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Soft tissue metastasis of the penis detected by copper-64 labeled prostate-specific membrane antigen positron emission tomography (^{64}Cu–PSMA PET/CT) in a patient with prostate cancer

Cherin Farhan, Siroos Mirzaei*

Institute of Nuclear Medicine with PET-Center, Klinik Ottakring, Vienna, Austria

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ABSTRACT

Prostate cancer is considered to be the most common solid cancer affecting men worldwide and leading to a significant morbidity and mortality. Metastases are usually seen in bone or lymph nodes. For recurrent disease, PET imaging with ^{68}Ga-PSMA-11 (also known as HBED-CC, Glu-urea-Lys(Ahx)-HBED-CC, and PSMA-HBED-CC) is widely used. However, preparation of ^{68}Ga-PSMA ligand requires the presence of radiochemistry facilities and can therefore not be utilized in centers lacking such facilities. Recently, copper labeled prostate-specific membrane antigen positron emission tomography (^{64}Cu-PSMA PET/CT) demonstrated promising results in patients with recurrent disease and in the primary staging of selected patients with progressive local disease. In the present case, a rare manifestation site of a metastatic lesion in a patient with advanced prostate cancer is detected by ^{64}Cu-PSMA PET/CT.

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Introduction

Prostate cancer is considered to be the most common solid cancer affecting men worldwide and leading to a significant morbidity and mortality (1, 2). Serum prostate-specific antigen (PSA) is a well-established screening method for detecting prostate cancer. Once diagnosed, it is essential to accurately determine the tumor stage to enable a patient- and stage-tailored therapy. Choline-based radiopharmaceuticals have been largely replaced by PSMA (prostate-specific membrane antigen) ligands in PET/CT for detection of metastatic lesions of prostate cancer. Metastases are usually seen in bone or lymph nodes. For recurrent disease, PET imaging with Ga-PSMA-11 is widely used (3). However, preparation of ^{68}Ga-PSMA ligand requires the presence of radiochemistry facilities and can therefore not be utilized in centers lacking such facilities. Recently, copper labeled prostate-specific membrane antigen positron emission tomography (^{64}Cu-PSMA PET/CT) demonstrated promising results in patients with recurrent disease and in the primary staging of selected patients with progressive local disease (3). In the present case, a rare manifestation site of a metastatic lesion in a patient with advanced prostate cancer is detected by ^{64}Cu-PSMA PET/CT.

Case presentation

We describe the case of an 82 year old male patient with prostate cancer diagnosed 4 years prior to PET exam with an initial serum PSA of 30 µg/L. Due to the initial clinical tumor stage (cT3b) and Gleason score of 9, treatment with leuprolelin acetate was initiated and PSA serum level declined to 2.3 µg/L. Subsequently, radical prostatectomy with obturator lymph node dissection was performed. Postoperative tumor

* *Corresponding author:* Siroos Mirzaei. Institute of Nuclear Medicine with PET-Center, Klinik Ottakring-Vienna Montleartstrasse 37, A-1171 Wien, Austria. Tel.: 0043-1-49150-3608; Fax: 0043-1-49150-3609; Email: siroos.mirzaei@gesundheitsverbund.at

classification was pT3b, L0, V0, pN0 (0/2).

10 months later, whole-body bone scintigraphy revealed a suspect lesion in the lumbosacral region and radiation therapy with 70.2 Gy was carried out in the following 8 weeks. Moreover, systemic therapy with leuprolelin acetate was broadened by addition of enzalutamide and Denosumab .

Six months after radiation therapy a ^{64}Cu-PSMA PET/CT was performed due to elevation of serum PSA. 275 MBq of ^{64}Cu-PSMA-617 was administered intravenously. Whole body PET/CT images (Siemens Healthineers, Erlangen, Germany) were performed 1 hour post injection (p.i.) and additional images of the pelvis were obtained 2 hours p.i. multislice contrast-enhanced CT was acquired after intravenous administration of 100 mL nonionic iodinated contrast .

PET imaging was acquired from (3D) in flow motion mode. Maximum standardized uptake values (SUV_{max}) of the lesions were obtained by drawing circular regions of interest, which were automatically adapted (40% isocontour) to a 3D VOI using commercial software provided by the vendor. The subsequent images were reconstructed using the ordered subset expectation–maximization reconstruction algorithm (OSEM, 2i/21s).

