BEWARE!!

Benign Bone Tumors, or Are They?

STAGING OF BENIGN BONE LESIONS

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DEFINITION</th>
<th>BEHAVIOR</th>
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<tbody>
<tr>
<td>1</td>
<td>Latent</td>
<td>Remains static or heals spontaneously</td>
</tr>
<tr>
<td>2</td>
<td>Active</td>
<td>Progressive growth, but limited by natural barriers</td>
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<tr>
<td>3</td>
<td>Benign Aggressive</td>
<td>Progressive growth NOT limited by natural barriers</td>
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*Enneking et al CORR 1980*
PRESENTATION-The Patient

- Pain & a mass.
- Pain @ rest (unrelated to activity).
- Progressively worsening.
- Night pain.
- Constant pain.
- Generally not responsive to NSAIDs or weak narcotics.

AGE!!!!

WHICH X-RAY DO YOU WANT???

Radiographic Approach to Bone Tumors

- Location
  - Epiphyseal/metaphyseal/diaphyseal
  - Cortical/intramedullary/eccentric
- Soft tissue involvement
- What’s it doing to the bone?
  - Zone of transition
  - Lytic vs. Blastic vs. Mixed
  - Geographic vs. Moth eaten vs. Permeative
- What’s the bone doing as a reaction?
  - Periosteal reaction
  - Sunburst
  - Codman’s triangle
- Matrix production
  - Osteoid
  - Chondroid
  - Fibrous

Change Over Time
Location, Location, Location

Lucent Lesions of Bone

Age & Location

[Diagrams showing various bone lesions and their locations]
Radiology - Ominous Findings

- Codman's Triangle
- Onion Skinning

WHICH SLIDE DO YOU WANT???

WHAT MAKES IT BAD???

Benign lesions are hypocellular, well-differentiated, little cellular atypia, zero mitotic figures.

Malignant lesions are hypercellular, anaplastic, disordered, numerous mitotic figures.

Lesions With A Characteristic Appearance (X-ray, histo, or both)

- Osteoid Osteoma (& Osteoblastoma)
- Chondroblastoma
- Non-Ossifying Fibroma
- Giant Cell Tumor
- Aneurysmal Bone Cyst
- Unicameral Bone Cyst
- Osteochondroma & Multiple Exostoses
- Enchondroma & Enchondromatosis
- Fibrous Dysplasia
- Chondromyxoid Fibroma
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Aneurysmal Bone Cyst (ABC)

- Common benign aggressive cystic lesion of the young.
- Can be described as a “process” or a “diagnosis”.
  Often found as other neoplasia such as CGT, chondroblastoma, FD, CMF, osteosarcoma.
- Avg age of ABC is 15y - Casadei, F&A Int, 1996.
- Locations: distal femur/prox tibia, pelvis, spine, distal tibia, hands, feet.

Histo=cavernous blood-filled spaces s endothelial lining. Cyst lining has giant cells, spindle cells, lacy new bone formation.

Tx=curettage, bone grafting. Very high local recurrence rate in Px’s c open physes (up to 50%).
Aneurysmal Bone Cyst (ABC)

- Metaphyseal, eccentric, lytic, can expand/destroy cortex, extends into ST's c thin shell of reactive bone.
- Typically has sharp, trabeculated margin and intralesional septae.
- Fluid/fluid levels on MRI.

