benign vertebral compression fractures where MRI is equivocal (slightly more sensitivity, lower specificity) 30
- ^{18}F-FDG-PET/CT is more sensitive than bone scintigraphy in detecting bone metastases, with added advantage of detecting unknown primary cancer and visceral metastases 31
- ^{18}F-FDG-PET/CT is more sensitive and equally specific in comparison to bone scintigraphy for detection of bony metastases in breast cancer 30
- A single study found C11-choline PET/CT was less sensitive but more specific than bone scintigraphy in detecting bone metastases and helped reduce the number of equivocal findings in patients with prostate cancer 32
- A recent metaanalysis studying imaging of bony metastases in patients with lung cancer found FDG-PET was the best modality, with PET/CT better than PET, compared to MRI and bone scintigraphy. MRI was the most specific on a per-lesion basis 33

Plain Radiography

- Certain radiographic features may help to distinguish metastases from other conditions and aid in identification of the primary tumour
- In patients with multiple myeloma, a radiographic skeletal survey is more sensitive than bone scintigraphy 3,4 and currently still considered the gold standard initial imaging modality to detect osteolytic lesions 6
- However, skeletal survey still requires at least 30% cortical bone destruction for the detection of osteolytic lesions, at which time the patient is already at risk for pathological fractures 7
- Limitations: Poor sensitivity for detection of bone metastases. 2,8,9 13% of metastatic bone lesions are in appendicular regions not included in radiographic skeletal surveys 10

References

Date of literature search: April 2013

The search methodology is available on request. Email

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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