Ring Sclerosis in Prostate Cancer: Circle of malignancy or benignity?

Charles Marcus, MD, Yoram Baum, MD, Olayinka A. Abiodun-Ojo, MD, MPH, Ashesh B. Jani, MD, MSEE, FASTRO, David M. Schuster, MD, FACR

1Division of Nuclear Medicine and Molecular Imaging. Department of Radiology and Imaging Sciences. Emory University School of Medicine. Atlanta, GA, USA
2Winship Cancer Institute. Department of Radiation Oncology. Emory University School of Medicine. Atlanta, GA, USA

Abstract
Prostate cancer osteoblastic metastases may have different morphologies, and some of these may overlap with certain benign bone lesions. In this series of 5 prostate cancer patients, we describe bone lesions with central lucency and surrounding peripheral sclerosis, and their varying appearances on different imaging modalities. Although prostate cancer metastases are commonly associated with sclerotic lesions, they can also present as osteolytic or lucent lesions and these lesions should be carefully evaluated. The findings emphasize the importance of correlation with prior imaging, comparing findings on different imaging techniques and follow-up to differentiate benign disease from metastatic disease in these situations.

Keywords
Prostate Cancer; Osseous Metastases; \textsuperscript{68}Ga-PSMA; PET/CT; Bone scan; \textsuperscript{18}F-Fluciclovine; Ring sclerosis

Abbreviations:

\begin{itemize}
\item \textsuperscript{18}F fluorine-18
\item PSMA prostate specific membrane antigen
\item \textsuperscript{68}Ga gallium-68
\item WBS whole body scintigraphy
\item PET/CT positron emission tomography/computed tomography
\item SUV standardized uptake value
\end{itemize}
References


Figure 1.
$^{68}$Ga-PSMA PET/CT and bone scintigraphy images of a 53-year-old man with prostate adenocarcinoma. Axial CT (A) and axial fused $^{68}$Ga-PSMA PET/CT (B) images show focal uptake (SUVmax 5.5) corresponding to a lesion with a sclerotic ring involving the left 10th rib (white arrows). Posterior planar (D), axial CT (E), axial fused SPECT/CT (F) images of a bone scintigraphy study performed approximately 12 months prior demonstrates focal uptake of radiotracer uptake (white arrows) and compatible with a benign osseous fibrous dysplasia. $^{68}$Ga-PSMA uptake in benign bone lesions such as fibrous dysplasia has been described in patients undergoing studies for prostate cancer evaluation[1-4].
Figure 2.
Staging $^{18}$F-Fluciclovine PET/CT images of a 60-year-old man with prostate adenocarcinoma. Axial CT (A) and axial fused $^{18}$F-fluciclovine PET/CT (B) demonstrates focal radiotracer uptake (SUVmax 2.7) with a lesion in the left anterior superior iliac spine which demonstrates peripheral ring sclerosis (white arrows). Axial CT (C) and axial fused $^{18}$F-fluciclovine PET/CT (D) performed 2 years later demonstrates increase in the associated sclerosis and radiotracer activity (SUVmax 4.0) (black arrows) with rising serum PSA compatible with metastasis. Although prostate cancer osseous metastases are commonly associated with sclerotic lesions, they can also present as lucent lesions[5].
Figure 3.
74-year-old man with prostate adenocarcinoma. Axial fused $^{68}$Ga-PSMA PET/CT image (A) and axial CT image (B) demonstrates focal uptake (SUVmax 3.1) within a lesion demonstrating ‘ring sclerosis’ in the right 10th rib (white arrows). The axial fused $^{18}$F-fluoride PET/CT (C) demonstrates no significant radiotracer uptake greater than the background marrow uptake. Axial CT (D) of a cardiac CT examination performed approximately 3 years prior to the PET/CT studies demonstrates the lesion, confirming benignity.
Figure 4.
60-year-old man with biochemically recurrent prostate adenocarcinoma. Axial CT (A), axial fused $^{18}$F-fluciclovine PET/CT (B) demonstrates a lucent lesion with peripheral rim sclerosis in the left superior pubic ramus with increased radiotracer activity (SUVmax 4.8) (white arrows). Axial CT image (C) of a CT examination performed approximately 3 years later on ADT demonstrates increased sclerosis of the same lesion characteristic for healing bone metastasis. Prostate metastases demonstrate significant avidity on $^{18}$F-fluciclovine and $^{68}$Ga-PSMA imaging, and progressive increase in radiotracer uptake or treatment related changes may help in differentiating metastasis from benign disease[6,7].
Figure 5.
65-year-old man with prostate adenocarcinoma. Axial CT (A), axial fused $^{18}$F-fluciclovine PET/CT (B) demonstrates a lucent lesion with peripheral rim sclerosis in the right iliac crest with mild increased radiotracer activity (SUVmax 2.8) (white arrows). Axial CT (C), axial fused $^{99m}$Tc-MDP SPECT/CT (D) examination performed 6 months prior demonstrates identical morphology of the lesion with mild focal radiotracer activity (black arrows). Patient was treated with salvage radiotherapy to the prostate bed only and achieved undetectable PSA, proving benignity. $^{18}$F-fluciclovine uptake in fibrous dysplasia has not been investigated. $^{18}$F-fluciclovine uptake has been observed in benign osseous disease such as osteoid osteoma, musculoskeletal inflammation, among others[8].