Case Report

Imaging of A Single Malignant Osseous Involvement by F-18 NaF PET/CT

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Since the introduction of Tc-99m methylene diphosphonate (Tc-99m MDP) for bone imaging in 1971 by Subramanian and McAfee, bone scans have become one of the most widely used investigations in nuclear medicine for malignant osseous involvement.[1] After its introduction by Blau et al in 1962, F-18 NaF was recognized as an excellent radiopharmaceutical for skeletal imaging, several decades before the introduction of the PET system.[2,3]

In the early 1990s, Phelp et al used F-18 NaF as a model for the development of whole body PET because of the favorable skeletal kinetics of F-18 NaF.[3] It was reported that F-18 NaF PET/CT improved the clinician's ability to identify the presence and extent of bone metastases.[3] We report our first experience using this technique in localizing a single skeletal metastasis at Siriraj Hospital.

Case Report

A 34-year-old female with previous history of breast cancer was sent for a bone scan because of her complaint of lower back pain. A previous plain radiograph of the lumbar spine appeared unremarkable (Figure 1A). The whole body bone images were obtained at 3 hours after the intravenous administration of 20 mCi of Tc-99m MDP using a dual-head gamma camera (Infinia Hawk Eye: GE Healthcare). The study showed increased radioactivity uptake at the left aspect of L4 (Figure 1B) with suspicion of osseous metastasis.

One week after the bone scan, PET/CT images were performed at 60 minutes after the intravenous administration of 10 mCi of F-18 NaF using a Discovery PET/CT system (GE Healthcare). Low-dose CT acquisition was performed first with 140 kV, 80 mA, 0.8 seconds per CT rotation, a pitch of 6 and a table speed of 22.5 mm/second. A PET emission scan was performed immediately after acquisition of the CT without changing the patient's positioning. Six bed positions were performed with an acquisition time of 3 minutes per bed from vertex to mid thigh. PET images were reconstructed using an ordered-subsets expectation maximization algorithm. CT data were used for attenuation correction. Studies were interpreted on a Xeleris workstation. PET image clearly showed abnormal activity at the left lateral aspect of the vertebral body of L4 (Figure 1C). CT part of the PET/CT images showed an osseous destruction at the corresponding site of abnormal activity, indicating an osseous metastasis.

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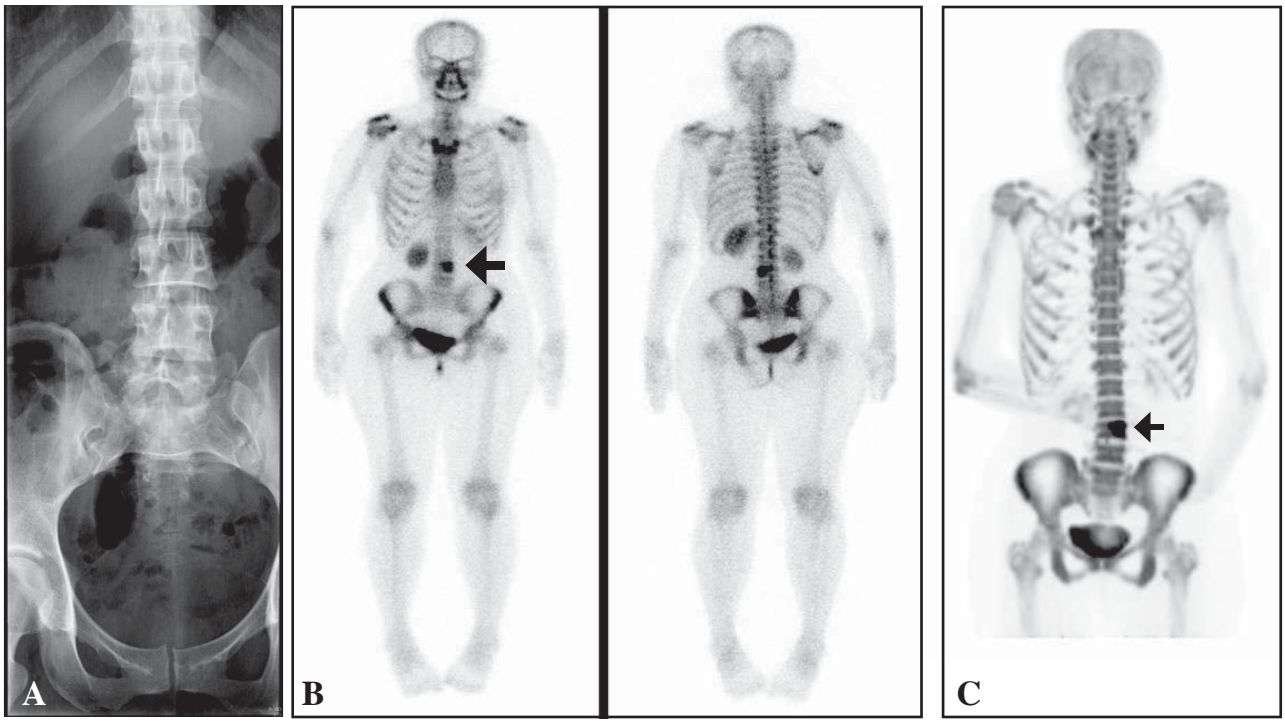

