

# Rheumatoid Arthritis Demonstrated on PET/CT as the Etiology of Hypercalcemia

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**A 60 YEAR-OLD WOMAN WITH A HISTORY OF** breast cancer status-post lumpectomy in 1997, hypothyroidism, rheumatoid arthritis, irritable bowel syndrome, and chronic fatigue syndrome was admitted to the hospital for hypercalcemia. At the time of admission serum chemistries were significant for elevated serum calcium of 11.1 mg/dL, decreased albumin of 2.5 g/dL, suppressed parathyroid hormone (PTH) of 6 pg/mL, elevated angiotensin converting enzyme (ACE) of 93 U/L, and elevated C reactive protein (CRP) of 13.4 mg/L. The patient was discharged after one day and referred to endocrinology.

A Technetium-99m-methylene diphosphonate bone scan was obtained to

assess for metastatic disease as an etiology of hypercalcemia and was remarkable only for left sided rib fractures without evidence of osseous metastatic disease (Figure 1). A chest CT was performed to assess for sarcoidosis, given the elevated serum ACE level, but did not show pulmonary parenchymal changes or adenopathy to confirm this diagnosis. A positron emission tomography/computed tomography (PET/CT) with 18F-fluorodeoxyglucose was then performed to assess for underlying malignancy (either breast cancer metastasis or another primary malignancy) or extrapulmonary sarcoidosis as the etiology of the patient's hypercalcemia. Maximum intensity projection (MIP) image (Figure 2), as well as axial and coronal images (Figure 3) from

the PET/CT scan showed increased activity at the atlantoaxial joint and symmetric markedly increased activity in the shoulders, scapulae, first costochondral joints, hips and ischia which were consistent with inflammatory changes from active rheumatoid arthritis. No additional abnormalities were seen on the PET/CT scan to indicate malignancy or sarcoidosis.

## DISCUSSION

Rheumatoid arthritis is a systemic inflammatory disorder which symmetrically affects both large and small joints. It is the most common inflammatory arthritis, and accounts for nine million physician visits in the US annually.<sup>1</sup> Direct correlation between markers of



Figure 1. Anterior (left) and posterior (right) planar images from a Tc99m whole body bone scan shows left sided rib fractures (arrows - confirmed on subsequent CT), but no evidence of osseous metastatic disease.



Figure 2. MIP image from an FDG-PET CT demonstrates symmetrically increased activity at the shoulders, scapulae, hips, first costochondral joints, and atlantoaxial joint, findings compatible with active rheumatoid arthritis.

