Use of NaF-18-Positron Emission Tomography/Computed Tomography in the Detection of Bone Metastasis from Papillary Renal Cell Carcinoma

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Abstract

We present a case of a 60-year-old white male with a history of papillary renal cell carcinoma (PRCC) status postpartial nepherectomy. He was followed-up annually with abdominal computed tomography (CT) scans to monitor for tumor recurrence. A solitary metastatic bony lesion was detected by CT 4 years after partial nephrectomy and it was confirmed by NaF-positron emission tomography (PET)/CT and magnetic resonance imaging. He underwent external beam radiation therapy (XRT) for solitary metastasis to L1 vertebra. The L1 lesion was treated with XRT, which exhibited no fluorodeoxyglucose activity after the treatment. This is the first case report to mention the use of NaF-18-PET/CT in the detection of bone metastasis from PRCC. Our case once again emphasizes the usefulness of NaF-18-PET/CT in RCC follow-up.

Keywords: Bone metastasis, NaF-18-positron emission tomography/computed tomography, papillary renal cell carcinoma, partial nephrectomy

Introduction

To the best of our knowledge, this is the first report in the English language literature which mentions the use of NaF-18-positron emission tomography/computed tomography (PET/CT) bone scan for papillary renal cell carcinoma (PRCC).[1] RCC represents about 2.6% of all adult cancers. In the US., approximately 56,000 cases of RCC are diagnosed and 13,000 deaths occur annually.[2] The peak incidence is in the sixth decade of life. PRCC represents 5-15% of all RCCs.[3] Hematuria is the most common symptom of this type of cancer. Other symptoms include flank pain, abdominal mass, fever, cough and bone pain. Laboratory abnormalities can include anemia and hypercalcemia and they are identified as poor prognostic factors. The most common sites of distant metastases are lung, bone, skin, liver, and brain.[3]

For RCC with widespread metastasis, no effective chemotherapy is available. Partial nephrectomy is indicated for patients with a single renal cortical tumor.[3] Elective partial nephrectomy is equivalent to radical nephrectomy in patients with stage T1 RCC.[3] Tumors confined to the renal capsule (T1-T2 stage) have a 5 years disease free survival of 90-100% after radical nephrectomy. 25% of patients with RCC will die from their cancer, compared with the 20% or lower mortality rates for prostate and bladder cancers.[3]

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Case Report

Our patient is a 60-year-old white male with a history of hepatitis C infection and liver cirrhosis. RCC was diagnosed incidentally on abdominal CT ordered for liver cancer screening. He underwent subsequent partial nephrectomy in 2005. Surgical pathology report revealed PRCC Fuhrman Grade 3 (T1bN0M0). The patient was

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follow-up with annual CT exams. On a CT exam in 2009, a solitary sclerotic lesion was found on the L1 vertebra. A NaF-18-PET/CT whole body bone scan was ordered for further workup. The bone scan revealed increased osteoblastic activity in a single sclerotic lesion within the anterior L1 vertebral body with no other suspicious osseous lesions [Figure 1]. The patient had an additional magnetic resonance imaging (MRI) study to further rule out widespread metastasis. The MRI showed 2.3 × 1.2 enhancing lesion in the anterior third of the L1 vertebral body [Figure 2]. The case was presented to the tumor board and the decision was made to start external beam radiation therapy (XRT) to L1. The lesion remained stable on follow-up CT exams. An MRI study was performed in 2012 to monitor the lesion and it showed a lesion of mild heterogeneity at L1suggestive of fatty infiltration, which is a known consequence of radiation therapy [Figure 2]. An fluorodeoxyglucose (FDG)-PET/CT study with lasix protocol was performed in 2012 as a postradiation therapy follow-up. Increased FDG activity (SUVmax = 9.1) was seen along the suture lines and also in the soft tissue area in the right paraspinal region adjacent to a surgical clip [Figure 3]. There was no interval change in size for the sclerotic bone lesion at L1 and it did not show increased metabolic activity [Figure 4]. There were no physical symptoms or laboratory abnormalities at the time of the FDG-PET/CT study.

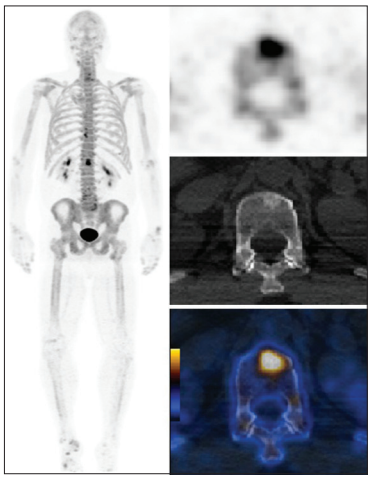

Figure 1: NaF-18-PET/CT images showing increased sclerotic activity within the anterior L1 vetebral body

Discussion

Lytic lesions are more common in RCC but in this case, there was a solitary sclerotic lesion on L1. Papillary tumors tend to be bilateral and multifocal and single isolated metastases as in our case are rare. RCC can spread hematogenously via the renal vain. Approximately, 25-30% of patients have evidence of metastatic disease at presentation.[4] In our patient, RCC was found incidentally on CT in an early stage. It is 2 times more common in males than in females. The incidence and mortality of RCC is higher in African Americans than in whites.[2] Our patient had no family history of cancer and he had no history of smoking.

