10 Musculoskeletal Neoplasms

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Case 10.1: Primary Osseous Lymphoma

History

Patient is a 27-year-old woman with left proximal tibial lesion. Recent MRI showed aggressive mass like marrow replacement throughout the proximal right tibia with cortical thinning and disruption. PET-CT is requested as part of initial staging.

Findings

There is an intensely active left proximal tibial lesion extending approximately 11 cm from the tibial plateau inferiorly with mixed lytic sclerotic changes on CT, predominantly sclerotic, and maximum SUV up to 27.5 (Fig. 10.1). Other smaller hypermetabolic satellite foci are seen within the left proximal tibia. This lesion was subsequently biopsied and consistent with diffuse large B-cell lymphoma. The patient had received chemotherapy followed by radiation treatment.

Impression

- Local disease in the left proximal tibia
- No other active in the remaining body

Pearls and Pitfalls

- FDG PET-CT can detect other disease sites and shows the most active area which is useful for biopsy planning.
- Primary osseous lymphoma can mimic other bone tumors.

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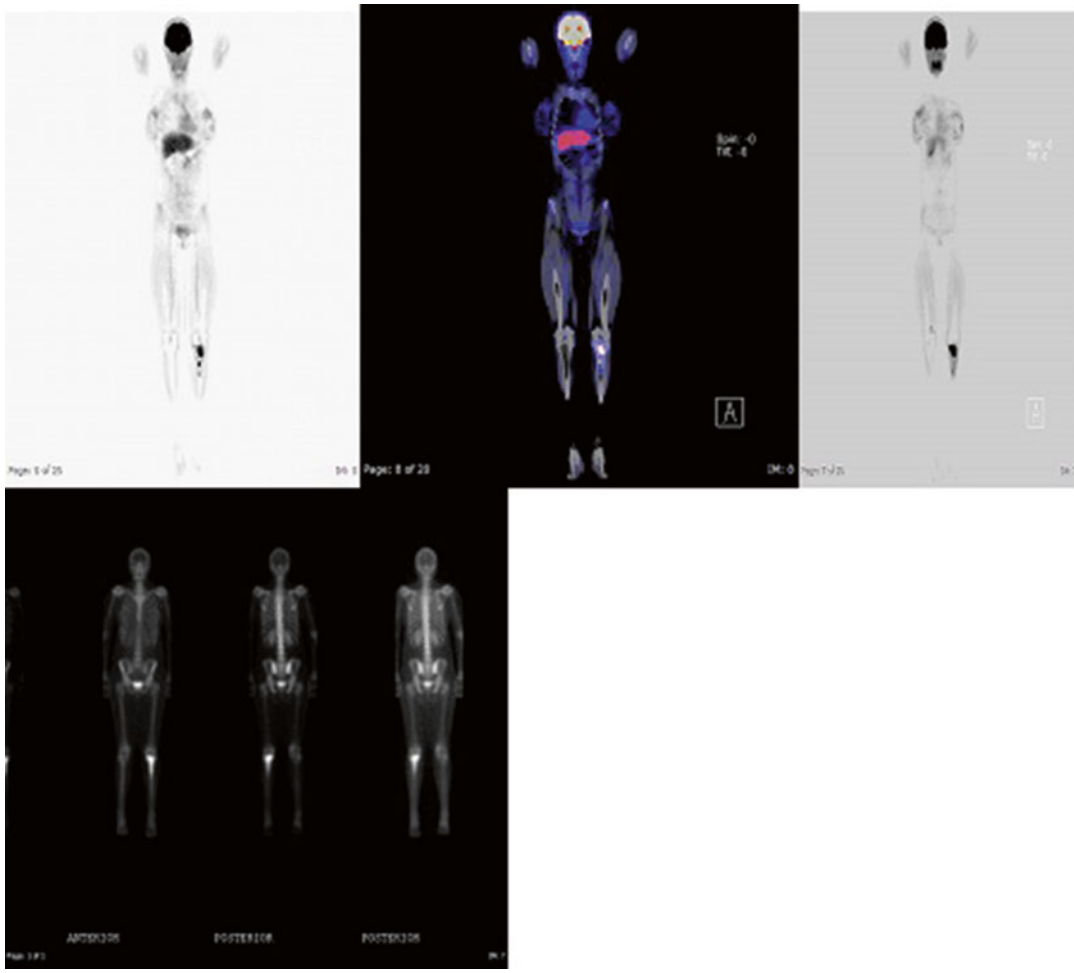

Fig. 10.1

Discussion

Primary lymphoma of the bone is a rare malignant condition that accounts for less than 5 % of all primary bone tumors. The vast majority of cases are of the non-Hodgkin type, with Hodgkin disease accounting for 6 % of cases. It is rare for patients younger than 10 years and occurs slightly more often in males. The femur is the most common site (especially in the metadiaphysis) and is affected in 25 % of cases. Other sites include the pelvis, humerus, head and neck, and tibia. Distinguishing primary bone lymphoma from other bone tumors is important because the former has a better response to therapy and a better prognosis (Fig. 10.1).

Case 10.2: Extra-Adrenal Paraganglioma

History

Patient is a 38-year-old female with newly diagnosed paraganglioma of the lower lumbar spine and upper sacrum.

Findings

There is an intensely active 4.5 × 7.8 × 5.6 cm soft tissue mass (maximum SUV of 8.9) centered in the lower lumbar and upper sacral spinal canal from the level of L4 through S2–3 (Fig. 10.2). This mass demonstrates osseous involvement of the L5, S1, and S2 vertebral bodies and posterior elements, consistent with the documented paraganglioma.

