

Orthopaedic Oncology: Review Questions

Brett R. Levine, MD, MS

QUESTIONS

Choose the single best answer for each question.

Questions 1 and 2 refer to the following case.

A 21-year-old man presents with worsening right knee pain after a minor twisting injury playing basketball 3 months ago. The patient reports increased swelling along the posterior aspect of his knee and generalized leg edema on the right side. His pain is exacerbated by weight-bearing activities and deep knee flexion. The patient denies night pain, fevers, chills, or recent weight loss. His past medical history is significant for unilateral retinoblastoma, which was treated with minimal residual visual deficit. A technetium bone scan depicts an isolated lesion located in the right distal femur, and magnetic resonance imaging (MRI) shows sparing of the neurovascular bundle. A plain radiograph of the distal femur is shown in **Figure 1**.

1. What is the cause of this patient's knee pain?

- (A) Chondromyxoid fibroma
- (B) Chondrosarcoma
- (C) Ewing's sarcoma
- (D) Osteochondroma
- (E) Osteosarcoma

2. How should this patient be treated?

- (A) Above the knee amputation
- (B) Curettage and bone grafting
- (C) Wide resection and chemotherapy
- (D) Wide resection and radiotherapy
- (E) Wide resection only

Questions 3 and 4 refer to the following case.

A 9-year-old boy presents with a chief complaint of worsening focal left groin pain. The patient and family report recent weight loss but no fevers. Activities involving hip rotation have become increasingly difficult. Initially, aspirin relieved the pain, and the patient was able to sleep through the night; however, now the pain is refractory to daily nonsteroidal anti-inflammatory drugs (NSAIDs). Plain radiographs reveal an 8-mm well-circumscribed lesion with a sclerotic border and central radiolucent nidus.

3. What is this patient's diagnosis?

- (A) Aneurysmal bone cyst



Figure 1. A plain radiograph of the distal femur of the patient described in questions 1 and 2.

- (B) Brodie's abscess
- (C) Femoral neck stress fracture
- (D) Fibrous dysplasia
- (E) Osteoid osteoma

4. Which of the following is the most appropriate treatment for this patient's lesion?

- (A) Chemotherapy
- (B) Curettage, cryotherapy, and bone grafting
- (C) Low-dose focal irradiation (600–800 cGy)
- (D) Percutaneous radiofrequency ablation (RFA)
- (E) Resection and prosthetic replacement

5. A 9-year-old girl with a past history of precocious puberty and premature vaginal bleeding presents with a 6-month history of vague hip and ankle pain. On physical examination, the patient has hyperpigmented skin lesions (café au lait spots) with irregular borders and mild hip and ankle pain. Radiographs reveal polyostotic "ground-glass" lesions in the proximal femur and distal tibia. What is this patient's most likely diagnosis?

- (A) Gardner's syndrome
- (B) Hand-Schüller-Christian disease
- (C) Letterer-Siwe disease

Dr. Levine is an attending physician, Midwest Orthopaedic Center, Peoria, IL.

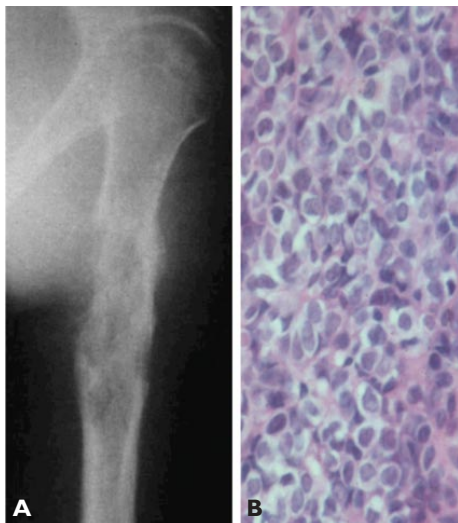


Figure 2. (A) Plain radiograph of the left humerus of the patient described in question 6, and (B) histologic sample demonstrating small round blue cells.

