Approach to Bone Tumors

(From radiological point of view)

Objectives

- Imaging modalities used in diagnosis of bone tumors
- Approach for differentiating benign from malignant lesion
- Osteosarcoma
- Ewing sarcoma
- Radiographic features of bony metastasis

Introduction

The main aim is to determine if the lesion benign or malignant (whether primary or secondary)

The most important determinators in the analysis of a potential bone tumor are:

- Age of the patient
- The morphology of the lesion on plain radiograph

Imaging modalities

Plain radiograph

Computed tomography (Ct scan)

Magnetic resonance imaging (MRI)

Radionuclide bone scan

Ultrasound

Plain radiograph

- Perfect plain films
- Avoid over penetrated or underpenetrated film
- Around the clock film
- Compare with previous films

- ▶ Correlate the size of the lesion with length of history

Approach on plain radiograph

1. Is the lesion lytic, sclerotic or mixed?
2. Zone of transition
   - ▶ narrow or wide?
   - ▶ sclerotic margin or not?
3. Expansion
4. Calcification within the lesion.
5. The adjacent cortex
6. Periosteal reaction
7. Soft tissue swelling
8. Site

Calcification within the lesion

Calcification within an area of bone destruction occurs in specific conditions; e.g.

- ▶ patchy calcification of a popcorn type usually indicates a cartilage tumor
- ▶ Diffuse ill-defined calcification suggests osteoid formation and indicates an osteosarcoma.

Expansion

Bone expansion with an intact well-formed
cortex usually indicates a slow-growing lesion such as an enchondroma or fibrous dysplasia

Periosteal reaction

Refer to excess bone produced by the periosteum, it’s either continuous or interrupted

Common types:

*Solid * Lamellated *Sunburst *Codman's triangle

Continuous periosteal reaction usually indicates benign process while an interrupted reaction indicate malignant or aggressive process

Soft tissue swelling

the presence of a soft tissue mass suggest an aggressive lesion
the better defined it is, the more likely the lesion is neoplasm

Site of the lesion within the bone and type of the bone

*cortex or medulla
*epiphysis, metaphysis or diaphysis
*flat or tubular bone
*axial or appendicular skeleton

Conclusion

Features of benign lesion:

Well demarcated narrow zone of transition ± sclerotic edge.

Bone expansion with an intact well-formed cortex.

Usually no periosteal reaction or only solid continuous type.

No soft tissue mass.

Stable on follow up.

Features of malignant lesion:

Wide ill-defined zone of transition

Cortical destruction

Soft tissue extension

Aggressive periosteal reaction

Rapid growth, Ill-defined matrix mineralization

Ct scan

Usually have a complimentary role to plain radiograph.

The indications for bone CT are:

- ▶ Demonstrating abnormalities in the spine, pelvis and hips

- Demonstrating the extent and characterization of bone tumors in selected cases and in detection of metastasis.
- As a guide for bone biopsy.

MRI

- MRI can demonstrate the bone marrow directly, making it possible to see the full extent of disease such as metastases, other tumors and infections, even in areas where bone destruction is not yet evident on plain films or CT.
- MRI is also particularly good for showing soft tissue abnormalities.
- Useful in local staging of malignant bone lesion.

Radionuclide bone scan

Detection of metastases.

Determination of whether a lesion is solitary or multifocal.

Investigation of a clinically suspected bone lesion despite a normal radiograph (this may occur with metastases)

Determination, in equivocal cases, of whether an abnormality seen on the radiograph is significant or not exist.

Ultrasound

Deal with extra osseous component of the lesion

- Real time imaging
- Can differentiate cystic from solid masses
- Color Doppler US for tumor vascularity
- US guided biopsy/ aspiration

Osteosarcoma

- Commonest primary malignant bone tumor.
- Bone forming tumor (osteoid matrix)
- Can be primary or secondary.

- Usual age for primary osteosarcoma (5-20 year), secondary type can occur in elderly following malignant change in Paget's disease or following radiation.
- Site: metaphysis, most commonly around the knee.
- Presents usually with localized pain or swelling, not infrequently the lesion may present with a pathological fracture.

Radiographic features:

- Bone destruction with new bone formation (usually mixture of sclerosis and destruction).
- Florid spiculated periosteal reaction (sunray appearance)
- The tumor may elevate the periosteum to form Codman's triangle.
- Associated well defined soft tissue mass.
- Early osteosarcoma may be only evident as subtle sclerosis.
- May metastasize to lungs, where the metastasis typically calcify.

Ewing sarcoma

- Highly malignant small round cell tumor
- Affecting children and adolescent (usually 5 to 15 yr)
- Arising in the shaft of long bones, pelvis.
- Usually present with pain of several weeks or months, systemic symptoms including fever are often present.

Radiographic features:

- Radiographic features are of an aggressive lesion, with permeative bone destruction principally involving the medullary cavity , cortical erosion and aggressive periosteal reaction (typically onion skin) and often an associated soft tissue mass

Metastasis

- Most common malignancy in bone.
- Must be considered in the differential diagnosis of any bone lesion in a patient > 40 years.
- At sites of persistent hematopoiesis.
- May present as well-defined osteolytic, ill-defined osteolytic and also as sclerotic bone lesion.
- Majority of osteolytic metastases originate from breast, lung, kidney, colon, melanoma and thyroid.

Radiological features of metastasis

- Usually multiple
- History of known primary
- Majority predominantly osteolytic
- Typically arise in medulla
- No much periosteal reaction
- Soft tissue extension relatively uncommon