18F-PSMA-1007 PET/CT Detects Micrometastases in a Patient With Biochemically Recurrent Prostate Cancer

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Clinical Practice Points

- To date, several radioactive tracers for imaging primary and recurrent prostate cancer are undergoing active investigation.
- In this case report fluorine-18 (^{18}F)–prostate-specific membrane antigen (PSMA)-1007 positron emission tomography (PET)/computed tomography imaging was performed, to our knowledge, for the first time in a patient with biochemical recurrence (prostate-specific antigen [PSA] 0.08 μg/L) after radical prostatectomy and adjuvant radiation.
- Seventeen lymph nodes with increased tracer uptake along the retroperitoneum and iliac arteries were detected. Therefore, early treatment with intermittent androgen deprivation was initiated instead of locoregional salvage therapy.
- Hence, ^{18}F-PSMA-1007 PET imaging at very low PSA levels provided critical information to correctly restage disease.

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Introduction

Radiotracer-labeled prostate-specific membrane antigen (PSMA) targeting positron emission tomography (PET) revolutionized prostate cancer imaging. In the following case study we evaluated the new fluorine-18 (^{18}F)-PSMA-1007 tracer, to our knowledge, for the first time, in a patient with biochemical recurrence.

Case

In August 2016, a 79-year-old man was referred to our clinic, with the request for restaging of prostate cancer because of slowly rising prostate-specific antigen (PSA) levels 9 years after radical prostatectomy and adjuvant radiotherapy. Technetium 99m-methyl diphosphonate whole body bone scan, computed tomography (CT) and magnetic resonance imaging (MRI) of the abdomen and pelvis revealed no remarkable pathological finding.

In March 2007, the patient was diagnosed with intermediate-risk prostate cancer and prostatectomy was performed, which presented with positive margins (pT3a, N0, M0; Gleason score 4+3; positive margins with tumor infiltration at the apical left site of the prostate). Adjuvant radiotherapy was administered to the prostatic bed with 60 Gy in 30 fractions. The PSA level decreased from 5.3 before to 0.03 ng/mL after surgery. Regular laboratory tests showed a gradual increase of PSA levels up to 0.08 ng/mL in July 2016, suggesting vital tumor tissue somewhere that might be amenable to salvage therapy such as stereotactic body radiation or high-intensity focused ultrasound, if found.

After multidisciplinary discussion we decided to perform PET/CT imaging with the ^{18}F-labeled PSMA-targeted radioligand PSMA-1007, an experimental molecular PET radiotracer, which has been described to have higher detection rates compared with standard morphological imaging modalities such as CT and MRI.[1]

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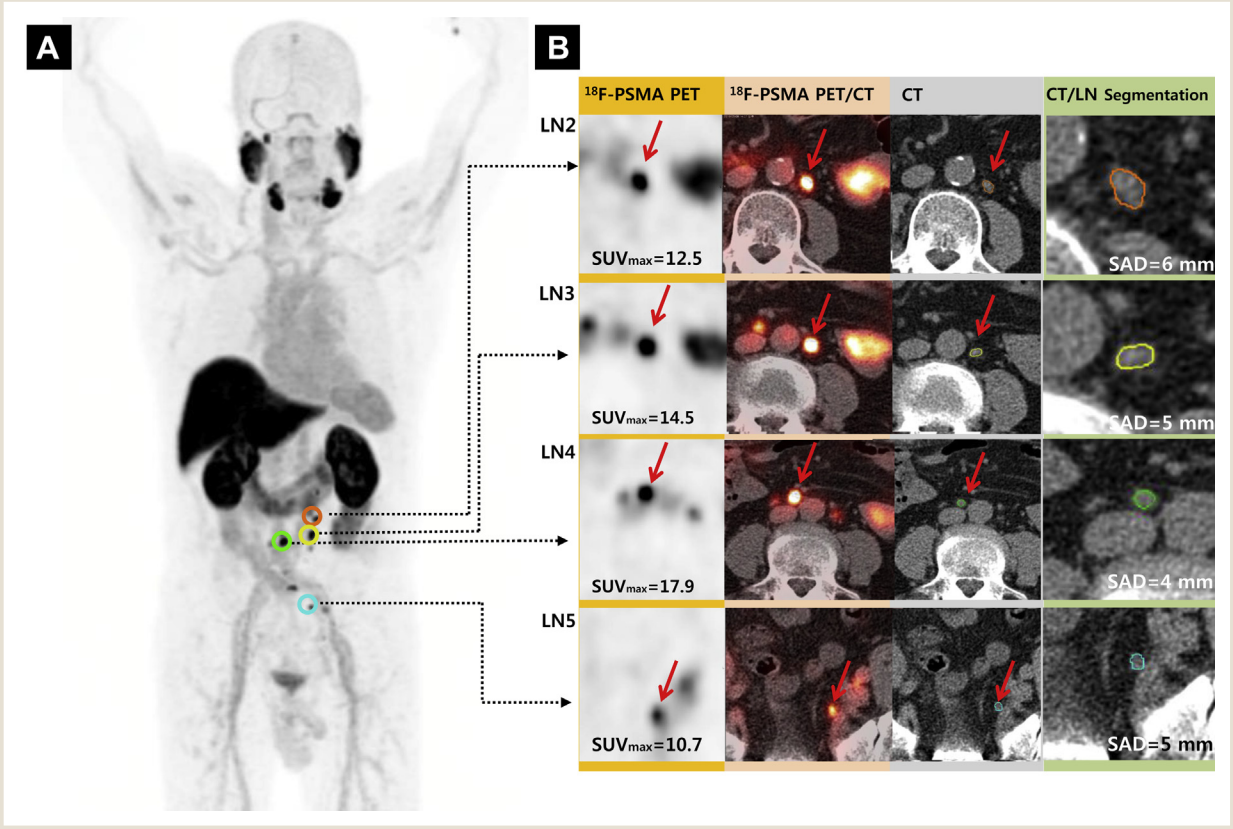
Figure 1 (A) Fluorine-18 (^{18}F)-Prostate-Specific Membrane Antigen (PSMA)-1007 Maximum Intensity Projection-Positron Emission Tomography (PET)/Computed Tomography (CT) in a Patient With Biochemical Recurrence After Prostatectomy Presented Lymph Nodes With Increased ^{18}F-PSMA-1007 Uptake, Consistent With Lymph Node Metastases. All ^{18}F-PSMA-1007 Positive Lymph Nodes (B) Were Under CT-Morphological Detection Rate; in Contrast All Lymph Nodes Presented a High PSMA-1007 Uptake in PET