- (D) McCune-Albright syndrome
- (E) Paget's disease

6. A 16-year-old boy presents with a 6-month history of worsening pain and swelling in his left arm. He has had night fevers and an elevated erythrocyte sedimentation rate. An anteroposterior radiograph of the left humerus is performed, and histologic evaluation of a sample obtained from a needle biopsy reveals small round blue cells (Figure 2). Cytogenic evaluation is likely to show which of the following chromosomal translocations?

- (A) t(8;14) (C) t(9;22) (E) t(17;22)
- (B) t(11;22) (D) t(X;18)

7. A 65-year-old man presents with the insidious onset of atraumatic left shoulder pain. He reports recent weight loss but no significant medical history. On physical examination, he has pain with range of motion of the shoulder and a palpable/painful fullness in the left shoulder. An anteroposterior radiograph of the left shoulder is performed (Figure 3). Histologic evaluation of the lesion reveals multiple densely packed hyperchromatic cells per lacunae, and immunohistochemical S-100 protein stain is positive. What is this patient's most likely diagnosis?

- (A) Chondroblastoma (D) Multiple myeloma
- (B) Chondrosarcoma (E) Osteosarcoma
- (C) Desmoplastic fibroma



Figure 3. Anteroposterior radiograph of the left shoulder of the patient described in question 7.

ANSWERS AND EXPLANATIONS

1. (E) **Osteosarcoma.** Classic osteosarcoma is a malignant spindle cell sarcoma that produces osteoids. After myeloma, osteosarcoma is the most common primary bone tumor. It typically occurs in patients aged 10 to 25 years and is more common in males than females (1.5:1). Osteosarcoma is often found in the distal femoral metaphysis (35%), the proximal tibial metaphysis (20%), and the proximal humerus (10%).¹ Pain, the most common symptom, is often exacerbated with physical activity. Plain radiographs typically show lesions with mixed lytic and blastic areas in the metaphysis of a long bone.¹ There is a wide zone of transition between tumor and normal bone, and often an extrasosseous soft tissue mass with fluffy irregular densities of bone formation is seen (Figure 1). MRI defines the extent of the soft tissue lesion and the involvement of neurovascular structures. Pathologic findings depict malignant cells producing osteoid.¹ There is also a strong correlation between retinoblastoma and osteosarcoma; the retinoblastoma gene is mutated in 25% to 80% of cases of osteosarcoma.¹ Chondrosarcoma is unlikely in this patient, as most cases occur in adults over age 40 years. Ewing's sarcoma involves small round cells and is not associated with the retinoblastoma gene. Osteochondroma is a benign tumor with a characteristic large cartilaginous cap. Chondromyxoid fibroma, a rare tumor of the long bones and short tubular bones of the foot, typically occurs in the third or fourth decades of life and does not match the radiologic or histologic findings in this case.
2. (C) **Wide resection and chemotherapy.** Successful surgical management of osteosarcoma is achieved by obtaining wide surgical margins with limb-sparing resection. However, the presence of metastasis is the largest predictor of 5-year survival, with a 10% to 20% rate compared with 60% to 80% without evidence of metastasis.¹ Preoperative and postoperative

chemotherapy significantly improve outcomes for patients with osteosarcoma. Above the knee amputation is an option, but limb salvage is indicated in patients with resectable tumors. Curettage and bone grafting and wide resection alone are insufficient for tumor excision. Radiation is not as effective in tumor eradication as compared with chemotherapy.

