MRI of Bone Marrow

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1. A 3-year-old with refusal to walk and normal peripheral white blood cell count undergoes MRI of the lower extremities (see images). What is the most likely diagnosis?
   A. Leukemia
   B. Osteomyelitis
   C. Osteonecrosis
   D. Metastatic neuroblastoma

   **Correct Answer: A**

   **Rationale**
   An MRI pattern of low signal intensity of the marrow on T1-weighted images and high signal intensity of the marrow on STIR images diffusely involving the epiphyses, metaphyses, and diaphyses is most characteristic of leukemia. This pattern may be observed on MRI before the development of peripheral blood abnormalities. Osteomyelitis and osteonecrosis are focal or multifocal rather than diffuse. Diffuse marrow infiltration by neuroblastoma metastases is less common than leukemia and is typically accompanied by an extraosseous primary tumor.

   **References**
   2. Brennan CM, Atkins KA, Druzgal CH, Gaskin CM. Magnetic resonance imaging appearance of scurvy with gelatinous bone marrow transformation. Skeletal Radiol 2012;41:357–360

2. A 9-year-old autistic boy with anemia and refusal to walk undergoes MRI of the lower extremities. What is the most likely diagnosis?
   A. Osteomyelitis
   B. Leukemia
   C. Red marrow hyperplasia
   D. Scurvy

   **Correct Answer: D**

   **Rationale**
   The MRI findings of bilaterally symmetric bands of edema-like signal intensity of the marrow of the long bone metaphyses with juxta-osseous edema is most characteristic of scurvy. This pattern has been attributed to gelatinous transformation of the marrow from malnutrition, and is reversible with nutritional supplementation.
Osteomyelitis typically involves the metaphyses, but is usually less sharply defined and rarely bilaterally symmetric. Leukemia typically demonstrates a more diffuse pattern of marrow infiltration that involves the epiphyses and diaphyses in addition to the metaphyses. Red marrow hyperplasia associated with hemolytic anemia may involve the metaphyses symmetrically, but should not be associated with juxta-osseous edema or refusal to walk.

References
2. Brennan CM, Atkins KA, Druzgal CH, Gaskin CM. Magnetic resonance imaging appearance of scurvy with gelatinous bone marrow transformation. Skeletal Radiol 2012;41:357–360

Imaging of Bone Tumors
Kirsten Ecklund, MD

3. Two 15 y.o. athletic boys with knee pain. Which one is malignancy?
   A. Answer A: _____________
   B. Answer B: _____________

   Correct Answer: B

   Rationale
   Primary bone lymphoma. Commonly involves the epiphyses as seen here. Margins are typically sharp on T1 and fluid sensitive sequences, although may have surrounding edema. Multifocality is common. Answer _A_ is incorrect. Explanation: Distal femoral stress fracture and proximal tibial stress reaction. The marrow abnormalities have indistinct margins which usually indicates inflammatory or traumatic edema.

   Reference

4. Assessment of tumors based upon RECIST depends upon which of the following:
   A. Primary tumor necrosis
   B. Primary tumor size
   C. Primary and metastatic tumor necrosis
   D. Primary and metastatic tumor size

   Correct Answer: D

   Rationale
   RECIST is size-based assessment of tumor burden. RECIST calculation is the sum of the longest dimension of all lesions (primary + all mets > 10 mm in size). Answer _A_ is incorrect. Explanation: RECIST does not include necrosis assessment. Answer _B_ is incorrect. Explanation: RECIST requires inclusion of metastases. Answer _C_ is incorrect. Explanation: RECIST does not include necrosis.
5. According to the most recent ACR appropriateness criteria; which modality is considered MOST appropriate for INITIAL evaluation of a palpable soft tissue mass?

A. Ultrasound  
B. X-ray  
C. MRI  
D. CT

Correct Answer: B

Rationale

Reference
1. https://acsearch.acr.org/docs/69434/Narrative/
6. What feature best predicts whether the lesion in the MR images shown is benign or malignant?
   A. Percent of non-lipomatous soft tissue components
   B. Enhancement characteristics
   C. Anatomic location
   D. Age of the patient

   **Correct Answer: D**

   **Rationale**
   Answer (A) is incorrect. Explanation: Many benign soft tissue lesions with macroscopic fat in young children may have substantial soft tissue components (lipoblastoma, fibrous hamartoma of infancy, involuting infantile hemangioma). Answer (B) is incorrect. Explanation: Enhancement characteristics may be helpful for distinguishing lipid containing vascular anomalies but does not distinguish benign vs malignant. Answer (C) is incorrect. Explanation: Both benign and malignant lipid containing tumors can occur anywhere in the body.

   **References**

7. The structure indicated by the arrow is referred to as the?
   A. Cloaca
   B. Sinus tract
   C. Sequestrum
   D. Involucrum

   **Correct Answer: C**

   **Rationale**
   Sequestrum refers to the central plug of devascularized “dead” bone in the setting of chronic osteomyelitis. Answer A is incorrect. Explanation: The cloaca refers to the fistulous connection between the intramedullary bone abscess and the extra-osseous soft tissues in the setting of sub-acute and chronic osteomyelitis. Answer B is incorrect. Explanation: Sinus tract refers to a fistulous tract which reaches the skin surface. Answer D is incorrect. Explanation: Involucrum is the “living” bone enveloping the sequestrum.
8. In which scenario is it imperative to perform contrast enhanced MRI for suspected musculoskeletal infection?
   A. Teenager who stepped on a splinter 6 months prior
   B. Teenager with normal pre-contrast images
   C. Suspected implant infection
   D. Infants and young children with suspected community acquired S. aureus skeletal infection

   **Correct Answer: D**

   **Rationale**
   Correct Answer is D. Community acquired S. aureus has a propensity for involvement of the unossified growth cartilage in infants and young children which can be missed on an unenhanced MRI. Answer A is incorrect. Explanation: Contrast administration is not imperative as it does not increase the sensitivity of MRI for diagnosing pediatric OM in many situations. Answer B is incorrect. Explanation: Contrast not needed in this age group if there is absence of edema on pre-contrast images. Answer C is incorrect. Explanation: Radiographs and US are a good combination for this indication and may obviate need for MRI.

   **References**