Nuclear Medicine
Case Report

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Background

A 48-year-old male presented to the emergency department with a five week history of constant hip and lower back pain which was exacerbated by ambulation. He denied any history of trauma. The initial workup included radiographs of the hips which showed extensive erosive changes within all bony structures concerning for a systemic process such as multiple myeloma or hyperparathyroidism. The subsequent bone survey radiographs demonstrated multiple thoracolumbar compression deformities and extensive lytic lesions within the spine. Laboratory workup revealed an elevated creatinine of 1.76 mg/dL and a low hemoglobin level on the complete blood cell count (6.6 g/dL). The calcium level was elevated at 10.8 mg/dL. The patient subsequently went on to bone marrow biopsy, which revealed plasma cell myeloma (aka multiple myeloma).

Imaging

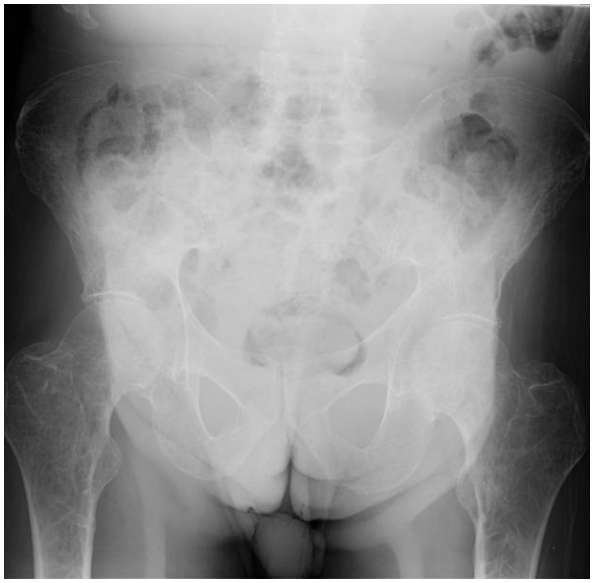

Figure 1A

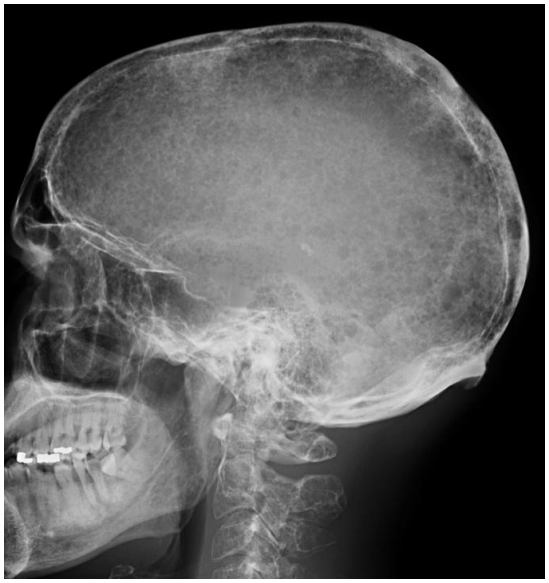

Figure 1B

Figure 1.
Radiographs of the hips (Figure 1A) and skull (Figure 1B) demonstrate innumerable lucent lesions throughout the skeleton which are most compatible with multiple myeloma.