Giant Cell Tumor

- Represents 5% of bone neoplasms
- Benign but aggressive
- Tendency to recur (0-65%)
- Age 20-50
- Slight female predominance
- Common locations:
  - Distal femur
  - Proximal tibia
  - Distal radius
  - Spine involvement is rare, often sacrum

Presentation

- Progressive pain initially related to activity and later also at rest
- Pain is rarely severe unless a pathologic fracture has occurred
  - 10-30% have path fxs at initial exam
- Locally aggressive, often manifest as stage 2 or 3 lesions
**Radiographic Findings**

- Often diagnostic
  - Eccentrically, epiphyseal, long bones, abut subchondral bone, purely lytic
  - Non sclerotic
  - Metaphyseal in skeletally immature
  - Zone of transition poorly defined
  - Intra-articular extension rare
  - Matrix production/periosteal rxn rare
  - Typically, rim of periosteal new bone ("neocortex") surrounds the tumor.
  - Less aggressive tumors: a partial rim of reactive bone may be present

**MRI useful to determine extent of lesion within bone and soft tissue**

- Dark on T1 and bright on T2
- May also reveal fluid-fluid levels typical of a secondary ABC, occurring in 20%
Histopathology

- Three cell types
  - Mononuclear histiocytic cells
  - Multinucleated giant cells that resemble osteoclasts
  - Neoplastic stromal cells

- Many multinucleated giant cells (40-60 nuclei per cell) in a sea of mononuclear stromal cells
- The nuclei of the mononuclear cells are identical to those of the giant cells
Benign Metastasis

- Most dx within first few years after primary tumor, though reported up to 24y later
- Hematogenous, lymphatic also reported
- Pulmonary Mets – *most common* (2-5%)
  - Spontaneous regression
  - Remain asymptomatic for years
  - Progressive lesions that despite remaining histologically benign, lead to death
  - Mortality rate for those with pulmonary mets is ~15%
    - Reported as high as 43%
  - More aggressive approach of excision generally favored

Malignant GCT

- Represents <5% of cases
  - Primary: sarcomas that occur within lesions that are otherwise typical of benign GCT
    - EXTREMELY rare
  - Secondary: sarcomas that occur at the sites of GCT that have been treated, usually with radiation
    - Osteosarcoma, fibrosarcoma, malignant fibrous histiocytoma
Multicentric GCT

- Usually solitary lesions
  - Though 1-2% may present as multiple synchronous or metachronous lesions

Treatment Goals

- Manage lesion thoroughly
- Preserve/improve functional status
- If possible, preserve adjacent joint

Treatment

- Intralesional curettage standard of care for primary GCT
  - vs. En Bloc resection
  - Historically, with curettage only, recurrence rates were >50%
  - Extended curettage—intralesional curettage + adjuvant (cryotherapy, burring, argon laser, cement, phenol) and bone graft or cement.
  - Now, decreased rates of 5-15%
  - MRI allows for more accurate assessment of the lesion
  - Improved curettage technique
    - Cortical window at least as large as lesion (exteriorization)
    - Power burr
    - Adjuvants
      - thermal: electrocautery, argon beam coagulator, liquid nitrogen
      - chemical: phenol, 3% hydrogen peroxide
      - Bone cement
Giant Cell Tumor Of Bone (GCT)

- Very locally aggressive, high (10-40%) local recurrence rate, “benign” lung mets in 2-5%.
- Mortality in benign metastasizing GCT is 10-20%, no standard Tx.
- Can develop secondary sarc if multiple local recurrences or radiation Tx.

Recurrence

- Expanding lucency on radiograph

- Soft tissue ossification or palpable mass
  - MRI to evaluate

Treatment

- Same as for primary. Biopsy. Benign-> Curettage or resection.
Alternative Therapies

• **Corticosteroids**
  o Control of unresectable metastases

• **Bisphosphonates**
  o Inhibit the growth of GCT lines with reduction in local recurrence rate

• **Denosumab**
  o Human monoclonal antibody, inhibits RANKL and therefore osteoclast-mediated bone destruction
  o In recurrent or unresectable GCT
  o Metastatic GCT

Chondroblastoma

• CC is pain in 86%, also effusion, limp, joint stiffness
• **EPiphyseal** lesion in skeletally immature Px’s, most common in males in 2nd decade.
• Mostly long bones.