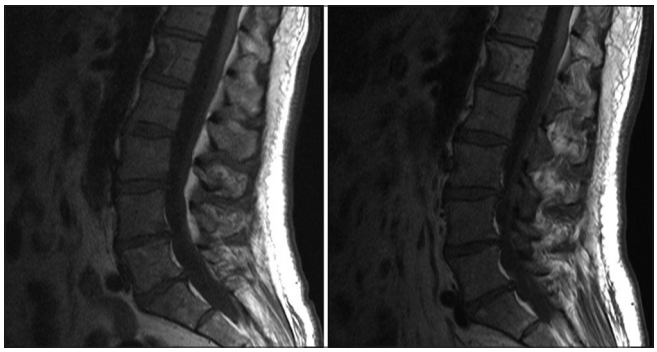

Figure 2: T2-weighted sagittal MRI images of L1 vertebra before XRT (left) and after XRT (right)

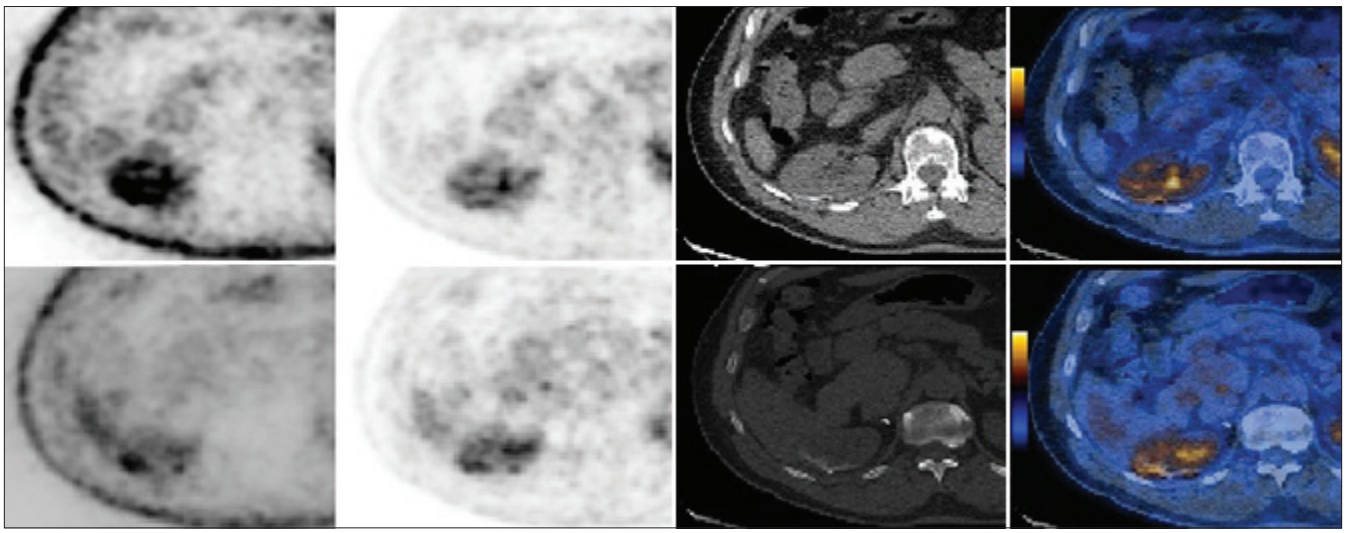

Figure 3: FDG PET/CT images showing the recurrence of PRCC along the surgical margins after partial nephrectomy

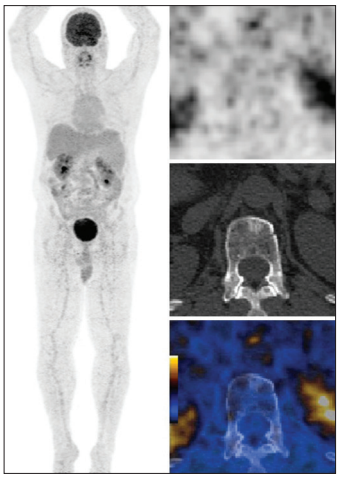

Figure 4: NaF-18-PET/CT images of the L1 lesion exhibit no FDG activity after XRT

For Caucasians, there is a strong association between smoking and RCC. Lane and Gill found that the majority (97%) of patients in their study with T1 stage RCC who underwent partial nephrectomy had 7 years of metastasis-free survival.[4] Our patient was diagnosed with T1 RCC and had a solitary metastasis 4 years after partial nephrectomy.

With increased use of CT in clinical practice, more and more RCC are being discovered incidentally in early stages. RCC can present as hypo, iso or hyperdense mass on unenhanced CT and it shows significant postcontrast enhancement. Moreover, it may or may not be calcified and can appear as heterogeneous or homogeneous.[5] Thus, RCC can be quite difficult to assess by CT. Other noninvasive imaging techniques are needed.

NaF-18-positron emission tomography/computed tomography can more correctly identify bone lesions as benign or malignant.[6] It has the advantage of being able to image the whole body in one exam. NaF-18-PET/CT bone scan is more sensitive than technetium 99m-methylene diphosphonate (Tc-99m-MDP) bone scan.[7] NaF-18-fluoride has double the bone uptake and faster blood clearance than Tc-99m labeled phosphonate compounds, and so, it provides a better quality image.[8] This type of bone scan can create high bone-to-background ratio in a short time. Thus, it is very suitable for skeletal exams to rule out bone pathologies.[9] Unlike Tc-99m tracer, there is no protein binding for NaF-18.[10] NaF-18-PET/CT bone scan has less radiation exposure than Tc-99m-MDP SPECT/CT.[10] No limitations to diet or physical activity are required for this exam, whereas, for FDG-PET/CT, the patient has to limit physical activity to avoid increased FDG uptake by the muscles.[10]

Conclusion

Our case proved that RCC can have osteoblastic in nature, which can be easily identified by NaF-PET/CT. We support the use of NaF-18-PET/CT in the management of RCC.

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