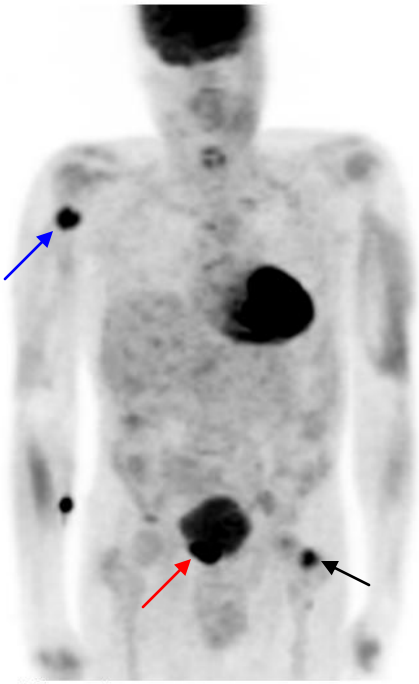

Figure 2a

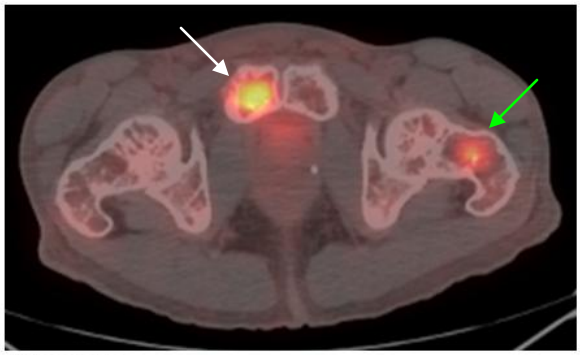

Figure 2b

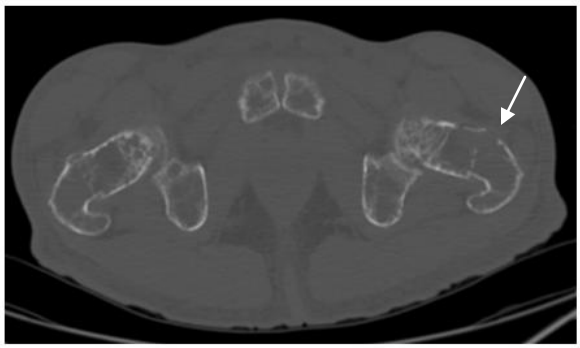

Figure 2c

Figure 2.
PET MIP image demonstrating multiple foci of abnormal radiotracer uptake (Figure 2a) within the left hip (black arrow), right humerus (blue arrow), and right pubic body (red arrow). A focus of uptake is present in the right forearm secondary to the injection of the radiotracer. Physiologic FDG uptake is present within the myocardium and bladder. A fused axial PET-CT image (Figure 2b) redemonstrates the abnormal radiotracer uptake within the left femoral neck (green arrow) and right pubic body (white arrow). There is an associated pathologic fracture through the left femoral neck (white arrow) on the corresponding axial CT image (Figure 2c).

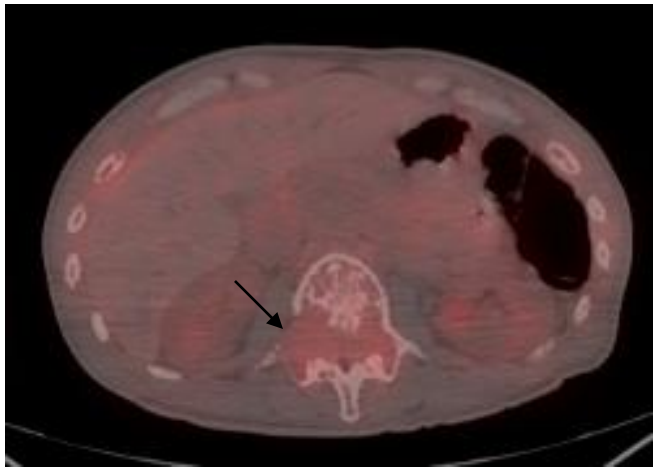

Figure 3

Figure 3.
Fused axial PET-CT image showing mild FDG uptake within the L2 vertebral body with an associated soft tissue component (arrow). The soft tissue component extends into the central spinal canal (please see Figure 4 for further details).