Chondroblastoma

• **Epiphyseal** lesion, radiographically lytic, 50% have sclerotic border, 60% in both epiphysis and metaphysis.
• Little or no matrix, calcifications present in 1/3, can be very destructive.
• **Intense edema adjacent to lesion on MR.**
**Chondroblastoma**

- Proliferating cell is the chondroblast, ovoid cell with ovoid nucleus.
- Histologically very cellular, field of mononuclear cells with fine "chicken wire" calcifications.

**Stage 3 lesion.**
- Tx=curettage, BG or cement as necessary. Local recurrence rate is ~10%.
- May have to resect AC and perform primary arthrodesis.
- Can develop occasional (1-2%) benign pulmonary mets. Tx is surgical excision and prognosis is excellent.

**Enchondroma**

- Benign, inactive hyaline cartilage tumor.
- Most common in small bones of the hands but is the most common benign tumor of the foot. Also common in metaphyses of long bones.
- Usually asymptomatic and present as incidental findings.
Enchondroma

- Cortex is intact. May be small erosions but these are less than 50% cortical width.
- Radiographs show lucent areas with variable mineralization, rings, arcs, stippled. May cause cortical expansion or FX.

Histologically looks like lobules of cartilage. Hypocellular, abundant hyaline cartilage, absence of myxoid change, cellular atypia.

Tx = observation & serial X-rays (3m, 6m, 1y, yearly)

Surgery when (1)-path FX or (2)-suspicous for low-grade chondrosarca. Tx = curettage, BG.

Enchondroma-Multiple Lesions

- Multiple enchondromas have sporadic inheritance. Ollier’s DZ has mutl enchondromas c deformity. Maffucci’s Syn has multi enchondromas, dysplasia, hemangiomases of skin and ST viscera.
- Malignant transformation to secondary chondrosarcoma=1% per year c solitary DZ, 25% c Ollier’s DZ, 100% c Maffucci’s Syn.
Enchondroma vs. Chondrosarcoma?

- Neither radiology or histopathology can always predict biologic behavior.
- Location in skeleton
  - Finger & toe lesions: aggressive rads/histo, less so clinically
  - Exostotic (secondary peripheral or periosteal) are more likely lower grade
- Increase in size or pain may indicate malignant transformation

Radiology

- High grade: Destructive, symmetric bone expansion, predominant lysis w mineralization, soft tissue mass
- Low grade: intraosseous, no cortical destruction vs endosteal scalloping

1. Characteristics to distinguish low grade CS from benign enchondromas?
   - Cold bone scan = benign
   - FDG-PET: grade II/III higher uptake than grade I
   - MRI: soft tissue mass (HGS) and entrapped fat within tumor (LGCS)
   - DCE MRI: 100% sensitivity, 65.3% specificity and 93.4% accuracy for LGCS but 36.7% FP with enchondromas
2. Effective use of imaging studies to plan biopsy site?

Histology

<table>
<thead>
<tr>
<th>Grade</th>
<th>Cytology</th>
<th>Matrix</th>
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<tr>
<td>I (50-60%)</td>
<td>Similar to enchondroma, slightly increased cellularity</td>
<td>Chondroid Rete, focal necrosis</td>
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<tr>
<td>II (40-50%)</td>
<td>Increased cellularity, irregular nuclei</td>
<td>Chondroid to myxoid, focal necrosis</td>
</tr>
<tr>
<td>III (5-10%)</td>
<td>Very cellular, pleomorphism, atypia, spindling, mitosis</td>
<td>Prominent myxoid stroma, extensive necrosis</td>
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*Presence of tumor entrapment of host bone lamellae most important indication of malignancy
2003
Knee pain.

2013
A Word About Dedifferentiated Chondrosarcoma

- Bimorphic pattern - low grade chondrosarcoma with sharply juxtaposed high grade sarcoma.
- 10% CS transform into more anaplastic, high grade lesions.
- Tx = wide resection, chemo for those who can tolerate it.
- 5y survival: 0-18%
Thank you!