Impressions

- Hypermetabolic soft tissue mass centered in the lower lumbar and upper sacral spinal canal, consistent with the known paraganglioma
- No definite evidence of distant metastasis

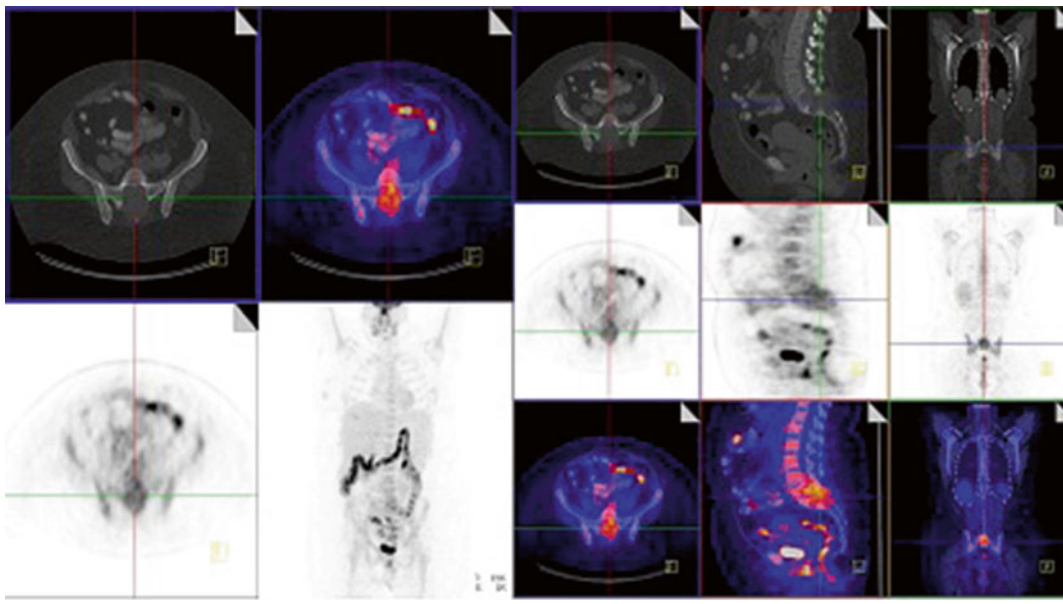

Fig. 10.2

Pearls and Pitfalls

- FDG PET positivity is almost a constant feature of pheochromocytomas and paragangliomas.
- Whole-body PET-CT study is helpful in detecting distant metastases.

Discussion

Pheochromocytomas and extra-adrenal paragangliomas are rare tumors of neuroectodermal origin. They belong to the heterogeneous family of neuroendocrine tumors. Pheochromocytomas and paragangliomas show consistent 18F-FDG avidity, with maximum SUV ranging from 1.9 to 42 in nonmetastatic tumors and 2.3–29.3 in metastatic tumors. FDG PET is superior to 131I-metaiodobenzylguanidine in the majority of metastatic patients (Fig. 10.2).

Case 10.3: Low-Grade Fibromyxoid Sarcoma

History

Patient is a 77-year-old man presented with left thigh mass. He is being seen for staging.

Findings

There is a moderately active $5.7 \times 10.5 \times 15$ cm left distal thigh mass with maximum SUV of 4.6, consistent with neoplasm (Fig. 10.3). The mass has mixed areas of increased and decreased metabolic activity. The patient subsequently had biopsy which was consistent with low-grade fibromyxoid sarcoma.

Impression

- Heterogeneous hypermetabolic soft tissue mass in the left distal thigh, consistent with neoplasm
- No definite evidence of distant metastasis

Pearls and Pitfalls

- Whole-body PET-CT study is helpful in detecting distant metastases.

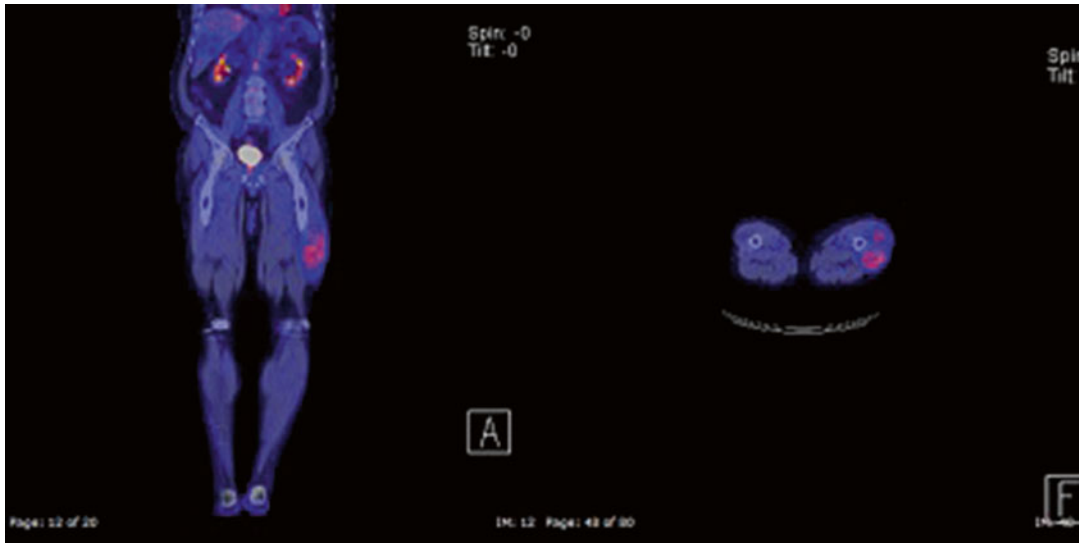

Fig. 10.3

- PET-CT is useful in biopsy planning to show the most metabolically active area of the tumor.
- More accurate staging with FDG PET can help guide and ensure the most appropriate therapy.

Discussion

Low-grade fibromyxoid sarcoma is a rare soft tissue neoplasm with a bland histologic appearance that nevertheless can follow an aggressive course with multiple local recurrences and eventual metastasis to the lung and sometimes bone (Fig. 10.3).

Case 10.4: Elastofibroma Dorsi

History

Patient is a 73-year-old female with history of bilateral breast carcinoma, status post bilateral mastectomies. She is being seen for restaging.

Findings

Moderately active soft tissue densities are seen in bilateral subscapular regions, with maximum SUV of 3.7 on the right and 3.1 on the left (Fig. 10.4).