Elevated metabolic activity was detected in the sacral region (S4) and in the soft tissue surrounding the penis base as well as in the left crus of the penis (Figure 1). Subsequently, palliative chemotherapy with docetaxel was initiated. The first ^{64}Cu-PSMA PET/CT follow up 5 months later showed new metastases in the sacral region (S2) as well as in the spina scapulae beside the metastases in the penis region. Despite intensifying of standard systemic therapy a significant disease progression with more metastatic lesions in the ischial, pubic bones and right scapula was detected three months later by ^{64}Cu-PSMA PET/CT (Figure 2). The PSA level increased from the first to the second PET/CT from 31 µg/L to 152 µg/L.

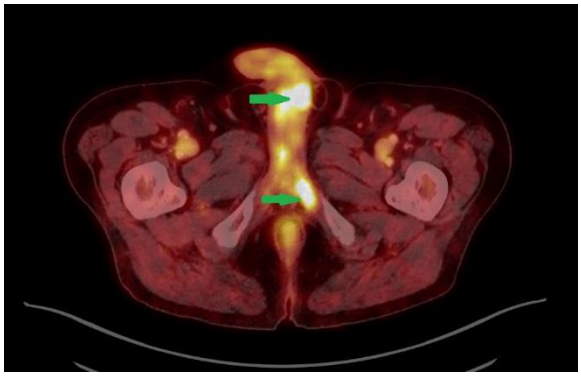

Figure 1. Primary ^{64}Cu-PSMA PET/CT showing enhanced metabolic activity in the the soft tissue surrounding the penis base as well as in the left crus of the penis (green arrows), PSA 31 µg/L

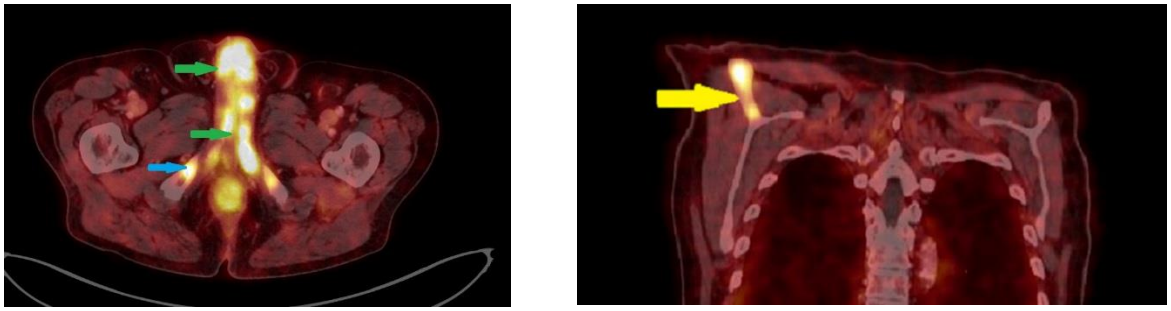

Figure 2. A) ^{64}Cu-PSMA PET/CT follow up: demonstrating a significant disease progression (green arrows), with more metastatic lesions in the Ischium dext (blue arrow), PSA 152 µg/L and **B**) new bone metastasis in the right scapula (yellow arrow)

Discussion

In the present case study, we could demonstrate penile metastatic spread of prostate cancer is a rare location using ^{64}Cu-PSMA PET/CT .

The use of ^{64}Cu was first evaluated with somatostatin ligand DOTATATE for neuroendocrine tumours (NET). More recent applications of ^{64}Cu-PSMA, ^{64}Cu-DOTATOC, ^{64}Cu-SARTATE were in the diagnosis, and pre-therapeutic dosimetry of NET and prostate cancer (4-7).

The longer half-life of ^{64}Cu with 12.7 hours compared to 68 minutes of ^{68}Ga enables clinical studies with delayed image acquisition with the potential of pre-therapy dosimetry calculations. Therefore, ^{64}Cu is suitable for pharmacokinetic studies with different agents (somatostatin analogs and monoclonal antibodies (mAbs), and PSMA) (5-8).

Additionally, ^{64}Cu emits positrons of favorably low energy (Eβ+av=278 keV) similar to 18F (Eβ+av=250 keV). Therefore, the image resolution is expected to be significantly better when compared to ^{68}Ga, which emits positrons of higher energy (Eβ+av=830 keV) (9). An important advantage of this imaging method is the long half-life of ^{64}Cu, which allows distribution of the tracer to other hospitals lacking radiochemistry facilities for the preparation of radiopharmaceuticals.

Conclusions

Penile metastatic spread of prostate cancer is very rare and in the present case it is detected using ^{64}Cu-PSMA PET/CT.

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