3. **(E) Osteoid osteoma.** Osteoid osteoma is a benign osteoblastic tumor consisting of a central core of vascular osteoid tissue (nidus) and a peripheral zone of sclerotic bone. Typically, these tumors occur in young patients (age, 7–25 yr), with an almost 3:1 male predominance.² These benign osseous tumors are painful because of high levels of local prostaglandins within the tumor; pain relief with aspirin, NSAIDs, and salicylate drugs is characteristic of these tumors. This patient's characteristic initial response to NSAIDs and described presentation are diagnostic for an osteoid osteoma.² A Brodie's abscess typically has signs of infection (eg, swelling, erythema, fevers), and an aneurysmal bone cyst has a classic expansile, eccentric, lytic lesion on plain radiographs. The radiographic findings in this case are not suggestive of fibrous dysplasia or a femoral neck stress fracture.
4. **(D) Percutaneous RFA.** The femoral neck is the most common location for an osteoid osteoma. Computed tomography (CT)-guided localization and percutaneous RFA are often used to treat osteoid osteoma. RFA has a success rate of up to 90%, and several recent studies have documented the efficacy of RFA while also reporting decreased morbidity;^{2–4} however, appropriate facilities and trained staff are required. CT-guided localization and resection of the tumor or an en bloc excision are slightly more invasive, and there is the possibility of incomplete excision of the nidus. Radiation and chemotherapy are not indicated in the treatment of osteoid osteoma.
5. **(D) McCune-Albright syndrome.** McCune-Albright syndrome is a condition with the classic triad of polyostotic fibrous dysplasia, cutaneous café au lait spots, and endocrine dysfunction.⁵ Precocious puberty and vaginal bleeding are also common in young female patients with McCune-Albright syndrome. Bone lesions typically have a ground-glass appearance on radiography and occur most commonly in the femur (91%) and tibia (81%).⁵ Letterer-Siwe disease (fulminant fatal form of histiocytosis X) and Hand-Schüller-Christian disease (classic triad of exophthalmus, dia-

betes insipidus, and lytic skull lesions) are associated with eosinophilic granulomatous lesions, not fibrous dysplasia. Paget's disease is a form of abnormal bone remodeling found in adults. Gardner's syndrome is an autosomal dominant disorder manifested in childhood by multiple neoplasms (ie, bone and mesenteric tumors, fatty and fibrous skin, and intestinal polyps).

6. **(B) t(11;22).** Based on the histology (small round blue cells) and clinical history, the patient has Ewing's sarcoma. Ewing's sarcoma is the second most common primary malignant bone tumor in children, with 80% occurring in patients younger than age 20 years.¹ Cytogenic studies have shown that 85% of Ewing's sarcomas contain the t(11;22) translocation. Burkitt's lymphoma, chronic myelogenous leukemia (Philadelphia chromosome), synovial sarcoma, and dermatofibrosarcoma protuberans contain the t(8;14), t(9;22), t(X;18), and t(17;22) translocations, respectively.
7. **(B) Chondrosarcoma.** Chondrosarcoma is a primary malignant bone tumor typically found in older adults (> 60 yr). The shoulder and pelvic girdles, knee, and spine are common locations for these chondrogenic lesions.¹ The lesions have a typical "ring and arc" pattern or "popcorn" calcifications on plain radiographs. Histologic evaluation typically reveals multiple cells per lacunae, mitotic activity, and pleomorphism. Immunohistochemical staining is often S-100 positive. Wide resection is typically the treatment of choice for these tumors.¹ This patient is too old to have a chondroblastoma, and the radiographic (typically distinct sclerotic border) and histologic (chondroblasts) findings are inconsistent for this lesion. Similarly, the radiographic findings are not consistent with a bone-forming tumor as seen with an osteosarcoma. Multiple myeloma is a small round blue cell tumor without specific lacunae. Desmoplastic fibroma, a rare tumor that is locally destructive and benign, would not demonstrate an aggressive, malignant process as seen in Figure 3.

REFERENCES

1. Gibbs CP Jr, Weber K, Scarborough MT. Malignant bone tumors. *Instr Course Lect* 2002;51:413–28.
2. Aboualfia AJ, Kennon RE, Jelinek JS. Benign bone tumors of childhood. *J Am Acad Orthop Surg* 1999;7:377–88.
3. Kjar RA, Powell CJ, Schlicht SM, et al. Percutaneous radiofrequency ablation for osteoid osteoma: experience with a new treatment. *Med J Aust* 2006;184:563–5.
4. Papagelopoulos PJ, Mavrogenis AF, Kyriakopoulos CK, et al. Radiofrequency ablation of intra-articular osteoid osteoma of the hip. *J Int Med Res* 2006;34:537–44.
5. Parekh SG, Donthineni-Rao R, Ricchetti E, Lackman RD. Fibrous dysplasia. *J Am Acad Orthop Surg* 2004;12:305–13.