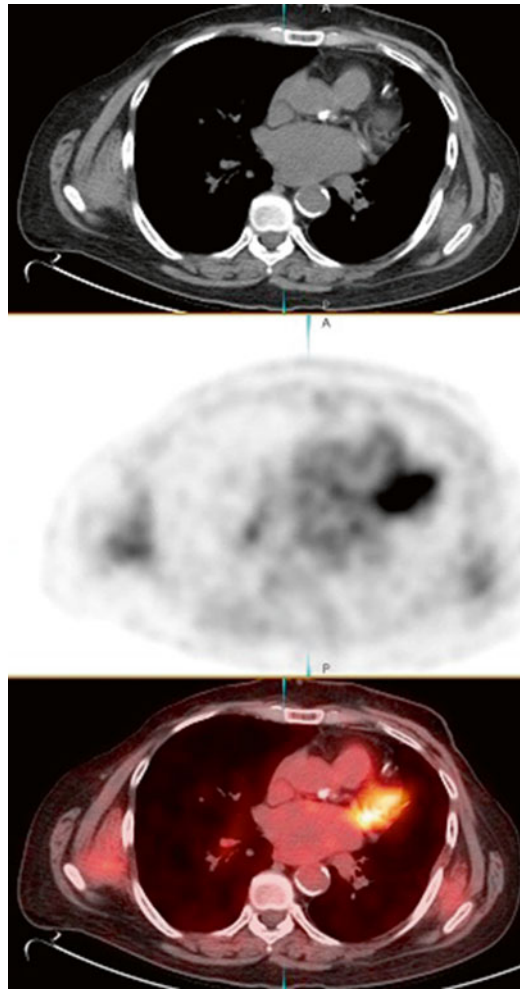

Fig. 10.4

These masses are located just deep relative to the serratus anterior muscles, displacing the muscle laterally. The soft tissue masses are oblong in shape, being longest in the superior-inferior plane. The attenuation of the lesions is similar to that of muscle, consistent with elastofibroma dorsi (EFD).

Impressions

- Bilateral EFD
- No definite evidence of recurrent or metastatic disease

Pearls and Pitfalls

- The diagnosis of EFD is made on the basis of the typical subscapular location of the lesions and the characteristic CT appearance (poorly circumscribed soft tissue with attenuation similar to that of muscle).
- EFD also shows hypermetabolism on FDG PET.

Discussion

Elastofibromas are benign, slowly growing lesions characteristically located in the subscapular region. Elastofibromas are pseudotumorous lesions characterized by fibroblastic proliferation and accumulation of abnormal elastic fibers. They are relatively common lesions; the prevalence revealed on CT was found to be 2 %, and an autopsy series reported an 11–24 % prevalence. A lack of awareness of the CT characteristics of EFD could have resulted in erroneous interpretation of the PET portion of the studies. The FDG hypermetabolism may have been attributed to an inflammatory or neoplastic process (Fig. 10.4).

Case 10.5: Fibrous Dysplasia

History

Patient is a 38-year-old female with history of breast cancer. She is being seen for restaging.

Findings

Expansile cortex with ground-glass appearance of the right posterior seventh rib, with associated moderate activity (maximum SUV of 3.4), consistent with fibrous dysplasia (FD) (Fig. 10.5).

Impression

- Fibrous dysplasia in the right posterior seventh rib
- No definite evidence of recurrent or metastatic disease

Pearls and Pitfalls

- Expansile cortex with ground-glass appearance.
- Fibrous dysplasia shows hypermetabolism on FDG PET.

Discussion

FD is a relatively common, benign skeletal disorder, typically encountered in adolescents and young adults. Rather than a true neoplasm, FD is a developmental anomaly in which the normal medullary space of the affected bone is replaced by fibroosseous tissue. The process may affect

a single bone (monostotic FD) or many bones (polyostotic FD). CT appearance of fibrous dysplasia will vary in direct proportion to the extent of mineralization within the lesion (Fig. 10.5).