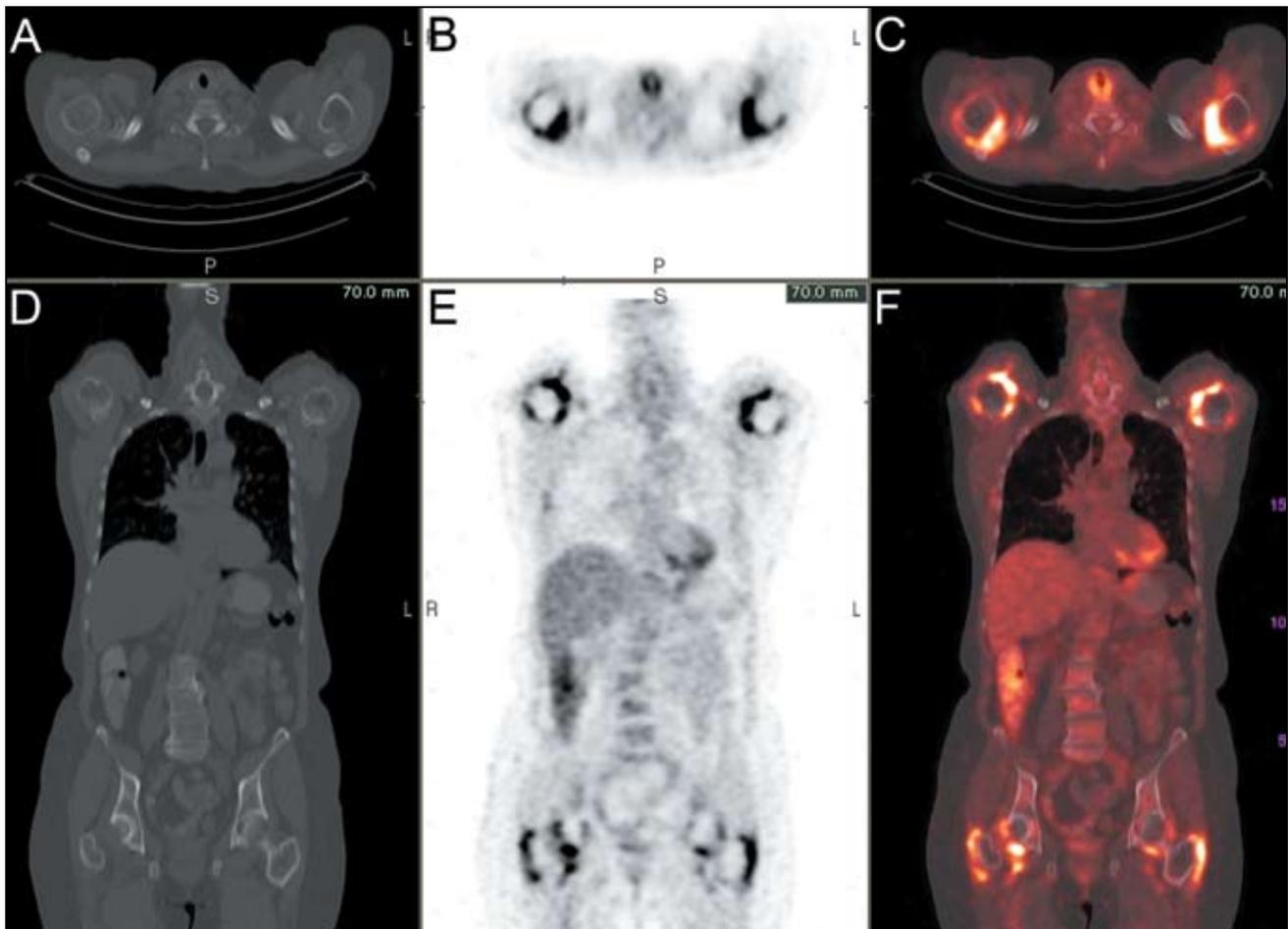


Figure 3. Axial CT (figure 3A) through the level of the shoulders showed no focal abnormalities, but axial PET (figure 3B) and fused PET/CT (figure 3C) images showed bilateral symmetric intensely increased activity around both shoulders. Coronal CT (figure 3D) also showed no significant abnormalities, but coronal PET (figure 3E), and fused PET/CT (figure 3F) images showed bilateral symmetric intensely increased activity around the shoulders and hips.

disease activity and serum hypercalcemia have been described, with the postulated mechanism involving the expression of inflammatory cytokines stimulating bone resorption, a similar mechanism to that responsible for hypercalcemia associated with malignancy.<sup>2</sup>

PET/CT with 18F-fluorodeoxyglucose is commonly used in the evaluation of many cancers due to increased glucose metabolism by a variety of tumors. Since there is also increased glucose utilization by most inflammatory processes, PET/CT will also typically identify sites of active inflammation and may be helpful for the evaluation of inflammatory disorders, although inflammatory processes are not currently considered reimbursable indications for PET/CT in the United States. Several authors have described the utility of PET/CT for rheumatoid arthritis in evaluation of disease activity, sites of in-

volvement, and evaluating the response to treatment.<sup>3,4,5,6</sup> PET/CT can also be useful in the evaluation of sarcoidosis, another systemic inflammatory disorder associated with hypercalcemia. Multiple reports have described the use of PET/CT in determining extent of this disease as well as evaluating response to treatment.<sup>7,8,9</sup> The appearance of rheumatoid arthritis on FDG-PET is quite different from that of sarcoidosis. Rheumatoid arthritis displays increased activity within the synovium of affected joints, as seen in this case, while sarcoidosis typically involves lymph nodes and the pulmonary parenchyma. PET/CT can be valuable for the diagnosis of inflammatory processes such as rheumatoid arthritis, however, more research is needed before there is sufficient evidence to support the routine use of PET/CT for inflammatory processes.

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#### **Disclosure of Financial Interests**

The authors and/or significant others have no financial interests to disclose.

Richard Noto, MD, discusses 18F-fluorodeoxyglucose use in inflammatory conditions.

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