Bone Reactions

- Bone reacts to invasion by tumors or infection in a predictable manner.
- It relates to the aggressiveness of the pathogenic process.
- The pattern of response is best appreciated on plain radiographs.

Bone tumors and infections can be diagnosed by understanding the biology of the host-bone interaction, translating this into a radiographic appearance, and understanding some of the special features of neoplasms.
Bone Reactions

- Analysis of the pattern of bone destruction and the host response to the lesion often allows one to accurately diagnose infection from tumor, and benign from malignant tumors.

Bone Reactions - Look at:
- bone destruction
- bone production
- matrix calcification and ossification
- reactive response of surrounding bone and periosteum

Bone Reactions - Ask:
- What is the lesion doing to the host bone?
- How is the bone reacting to this assault?
- Are there any specific features of this particular lesion?
Patterns of Bone Destruction

- Permeative Destruction
- “Moth-eaten”
- Geographic destruction

Host response

- The host bone “responds” by trying to contain the lesion
- Margination
- The more benign the lesion (i.e., slower growing) the more mature the surrounding bone
Host reactions to tumors

- **Periosteal reactions**
  - Slow growing tumors evoke a solid buttress of periosteal bone (e.g., nonossifying fibroma)
Host reactions to tumors

*Periosteal reactions*

– More rapidly growing tumors are associated with incomplete responses seen as:
  » lamellated periosteal new bone (onion skin, spiculated)
  » incomplete response (Codman triangle)
Mineralization of the matrix of a tumor varies with the types of matrix:

- **Cartilage tumors**: rings, arcs, stippled calcification
- **Bone tumors**: cloud-like amorphous density or linear trabecula
Bone tumors - types

- primary benign
- primary malignant (sarcoma)
  - **sarcoma** is a malignant tumor arising in mesenchymal tissue
  - **carcinoma** is a malignant neoplasm of epithelial tissue derived from any of the three germ layers (ectoderm, mesoderm and endoderm)
- metastatic carcinoma

Origin of tumors

- benign lesions are generally due to abnormalities of normal bone development (e.g., osteochondroma)
- malignant tumors believed to be due to one or more gene mutations or chromosomal rearrangements

Non-ossifying fibroma:

- benign metaphyseal lesion
- main importance is fracture risk
- resolves spontaneously usually in late adolescence
Osteochondroma
- exostotic metaphyseal lesion
- believed to arise from the growth plate
- enchondral ossification
- cortex of the lesion and host bone are continuous
- almost no malignant potential
Osteosarcoma

- adolescent and older adult,
- long bones (knee)
- very aggressive, highly lethal if treated by surgery alone
- systemic disease (micrometastases present at diagnosis)
**Chondrosarcoma**
- adult age, chemoresistant
- long bones and pelvis
- hyaline cartilage neoplasm
- treated by surgery alone

**Myeloma**
- malignant neoplasm of plasma cells
- solitary (plasmacytoma)
- multiple myeloma (anemia, elevated ESR, abnormal IEPA)
Metastatic Carcinoma

- Lung, breast, prostate, renal and thyroid are the most common primaries
- Pathological fractures
- Hypercalcemia

Bone metastasis

It's about survival!

- 80% of men with localized prostate cancer have tumor cells in bone marrow
- Only 30% eventually develop bone metastasis
Breast Cancer and Bone

Prostate Cancer causes osteoblastic metastasis

Osteomyelitis

- Bacteria enter blood stream
- sludging in metaphyseal blood vessels
- adhesion of bacteria to receptors on bone surfaces (role of trauma?)
- acute purulent inflammatory reaction
- pus percolates through trabeculae of bone and Volkmann canals
- osteonecrosis, subperiosteal abscess (sequestrum, involucrum)
Pathology of osteomyelitis
Pathology of osteomyelitis

- Abcess cavity
- Wall
- Woven bone

Radiology of osteomyelitis

- Arrows at inner edge of involucrum

Sequestrum and Involucrum
Clinical spectrum of osteomyelitis

Hematogenous osteomyelitis

- Accounts for 85% in children
- Only 20% overall
- Usually in the metaphyses of long bones
- Organisms: Staphlococcus aureus, streptococcus, gram neg in IVDA

Clinical spectrum of osteomyelitis

Contiguous osteomyelitis

- The most common form
- Bimodal age distribution:
  - Trauma or surgery in the young
  - Decubitus ulcers, total joint replacement in the elderly
- Organisms: (polymicrobial) staph, strep, gram negative, anaerobes

Osteomyelitis associated with vascular insufficiency

- Usually in diabetics
- Diabetic feet with vascular insufficiency and neuropathy
- Often contiguous spread from a foot ulcer
- Organisms: (polymicrobial) staph, strep, gram neg, anaerobes
Chronic osteomyelitis