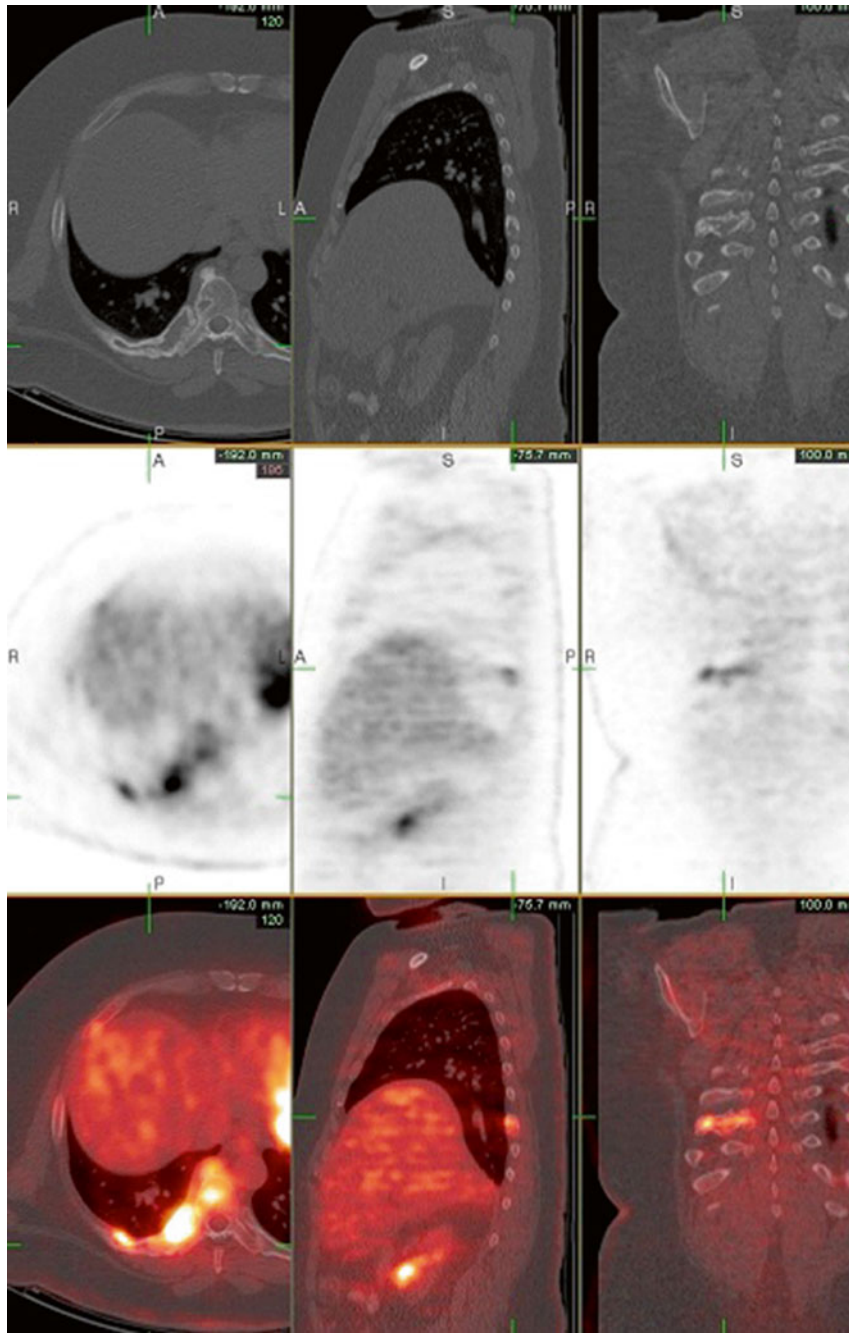

Fig. 10.5

Case 10.6: Squamous Cell Carcinoma of the Lower Extremity

History

Patient is a 40-year-old man with history of recurrent metastatic squamous cell carcinoma involving his left lower extremity. The patient initially had wide excision in June 2010 followed by adjuvant chemoradiation treatment. He subsequently had local recurrence in the pretibial region with metastasis to the left foot. MRI study of the lower extremity showed extensive disease in the left foot including the talus and calcaneus with extension into the adjacent proximal tibia with other smaller lesions noted in the bones of the left foot consistent with metastatic disease. PET-CT is requested for restaging.

Findings

Multiple disease sites are seen below the left knee including the soft tissue masses in the anterior tibial region, destructive lesion in the distal third of the fibula, distal left tibial mass with cortical destruction and extraosseous component, and large destructive heterogeneously hypermetabolic mass involving the hindfoot and posterior midfoot on the left with extension to base of third, fourth, and fifth metatarsal proximally as well as the distal fourth metatarsal, with maximum SUV of 8.2 in the large destructive mass (Fig. 10.6).

In addition, there is metastatic disease involving a left inguinal lymph node and bilateral lungs.

Impressions

- Multiple sites of tumor in the left lower leg below the knee as well as focus of increased activity in the left lateral tibial plateau, probably a site of additional metastasis
- Left inguinal and bilateral pulmonary metastatic disease

Pearls and Pitfalls

- Whole-body FDG PET scan can detect skip metastasis such as left inguinal and bilateral pulmonary metastasis.

Discussion

The association of preexisting scars and sinuses in the extremities with the later development of squamous cell carcinoma is well established. This rare form of carcinoma carries a poor prognosis, with a recurrent rate of 50 %. The most significant prognostic factor predicting recurrence is the histologic grading of the tumor. Amputation is recommended in all grade II or III disease and wide local excision only in very small lesions that can be radically excised or in grade I lesions, with prophylactic nodal irradiation in all grades II and III carcinoma (Fig. 10.6).