Figure 1*: A. Radiograph of lumbar spine shows unremarkable findings.*
B. Anterior and posterior whole body bone scan (Tc-99m MDP) show increased radioactivity uptake at left aspect of L4 (arrow).
C. Anterior whole body PET/CT (F-18) shows increased radioactivity uptake at left aspect of L4 (arrow).

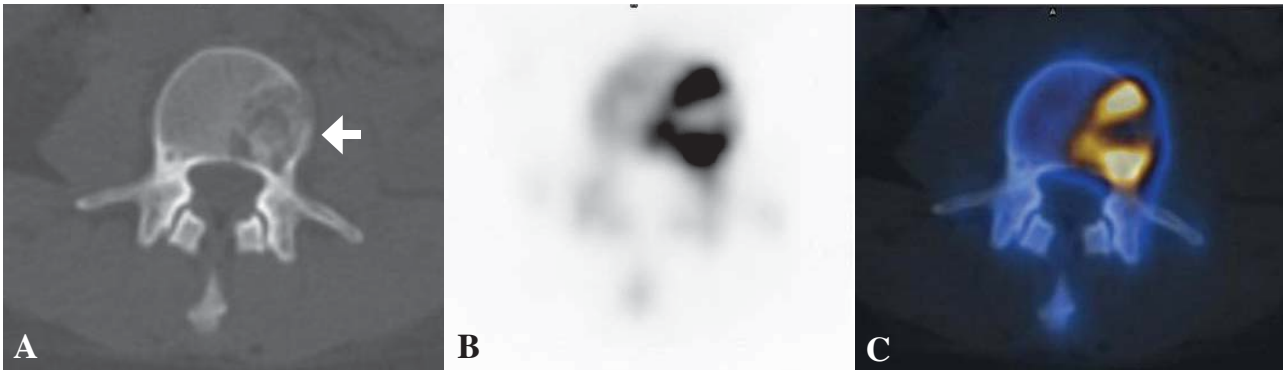

Figure 2: *A. CT part of PET/CT image shows osseous destruction at vertebral body of L4 (arrow) (Same patient as fig. 1C).*
B. PET scan shows abnormal activity at the corresponding osseous destruction.
C. Fusion PET/CT of the osseous metastasis.

Discussion

Schirrmeister, et al.[4] reported 80-90% sensitivity of the planar bone scan for the detection of peripheral skeletal metastases, however the sensitivity for detection of vertebral metastases is only 20-40%. Because the planar bone scan has variable sensitivity and low specificity, there is a recommendation to perform SPECT of the entire spinal column in patients at high risk for bone metastases.[4] The major advantages of SPECT are that it allows direct correlation with anatomic lesions, improves interpreter confidence and diagnostic accuracy.[5] The major drawback of bone SPECT is the long acquisition time (25 to 30 minutes per field of view). PET/CT technique can offer whole body tomographic images so it provides higher spatial resolution and improves anatomic detail. In our patient, F-18 NaF PET/CT accurately characterized a single osseous metastasis even though this lesion was indeterminate on the planar bone scan and not demonstrated by plain radiograph. Last but not least, this technique uses a shorter imaging time (one hour) as compared to Tc-99m MDP bone scan (3-4 hours) so it may

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be more convenient for the patient, who will experience less emotional and physical stress due to a long wait.

F-18 NaF PET/CT may be an alternative technique for characterizing benign and malignant disease of the skeleton as it can provide higher quality imaging, increase clinical accuracy and provide greater convenience to the patients.

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