NaF18-PET/CT Imaging of Secondary Hyperparathyroidism

Aung Zaw Win • Carina Mari Aparici

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The patient was a 59-year-old man with a history of hypertension and end-stage renal disease (ESRD), undergoing hemodialysis for 14 years. The patient did not have any complaints of bone pain, joint pain, fever or weight loss. The lab values at the time of imaging were calcium 8 mg/dl (normal, 8.5–10.5 mg/dl), phosphorus 2.9 mg/dl (normal, 2.5–4.5 mg/dl), alkaline phosphatase (ALP) 1,042 U/l (normal, 44–147 U/l), bone-specific alkaline phosphatase 146 µg/l (normal, 6.5–20.1 µg/l), parathyroid hormone (PTH) 775.3 pg/ml (normal, 15–88 pg/ml), creatinine 6.55 mg/dl (normal, 0.6–1.3 mg/dl). An NaF-18 positron emission tomography/computed tomography (PET/CT) bone scan was ordered to rule out osteosarcoma or other possible bone malignancies (Fig. 1). Diffuse increased bone remodeling was seen throughout the skeleton, including the proximal and distal skeleton. The calvarium is thickened with increased osteoblastic activity. There was a “rosebead” pattern of uptake at the costochondral junction and increased uptake near the vertebral endplates. No suspicious lesions are present to suggest osseous metastatic disease or primary malignant bone tumor. A lesion representing a brown tumor was observed on the left femoral shaft. He is currently being treated with cinacalcet, hectorol, cholecalciferol and sevelamer.

Secondary hyperparathyroidism is a frequent complication in patients with ESRD [1]. The incidence of ESRD is about 400 cases per million in the United States and it has risen fastest in older individuals [1]. The incidence of renal osteodystrophy is unknown, but almost 325,000 Americans are on dialysis therapy [2]. Renal osteodystrophy encompasses four types of bone disease: secondary hyperparathyroidism, osteomalacia, mixed renal osteodystrophy and adynamic bone disease [3]. This is the second paper to report the use of NaF18-PET/CT to image secondary hyperparathyroidism [4]. Bone turnover is markedly increased in secondary hyperparathyroidism. The skull and the spine are common locations to visualize secondary hyperparathyroidism. In general, high levels of PTH (>400 pg/ml) and ALP (>1,000 U/l) are accompanied by bone pain and other skeletal symptoms [5]. The skeletal complications are most commonly reported in the cervical and lumbar spine [6]. Older patients tend to experience more bone pain than younger patients in hyperparathyroidism [7]. Even though our patient had high levels of ALP, he did not have any skeletal complaints. Brown tumors are found in both primary and secondary hyperparathyroidism and they are rare in developed countries [8, 7]. Brown tumors are detected as early as 2 years after starting dialysis and they can regress spontaneously after the control of hyperparathyroidism [9, 10].

PET scans have higher spatial resolution and a greater sensitivity than gamma cameras and offer direct quantification of bone imaging studies [11]. Even though secondary hyperparathyroidism has similar appearances on Tc99m-methylene diphosphonate (MDP) bone scan and NaF18-PET/CT, the latter has superior qualities. NaF18 has twofold tracer accumulation in the skeletal system compared with Tc99m-MDP and unlike Tc99m tracer, there is no protein binding for NaF18

This work was performed at the San Francisco VA Medical Center, 4150 Clement Street, San Francisco, CA 94121, USA

A. Z. Win (✉)
Department of Radiology, San Francisco VA Medical Center,
4150 Clement Street, San Francisco, CA 94121, USA
e-mail: aungzwin@gmail.com

C. M. Aparici
Department of Radiology, University California San Francisco
(UCSF), 500 Parnassus Ave, San Francisco, CA 94143, USA
e-mail: Carina.Mari@ucsf.edu

Fig. 1 NaF-18 PET/CT bone scan of the patient. **a** Anterior and **b** left lateral views from NaF18-PET/CT maximum intensity projection (MIP)

[12]. Thus, NaF18-PET/CT is useful in detecting metabolic bone disease associated with secondary hyperparathyroidism. Additionally, NaF18-PET/CT can be used to evaluate response to therapy in patients with renal osteodystrophy [12]. Our case demonstrated that secondary hyperparathyroidism should be given high consideration in cases with chronic renal failure and rising alkaline phosphatase levels, even in the absence of bone pain.

Conflicts of Interest Aung Zaw Win and Carina Mari Aparici declare that they have no conflicts of interest.

Ethical Statement All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000. The manuscript does not contain clinical studies or patient data.

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