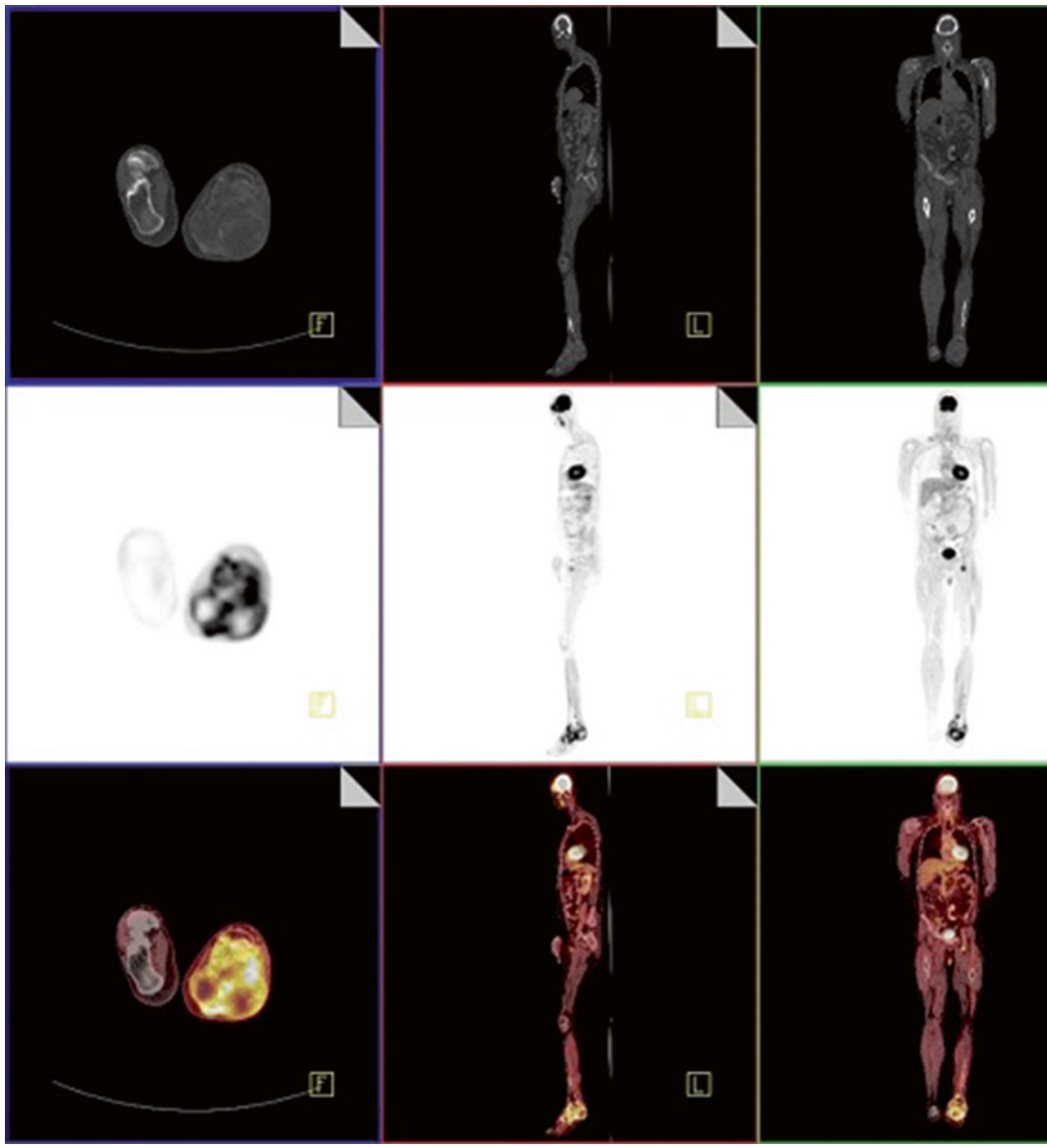

Fig. 10.6

Case 10.7: Low-Grade Chondrosarcoma of the Pelvis

History

Patient is a 73-year-old man with history of low-grade chondrosarcoma of the right pelvis, status post radiation therapy. The current PET-CT is requested for restaging.

Findings

There is a large, heterogeneous pelvic mass with matrix calcifications causing permeative destructive changes within the right iliac bone and acetabulum, demonstrating mild FDG activity at the periphery (Fig. 10.7). This mass measures 20.0 × 16.0 cm and shows heterogeneous activity more significant in the periphery (with maximum SUV up to 4.0).

Impression

Recurrent disease in the right pelvis with permeative destructive changes within the right ilium and acetabulum.

Pearls and Pitfalls

- Whole-body FDG PET is helpful in detecting local recurrences and metastatic disease.
- Low-grade sarcomas are generally less FDG avid than a high-grade sarcoma.

Discussion

Chondrosarcoma, a malignant tumor characterized by the production of a cartilage matrix, accounts for about 11 % of cases of primary malignant bone tumors. The average age at presentation is 46 years (range, 5–82 years). The pelvis is the most common location. Local pain is the most frequently reported initial symptom. The overall 5-year survival rate is 77 %. The recurrent rate is higher for tumors of the shoulder and pelvis than for tumors of long bones. Radiographically, chondrosarcomas have a characteristic appearance, including a combination of bone expansion and cortical thickening. Histologic tumor grade is an important predictor of local recurrence and metastasis (Fig. 10.7).

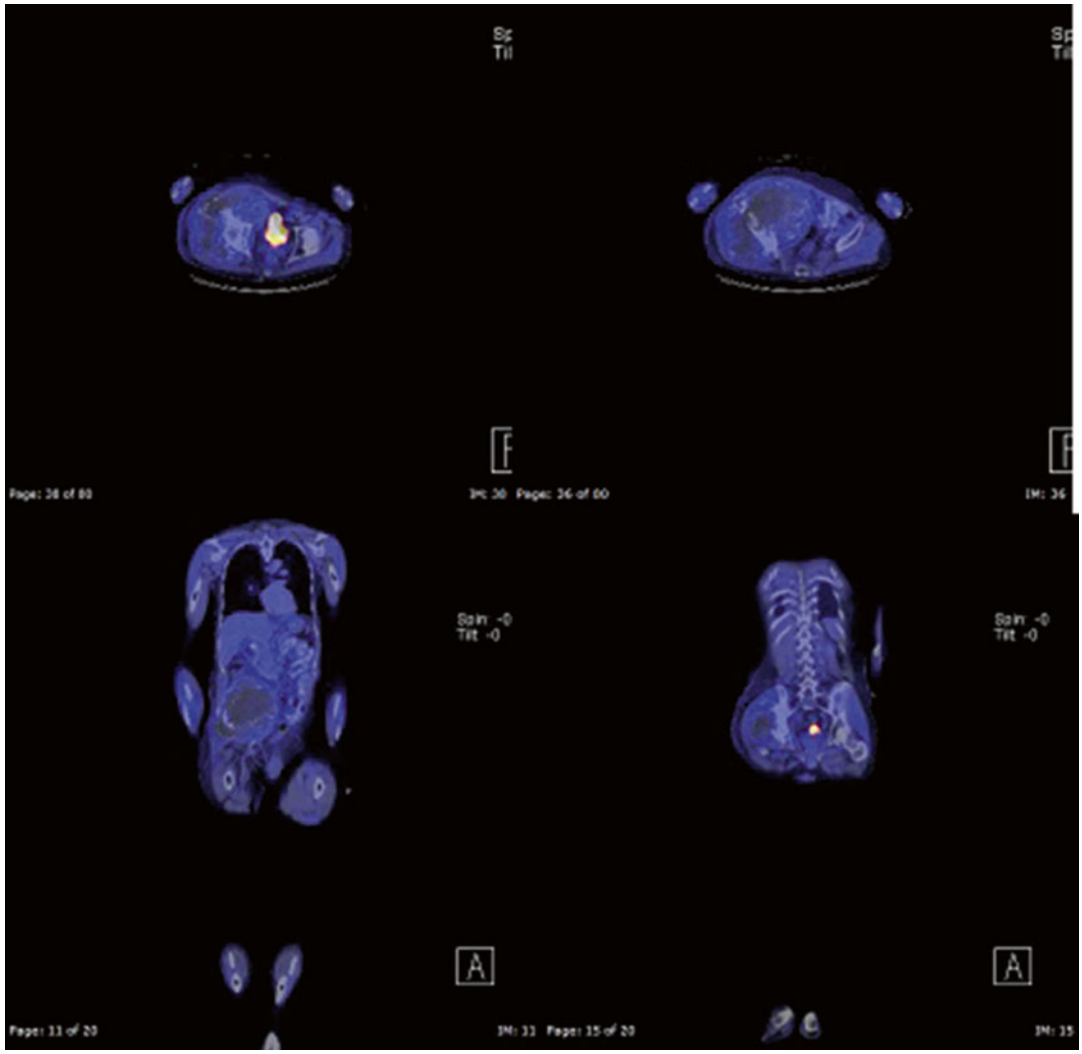

Fig. 10.7

Case 10.8: Multiple Myeloma

History

Patient is a 66-year-old man with history of multiple myeloma, currently on chemotherapy. PET-CT is requested for restaging.

