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What are top differential considerations for lytic/lucent bone lesions?

Two primary mnemonics are common for this

FOGMACHINES

Fibrous dysplasia/Fibrous cortical defect, Osteoblastoma, Giant cell tumor/Geode, Mets/Myeloma, Aneurysmal bone cyst, Chondromyxoid fibroma/Chondroblastoma, Hyperparathyroidism (brown tumor)/Hemangioma, Infection/Infarction, Non-ossifying fibroma, Enchondroma/Eosinophilic granuloma, Solitary (unicameral) bone cyst

FEGNOMASHIC

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What location is most common for enchondromas?

Hands and feet (approximately 50% of enchondromas). Note that malignancy of the fingers/toes is rare so if you see a lucent lesion in the bones of the fingers or toes enchondroma needs to be on your differential diagnosis. Enchondromas are typically intramedullary lesions. Enchondroma with pain think pathologic fracture due to enchondroma cortical weakening.

What are differential considerations for an enchondroma of the hands/feet?

Brown tumor (hyperparathyroidism), sarcoid, intraosseous ganglion, metastatic disease.

What is bizarre parosteal osteochondromatous proliferation (BPOP) aka Nora's lesion?

Heterotopic ossification that can form mass-like lesions arising from the periosteum of the phalanges. This is an acquired exostosis meaning it is reactive and often post-traumatic in etiology. Other features include lack of cortical disruption. Common location is the proximal phalanges of the hand. Differential consideration is a juxtacortical chondroma. It is important not to confuse BPOP with a chondrosarcoma or osteosarcoma. BPOP is most common in patients under 30 years old. BPOP shows cortical continuity with the lesion with lack of medullary involvement. BPOP is a benign lesion that may be locally aggressive and recurrent following excision but is thought to have no risk of distant metastatic disease.

Chondrosarcomas may be secondary to what lesions?

Enchondromas and osteochondromas may degenerate into a chondrosarcoma. Note that primary chondrosarcomas are also possible. Chondrosarcomas commonly involve the pelvis, femur and humerus. Characteristic features include a lobular growth pattern with high T2 signal due to high water content and cartilaginous nodules, "rings and arcs" pattern of chondroid mineralization (best depicted by CT), endosteal scalloping, and soft tissue extension.

What may be the best feature to distinguish between an enchondroma and a chondrosarcoma?

Endosteal scalloping may be the best distinguishing feature to tell the difference between a chondrosarcoma and an enchondroma. Increased length and depth of scalloping (scalloping >2/3 of normal cortical thickness) is most suggestive for chondrosarcoma.

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What are the 3 most common malignant bone tumors?

Myeloma, osteosarcoma, then chondrosarcoma.

Most chondrosarcomas are well-differentiated low-grade tumors. What are imaging findings that suggest a de-differentiated, high-grade chondrosarcoma?

A chondrosarcoma with a soft tissue mass without mineralized matrix is suggestive of a high-grade malignancy. Some have termed this a bimorphic appearance (part mineralized "arcs and whirls", etc and part non-mineralized with soft tissue component).

What are key features of a telangiectatic osteosarcoma?

Distal femur location is most common, tumor has necrotic and hemorrhagic portions with multiple fluid-fluid levels.

What is the top differential consideration for a telangiectatic osteosarcoma?

Aneurysmal bone cyst. 2/3 of aneurysmal bone cysts are primary. Secondary aneurysmal bone cysts may arise from a giant cell tumor or chondroblastoma. Note that of the lytic lesions this is the most expansile lesion which can help differentiate an ABC from other lytic processes.

What are key features of a chondromyxoid fibroma?

A chondromyxoid fibroma is a rare eccentric lytic lesion, commonly in people under 30 years of age, with a metaphyseal location, commonly around the knee, demonstrating cortical thinning, pseudotrabeculation (septations), no periosteal reaction, and sclerotic, well-defined margins.

What is the classic location on board exams for an adamantinoma?

The tibial diaphysis is the classic location on board exams for an adamantinoma. Adamantinomas are very rare lesions that may be multicentric. These appear as eccentric lesions involving the anterior tibial cortex, much less commonly involving the fibula. These are often indolent lesions with risk of late metastases to the lungs. Classic would be the primary lesion that recurs after therapy, then shows late metastatic disease to the lungs.

True of false: synovial sarcomas arise from joints

False—synovial sarcomas arise in proximity to but not from joints. Synovial sarcomas are most common in the extremities and present as juxta-articular lesions. Classic history on a board exam would be a pediatric patient with a multi-cystic appearing mass with well-defined margins around the knee joint but can also be seen around the ankles and other joints.

What is the "triple sign" of a synovial sarcoma?

Heterogeneous signal from: solid mass, hemorrhage, and calcification.

What is the "bowl of grapes" sign of a synovial sarcoma?

Mass with a multilobular appearance with multiple cyst-like areas with diffuse blood-fluid levels.

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What are imaging features suggestive of well-differentiated, de-differentiated, pleomorphic and myxoid liposarcoma?

Well-differentiated liposarcomas often show >75% fat, thickened septa (>2 mm), and soft tissue nodularity.

De-differentiated liposarcomas often have a nodular dominant focus > 1 cm in size.

Pleomorphic liposarcoma typically presents as a heterogeneous mass with dominant soft tissue components and only small fat-containing foci.

Myxoid liposarcoma often shows a classic myxoid background (T2-bright) with some nodular soft tissue and adipose tissue components.

Part II

If you see a lytic lesion in a person who is older than 40 years old what should you consider first?

With a lytic lesion in a person who is greater than 40 years of age, metastasis or myeloma is the first consideration.

Does heterotopic ossification typically present with early peripheral calcification or early central calcification?