Abbreviation: SUV = standardized uptake value.

The patient underwent ^{18}F-PSMA-1007 PET/CT imaging and, surprisingly, 17 lymph nodes were detected with increased PSMA uptake (n = 17; median = standardized uptake value (SUV) max = 7.71; maximum = 18.8/minimum = 3.2) along the retroperitoneum and iliac arteries, which were consistent with prostate cancer recurrence. An automated segmented volumetric analysis was applied to measure the sizes of ^{18}F-PSMA-1007-positive lymph nodes. All were below the morphological detection limit and thus could be not considered as lymph node metastasis according to Response Evaluation Criteria in Solid Tumors criteria (n = 17; median = 4.6 mm; maximum = 6.6/minimum = 3.2 mm; Figure 1). Because of ^{18}F-PSMA-1007-positive prostate cancer spread along the lymph nodes, the patient was classified as M1. Therefore, early treatment with intermittent androgen deprivation was initiated instead of locoregional salvage therapy.[2,3]

Discussion

In patients with biochemical recurrence localization of recurrent prostate cancer is essential for further therapy planning. Conventional cross-sectional imaging or bone scintigraphy shows only limited detection rates in these cases, especially at low serum PSA values.[4] Therefore, several radioactive tracers for improved imaging of recurrent but also primary prostate cancer are under active investigation.[5-9] PSMA radioligands have been presented so far as the most sensitive and specific with regard to prostate cancer detection, in particular in high-risk prostate cancer patients. For the most commonly used ^{68}Ga-PSMA-11 radioligand, detection rates of 50% to 57.9% are described in patients with biochemical recurrence and serum PSA levels < 0.5 ng/mL.[10,11] Nevertheless, ^{18}F-PSMA-1007 does have some advantageous characteristics: ^{18}F is produced by a cyclotron facilitating a higher available amount of radioisotope compared with generator-capacity bound ^{68}Ga-PSMA. Its low positron emission energy results in a higher image resolution and its partially hepatobiliary elimination might ease the evaluation of the prostate bed and pelvis.[12,13] In this case report ^{18}F-PSMA-1007 was used, to our knowledge, for the first time, in a patient with biochemically recurrent prostate cancer and 17 lymph nodes were detected with increased PSMA uptake at a PSA serum level of 0.08 ng/mL implying major potential for staging recurrent prostate cancer.

Conclusion

Novel ^{18}F-PSMA-1007 PET imaging at very low PSA levels provided critical information to correctly restage disease and to discuss appropriate treatment options.

Acknowledgments

Written informed consent was obtained from the patient.

Disclosure

J.C., F.L.G., U.H., and K.K. disclose a patent application for PSMA-1007. The remaining authors have stated that they have no conflicts of interest.

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