Findings

Multiple hypermetabolic lytic lesions are seen involving the axial and appendicular skeleton, consistent with the documented myeloma (Fig. 10.8). The reference lesions are located in the left posterior parietal bone (maximum SUV of 17.5) and left proximal humerus (maximum SUV of 24.3).

Impression

Multiple hypermetabolic lytic osseous lesions involving the axial and appendicular skeleton, consistent with the known myeloma.

Pearls and Pitfalls

- FDG PET/CT is able to detect bone marrow involvement in patients with multiple myeloma and useful in assessing extent and burden of disease at time of initial diagnosis and for evaluating therapy response.

Discussion

Multiple myeloma (MM) is a malignant hematologic disorder characterized by bone marrow infiltration with neoplastic plasma cells. MM accounts for 10 % of all hematologic cancers. Approximately 5–10 % of patients have a solitary plasmacytoma, and two thirds of these patients progress to multiple myeloma. Patients with stage I MM, with only limited alteration of blood parameters and not more than one skeletal lesion, are followed clinically without therapy. Patients with stage II or III MM require chemotherapy (Fig. 10.8).

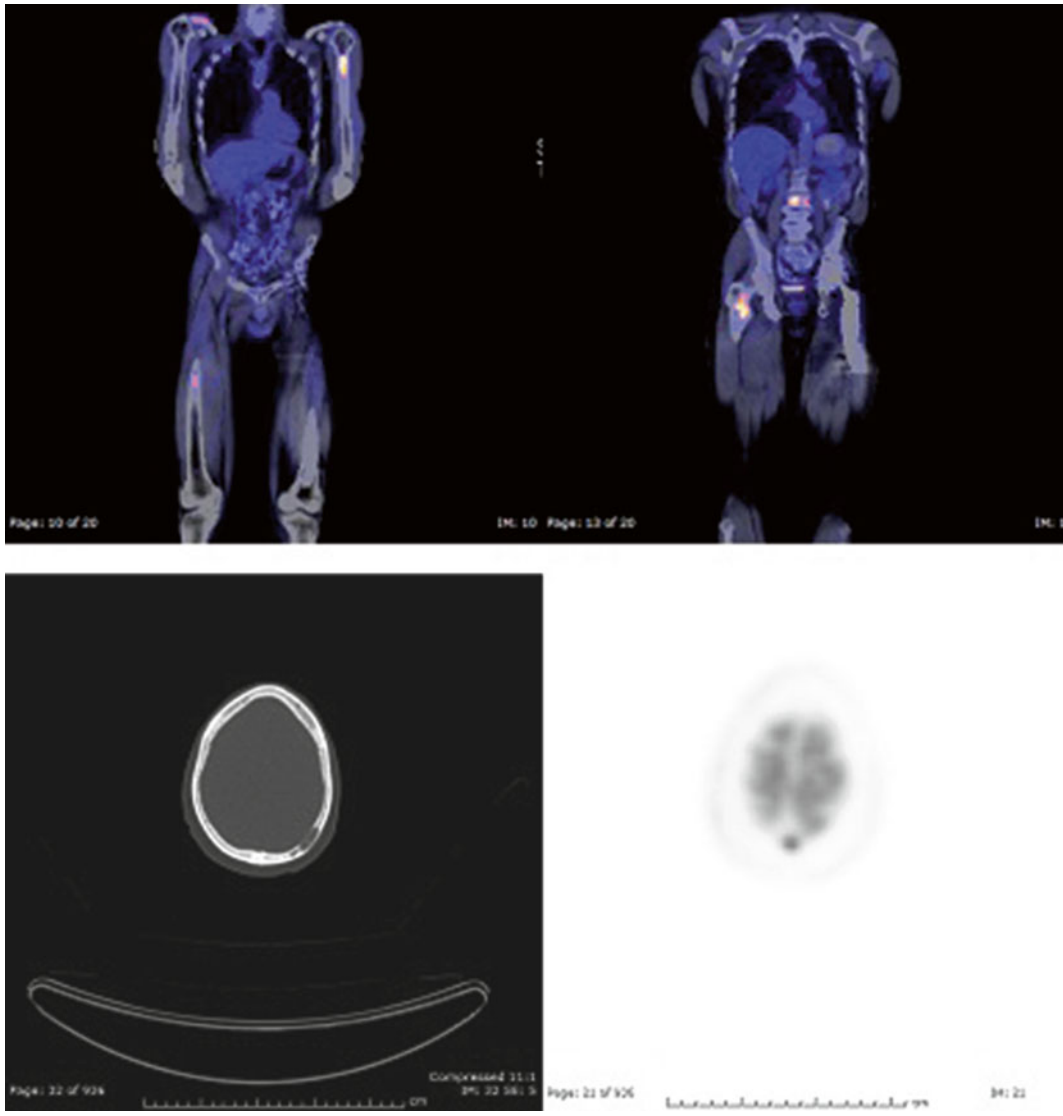

Fig. 10.8

Case 10.9: Low-Grade Soft Tissue Sarcoma

History

Patient is a 77-year-old man presented with left thigh mass with MRI reporting mass consistent with soft tissue sarcoma (biopsy dated February 7, 2011, stating low-grade fibromyxoid sarcoma).

Findings

Moderately hypermetabolic 5.7 × 10.5 × 15 cm left distal thigh soft tissue mass, with maximum SUV of 4.6, consistent with tumor (Fig. 10.9). The mass shows heterogeneous attenuation and metabolic activity. The mass was subsequently biopsied and consistent with low-grade fibromyxoid sarcoma.

Impression

- Hypermetabolic left distal thigh soft tissue mass, consistent with primary tumor
- No definite evidence of distant metastasis

Pearls and Pitfalls

- FDG PET could be useful in rare soft tissue sarcomas to demonstrate possible metastasis and direct biopsy.