Heterotopic ossification classically presents with peripheral calcification with onset of roughly a month after injury. Malignancy is more likely to present with central calcification.

True of false: Myositis ossificans is a form of heterotopic ossification?

True. Myositis ossificans is typically post-traumatic in etiology and presents with peripheral calcifications at early stage. Myositis ossificans is actually the most common form of heterotopic ossification. Location within large muscles is common post-trauma. This is a "don't touch" lesion. If you see this, get follow-up radiographs or CT instead of biopsy.

If you are given a history on a board exam question of a young male with nocturnal pain that improves with aspirin, what bone lesion is this history classic for?

Osteoid osteoma. This is a classic board exam question.

How do osteoid osteomas appear on imaging?

Lesion with cortical thickening and an intracortical nidus with variable calcification. Osteoid osteomas are also highly vascular on contrast-enhanced imaging. Note that an infection with Brodie's abscess can appear similarly (Brodie's abscess can present with various imaging appearances) but the clinical history will be different and should point you to a subacute to chronic infection rather than nocturnal bone pain relieved by aspirin.

What is the most common location of a Brodie's abscess?

The tibial metaphysis (proximal or distal) followed by the femur. Can also involve the carpal/tarsal bones.

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A calcaneal lesion that is bright on T1-weighted imaging and dark on MRI imaging with fat saturation is most suggestive of what lesion?

A calcaneal intraosseous lipoma. This location of an intraosseous lipoma is high-yield for board exams as this is the most common calcaneal bone lesion. Otherwise, an intraosseous lipoma is most common in the bones of the lower extremities. Look for fat density in the lesion on x-ray, CT, and fat signal with signal dropout on fat saturated images on MRI.

"Dripping candle wax" is a buzzword for what bone lesion?

Melorheostosis. This has an appearance of dripping candle wax related to cortical and medullary hyperostosis.

A Shepherd's Crook Deformity is most typical for what lesion?

Polyostotic fibrous dysplasia. This is coxa varus angulation of the proximal femur. This can also be seen with osteogenesis imperfecta or Paget's disease along with other entities.

True or False: A simple bone cyst is typically eccentric in location?

False. Aneurysmal bone cysts are typically eccentric in location whereas a simple bone cyst (aka unicameral bone cyst) is typically centered in the medullary space. Simple bone cysts are most classic in the humerus and are about 90% located in long bones. Remember the fallen fragment sign in which a fracture fragment falls dependently with gravity within the lesion is a sign of a simple bone cyst. Simple bone cysts are frequently first identified after a fracture occurs.

What is the most common bone tumor in young adults under 40 years of age?

Giant cell tumor. GCTs are most common in the distal femur followed by the proximal tibia and then the distal radius. GCTs are also more common in the sacrum and pelvis than the vertebrae. A GCT is a metaphyseal lesion with subchondral epiphyseal extension.

True or false: Giant cell tumors have sclerotic margins?

False. GCTs classically show non-sclerotic margins with a narrow zone of transition.

True or false: Aneurysmal bone cysts are commonly associated with a giant cell tumor?

True. There is a high association between GCTs and an aneurysmal bone cyst.

A "long lesion in a long bone" with groundglass matrix centered in the medullary space is most typical for what bone lesion?

Fibrous dysplasia which results from marrow being replaced by benign fibro-osseous tissue.

What are two common syndromes associated with polyostotic fibrous dysplasia?

McCune-Albright syndrome and Mazarbraud's syndrome. Mazarbraud's syndrome is classic for polyostotic fibrous dysplasia with myxomas. McCune-Albright syndrome is associated with café-au-lait spots and precocious puberty and/or other endocrinopathies to include Cushing's syndrome. These are both high-yield entities for the ABR core exam.

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What bone lesion is sometimes referred to as "a giant osteoid osteoma"?

Osteoblastoma, an osteoid osteoma-like lesion that is greater than 2 cm in size.

What is the most classic location for an osteoblastoma?

Posterior elements of the spine. These are expansile lesions located eccentrically in the medullary space in teens and young adults most commonly.

Chondroblastomas are most common in which age group and in which location?

Chondroblastomas are most common in the epiphyseal region of long bones, or in epiphyseal equivalents, and are most common in individuals under 20 years of age with male predominance. A chondroblastoma typically presents as a well-defined lytic lesion that may have internal calcification with adjacent metaphyseal periosteal reaction.

What are some of the "epiphyseal equivalents"?

Patella, calcaneus, trochanters, tuberosities, tarsal and carpal bones.

Non-ossifying fibromas are most common in what age group and in which location?

A non-ossifying fibroma is most common in young patients (ages 10-20) in the distal tibia and femur in a metadiaphyseal, cortical location. NOFs present with a narrow zone of transition and a sclerotic margin with no soft tissue mass or periosteal reaction. If <2-3 cm in size this may be termed a fibrous cortical defect. An NOF may also heal and become sclerotic.

What are common differential considerations for vertebra plana?

Mnemonic is MELT. Metastasis/Myeloma, Eosinophilic granuloma, Lymphoma, Trauma/Tuberculosis.

What are common imaging appearances for eosinophilic granuloma?

Beyond vertebra plana, EG may show the "hole-within-hole" appearance (lytic lesions asymmetric in both inner and out table of skull), may have a button sequestrum, and often appears as a well-defined medullary lucency "punched out lucency" with or without endosteal scalloping and periosteal reaction. However, EG can also appear aggressive and indistinct. Common locations include the skull, pelvis, femur and spine. Note that EG can also cause a "floating tooth" appearance. Most patients with EG will be under 20 years of age. Note that eosinophilic granuloma denotes skeletal involvement of Langerhans cell histiocytosis.