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Diagnosing small bowel carcinoid tumor in a patient with oligometastatic prostate cancer imaged with PSMA-Targeted [^{18}F] DCFPyL PET/CT: Value of the PSMA-RADS-3D Designation

Eugene Shenderov [a], Michael A. Gorin [a, b, c], Seohyun Kim [a], Pamela T. Johnson [c], Mohamad E. Allaf [b], Alan W. Partin [b], Martin G. Pomper [a, b, c, d], Emmanuel S. Antonarakis [a], Kenneth J. Pienta [a, b, d], Steven P. Rowe [b, c, *]

[a] Department of Medical Oncology, Sidney Kimmel Comprehensive Cancer Center, Johns Hopkins School of Medicine, Baltimore, MD, United States
[b] The James Buchanan Brady Urological Institute and Department of Urology, United States
[c] The Russell H. Morgan Department of Radiology and Radiological Science, United States
[d] Department of Pharmacology and Molecular Sciences, United States

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ABSTRACT

Radiotracers targeting prostate-specific membrane antigen (PSMA), including [^{18}F]DCFPyL, have been extensively investigated as a means to image prostate cancer more accurately. We present the case of a man with oligometastatic prostate cancer who was also diagnosed with a metastatic small bowel carcinoid tumor following the detection of indeterminate findings on a [^{18}F]DCFPyL PET and discuss how this case highlights the utility of a newly proposed reporting system for PSMA-targeted PET (PSMA-RADS version 1.0).

Introduction

Prostate-specific membrane antigen (PSMA) is a cell surface protein that is highly expressed on prostate cancer epithelial cells; as such, it has been extensively studied as a target for the molecular imaging of prostate cancer.[1] As PSMA-targeted imaging with small molecule radiotracers appropriately labeled for positron emission tomography (PET) has become widespread throughout much of the world, the interpretive pitfalls of this new imaging modality have begun to come to light.[2] Among these pitfalls are findings that have radiotracer uptake but represent a process other than prostate cancer, including non-prostate malignancies,[3] and important findings that lack radiotracer uptake but demonstrate abnormalities on accompanying anatomic imaging.[4] The proper management of patients being imaged with PSMA-targeted PET will often rely on the correct interpretation of these pitfalls, and for this purpose our group has recently proposed a systematic method (PSMA-RADS Version 1.0) to categorize findings on PSMA-targeted PET including recommendations for appropriate follow-up.[5]

In the following report, we present the case of a patient with high-risk prostate cancer who presented for a systemic staging examination with the PSMA-targeted radiotracer [^{18}F]DCFPyL and was found to harbor a second malignancy that was not radiotracer avid. The importance of recognizing suspicious findings on anatomic imaging that lack radiotracer uptake and the utility of PSMA-RADS in this context are highlighted.

Case presentation

A 65 year old man presented with a prostate specific antigen (PSA) level of 5.7 ng/mL. Prostate biopsy showed Gleason 4 + 4 = 8 adenocarcinoma, and a digital rectal examination was consistent with stage T1c disease. Consistent with NCCN guidelines for high risk patients (Gleason ≥8) a staging computed tomography (CT) scan was obtained and showed an enlarged 2.0 cm short axis lymph node between the common iliac vasculature just below the aortic

* Corresponding author. Division of Nuclear Medicine and Molecular Imaging, The Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, 601 N. Caroline St., Baltimore, MD, United States.
E-mail address: srowe8@jhmi.edu (S.P. Rowe).

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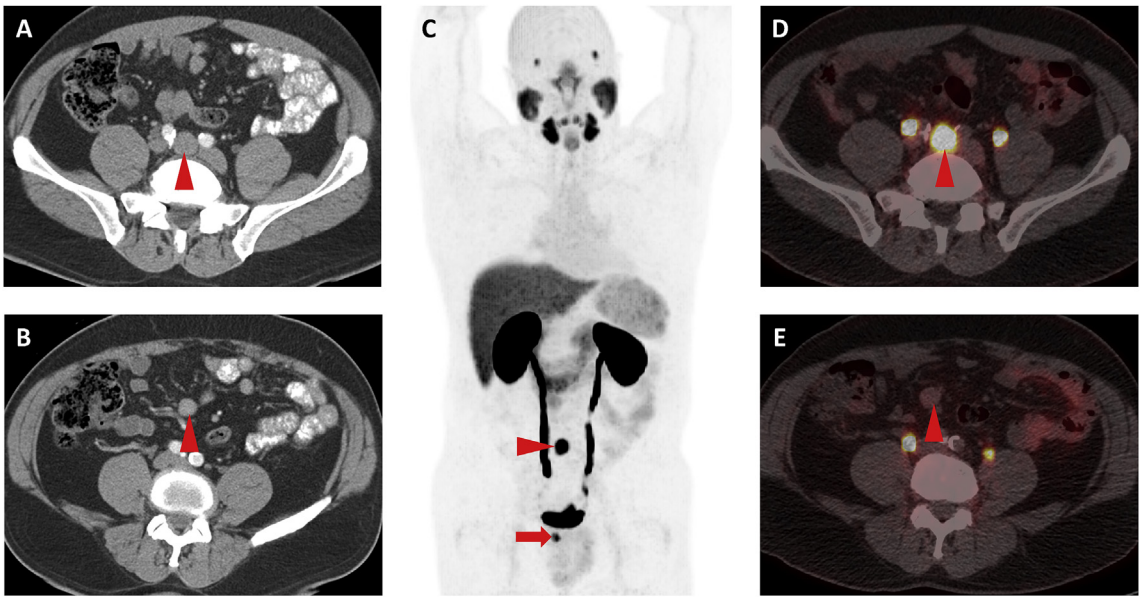