Discussion

Low-grade fibromyxoid sarcoma is a rare type of low-grade sarcoma. It is characterized by a long and indolent clinical course and the possibility of local recurrence or distant metastases in a subset of patients. Unlike many other types of cancer, low-grade fibromyxoid sarcoma can metastasize after many years, sometimes decades after the initial presentation of the tumor, to the lung and sometimes bone (Fig. 10.9).

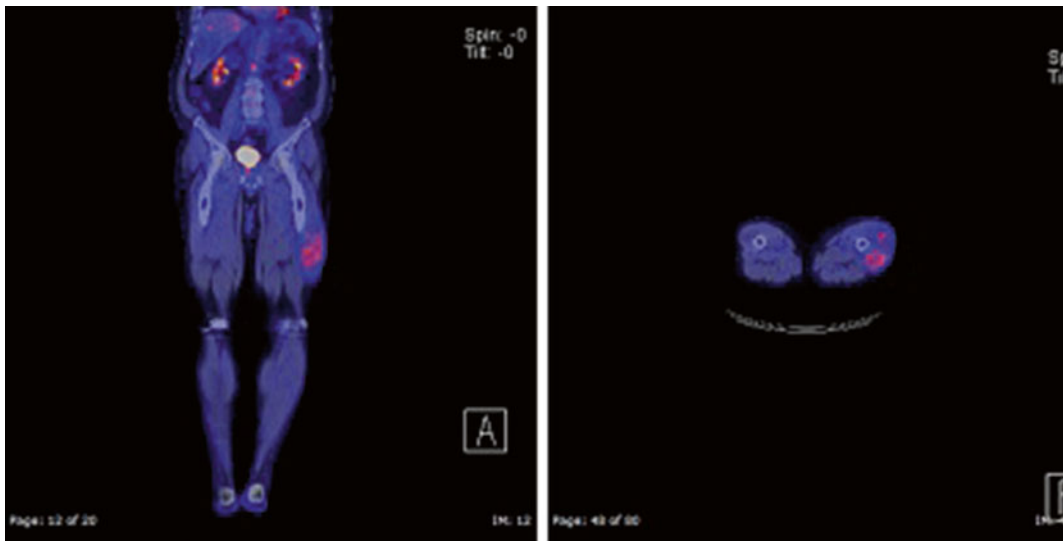

Fig. 10.9

Case 10.10: Myxofibrosarcoma

History

Patient is a 68-year-old female presented with right medial thigh mass. PET/CT is requested for further evaluation.

Findings

A 16.7 × 22.1 × 17.5 cm (in transverse, craniocaudal, and anteroposterior dimensions, respectively) well-defined, compartmentalized, heterogeneous right medial thigh soft tissue mass (Fig. 10.10). This finding demonstrates diffuse heterogeneous activity, with the most active areas located in the superolateral aspect (with SUV max up to 11.4). There are scattered areas of hypoattenuating photopenia within the mass consistent with necrosis. No definite evidence of underlying bony erosion or involvement is noted.

The patient subsequently had right thigh mass biopsy which was consistent with myxofibrosarcoma (MFS), for which she had received chemoradiation treatment.

Impression

1. Large, heterogeneous active right thigh soft tissue mass, consistent with neoplasm
2. No definite evidence of distant metastasis

Pearls and Pitfalls

- FDG PET-CT is useful in detecting distant metastasis and also for biopsy planning.
- MFS shows heterogeneous FDG uptake.

Discussion

Myxofibrosarcoma (MFS), also known as a myxoid subtype of malignant fibrous histiocytomas, is one of the most common sarcomas in the extremities of old patients and is characterized by a high frequency of local recurrence. For high-grade lesions, they tend to form solid parts with a continuous transition to a storiform-pleomorphic-type MFH. No to heterogeneous FDG uptake within MFS was previously reported which probably correlates to the tumor histologic grade (Fig. 10.10).

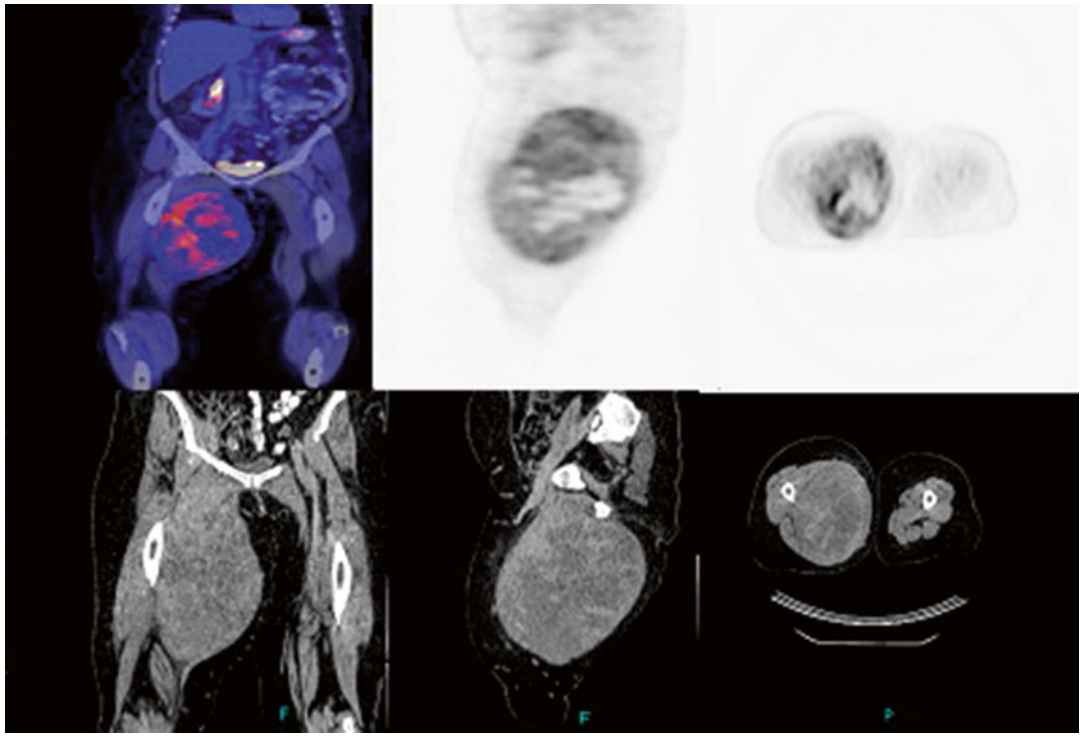

Fig. 10.10

Case 10.11: Osteosarcoma

History

Patient is a 12-year-old female with newly diagnosed left femoral osteosarcoma. PET-CT is performed as part of initial staging.