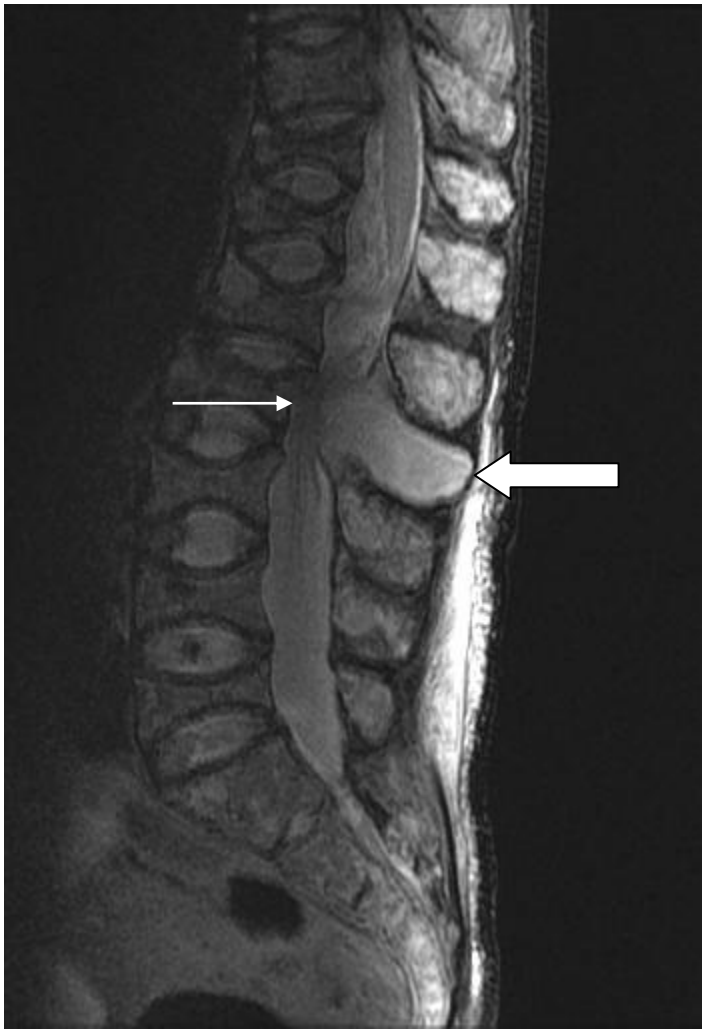

Figure 4

Figure 4.
Sagittal T2-weighted MR image with fat saturation demonstrates disruption of the posterior cortex of L2 with extension of the soft tissue tumor into the central canal (small arrow). This causes marked compression of the thecal sac at this level. Also seen is tumor involvement of the L2 spinous process (large arrow).

Discussion

Multiple myeloma is a malignant hematologic disorder that primarily occurs in bone marrow, but may also involve the soft tissues. It is the most common primary malignancy of bone and has an incidence of approximately 4 out of every 100,000 per year. The diagnosis and treatment of multiple myeloma has been based predominantly on the extent of bone involvement. Additional diagnostic criteria include the presence of monoclonal immunoglobulin in blood/urine, renal insufficiency, anemia, and hypercalcemia.

Skeletal survey radiographs are used for the initial imaging workup of patients with suspected multiple myeloma. In patients with a single plasmacytoma, magnetic resonance imaging is the modality of choice to search for additional lesions. While MRI and radiography are useful in the initial staging of disease, they are less sensitive and specific in differentiating between treated osseous lesions and residual neoplastic disease. FDG PET has been shown to assume this role.

FDG (fluorine 18 fluorodeoxyglucose) is a glucose analog which is taken up by metabolically active cells and remain trapped inside of the cells once they are phosphorylated by hexokinase. High uptake is present within neoplastic cells given their high metabolism. Therefore, FDG, which is a positron emitter, can be imaged using PET technology.

In patients with multiple myeloma, PET imaging is a valuable tool to stage patients with multiple myeloma and to search for radiographically occult lesions. One of the main roles of PET, however is to assess for a patient's response to therapy. In treated osseous lesions, decreased FDG uptake is demonstrated on the PET images. While MR imaging may also have a role in assessing response, the changes on PET are typically noted earlier and are easier to detect.

References

Bredella, M., Steinbach, L., Caputo, G., Segall, G., Hawkins, R. Value of FDG PET in the Assessment of Patients with Multiple Myeloma. *AJR*. 2005; 184:1199-1204.

Hanrahan, C., Christensen, C., Crim, J. Current Concepts in the Evaluation of Multiple Myeloma with MR Imaging and FDG PET/CT. *Radiographics*. 2010; 30:127-142.