Fig. 1. (A) Axial contrast-enhanced CT image through the upper pelvis, inferior to the aortic bifurcation, demonstrating an enlarged (2.0 cm short axis) lymph node between the common iliac vasculature (arrowhead). (B) More superiorly, an axial contrast-enhanced CT image demonstrates mesenteric adenopathy with lymph nodes measuring up to 1.6 cm in short axis (arrowhead). (C) Maximum intensity projection image from a [^{18}F]DCFPyL PSMA-targeted PET study in which the lymph node inferior to the aortic bifurcation shows intense radiotracer uptake (arrowhead) and the patient's primary prostate cancer is also visible (arrow). Although there is overlapping small bowel with normal radiotracer uptake, there is no focal central abdominal uptake to suggest that the mesenteric adenopathy is radiotracer-avid. (D) Axial PET/CT fused image from the [^{18}F]DCFPyL study again showing the intense uptake in the lymph node inferior to the aortic bifurcation (arrowhead). (E) Axial PET/CT image from the [^{18}F]DCFPyL study at the level of the mesenteric adenopathy demonstrates no radiotracer uptake above background (arrowhead).

bifurcation (Fig. 1A), resulting in a diagnosis of oligometastatic disease. Additionally, the same imaging study revealed an enlarged and hyperenhancing mesenteric lymph node measuring 1.6 cm in short axis (Fig. 1B). A technetium-99 m methylene diphosphonate bone scan was negative for osseous disease. A PSMA-targeted PET study as part of clinical trial NCT02151760 in advanced prostate cancer patients, employing the investigational agent [^{18}F]DCFPyL, was ordered and demonstrated intense radiotracer uptake fusing to the iliac lymph node (Fig. 1D), but no uptake above background at the level of the mesenteric node (Fig. 1E).

The patient's prostatectomy was postponed due to his oligometastatic disease (T1c, N1, M1; stage IV), and the patient began chemohormonal therapy with docetaxel, leuprolide, and abiraterone with a plan to undergo subsequent cytoreductive prostatectomy. After chemotherapy, IV contrast-enhanced CT revealed a notable decrease in size of the PSMA-positive inferior iliac node from 2.0 cm to 0.8 cm in short axis (Fig. 2A), but unchanged size of the mesenteric node (Fig. 2B). As the PSMA scan described above was a research study and not clinically approved to guide treatment, the mesenteric node was treated as still being likely prostate carcinoma based on best available clinical data. The patient underwent radical prostatectomy with bilateral pelvic lymph node dissection and excisional biopsy of the mesenteric lymph node. Pathology from the prostatectomy specimen confirmed adenocarcinoma positive for NKX3.1 and PSMA with extensive treatment effect, negative surgical margins, and ypT2 disease with negative pelvic lymph nodes (0/11). The mesenteric lymph node was found to be sclerotic and negative for all prostate lineage markers: PSMA, NKX3.1, PSA, and p501s. This then prompted concern for a secondary gastrointestinal malignancy and the patient underwent upper endoscopy and colonoscopy; however both were negative. He then underwent adjuvant stereotactic radiotherapy to the previously noted PSMA positive inferior iliac node. Restaging contrast-enhanced CT imaging revealed an enhancing 2 cm polypoid mass in

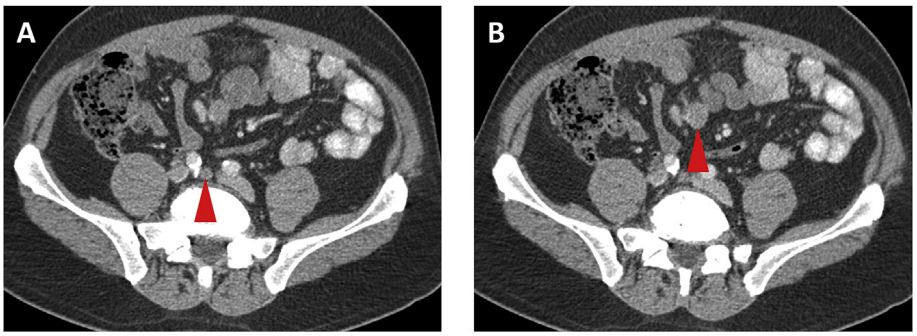

Fig. 2. (A) Follow-up, post-chemotherapy axial contrast-enhanced CT image showing treatment response in the lymph node inferior to the aortic bifurcation, with short axis measurement now 0.8 cm (arrowhead). (B) However, the mesenteric adenopathy remained unchanged after chemotherapy on the follow-up contrast-enhanced CT (arrowhead).