Findings

There is an intensely active lesion in the left distal femur (maximum SUV of 10.3), corresponding to medullary sclerosis with small area of cortical disruption and associated periosteal reaction medially on CT images (Fig. 10.11). No other abnormal activity is seen in the remaining body.

Impression

1. Intensely active medullary sclerotic lesion with small area of cortical disruption and associated periosteal reaction in the left distal femur, consistent with the documented osteosarcoma.
2. No definite evidence of distant metastasis.

Pearls and Pitfalls

- FDG PET helps to determine the presence and extent of sarcomas and may allow the noninvasive estimation of the histologic grade of these tumors.
- The measured SUV of a sarcoma has been used to predict patient outcome both before and after neoadjuvant therapy. This in turn allows targeted biopsies, which can reduce the likelihood of underestimation of tumor grade and inadequate therapy.
- PET may help to detect intraosseous skip lesions, which may be difficult to differentiate from physiologic hematopoietic marrow at MR imaging.

Discussion

Osteosarcoma, or sometimes referred to as osteogenic sarcoma, is the second most common primary malignant bone tumor, exceeded in frequency only by multiple myeloma. It is the most common primary malignant bone tumor to affect children and adolescents. The intraosseous tumor usually arises in the metaphyses of the long bones, distal femur (44 %), proximal tibia (22 %), and proximal humerus (9 %). It can extend into the diaphysis, epiphysis, or both. The overall prognosis for patients with osteosarcoma depends on the stage of the tumor at presentation. Without metastases, long-term survival is in the order of 60–85 % (Fig. 10.11).

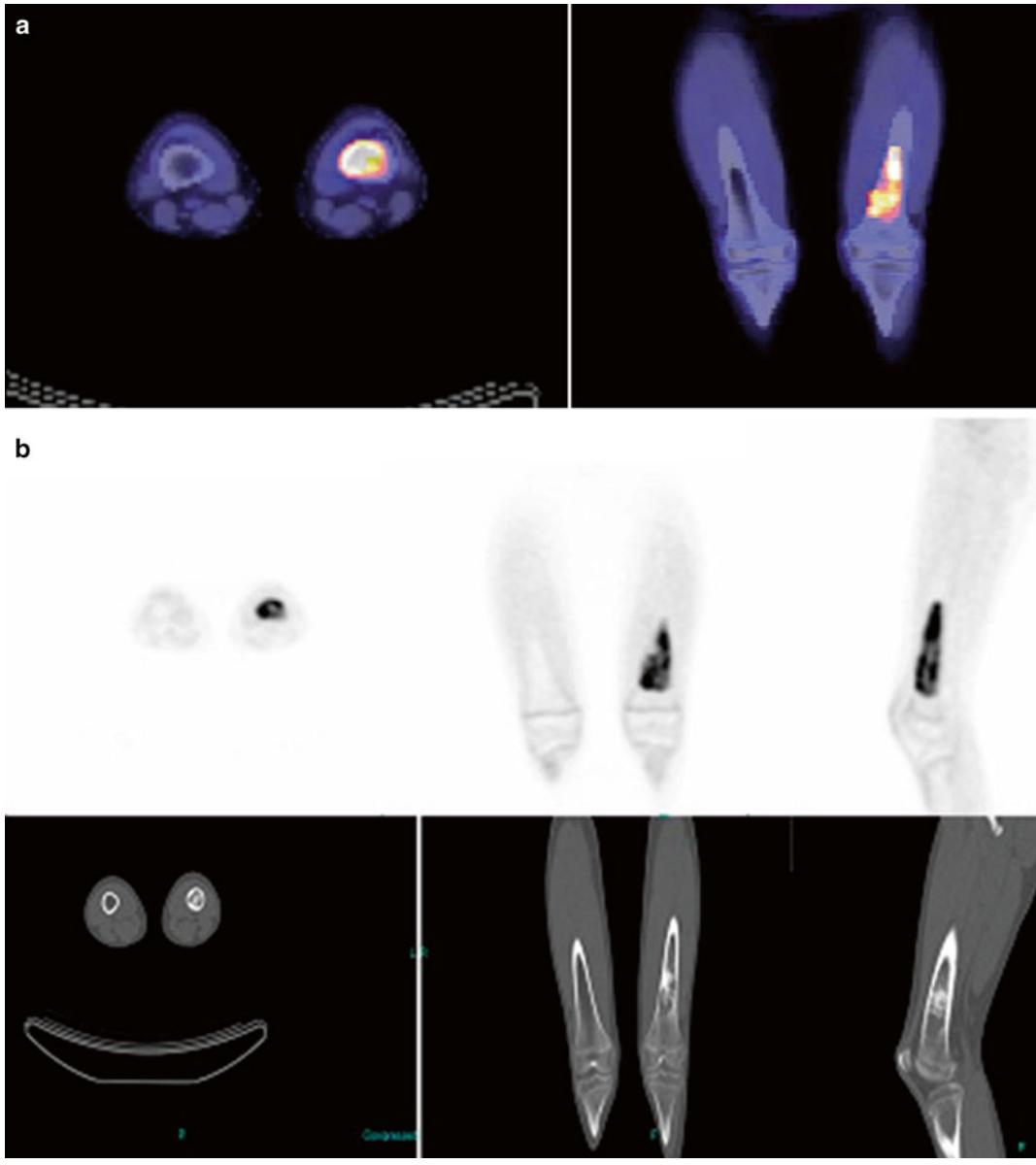

Fig. 10.11

Suggested Reading

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