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Case Presentation

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# Case Report: Tc99m-PSMA in a Patient with Metastatic Castration-Resistant Prostate Cancer with False-Positive Post Therapy Tc99m-MDP Bone Scan

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## Abstract

Prostate cancer is the most frequent cancer diagnosis in men and the third cause of cancer-related death in men in Peru. The detection of lesions with overexpression of PSMA receptors in metastatic prostate cancer cells is detectable with PET CT - PSMA, however due to its high cost and low availability in our country, we used the SPECT CT study with Tc99m- PSMA, which allows the localization of lesions with PSMA surface antigen expression, limiting the false positives that usually give conventional studies with SPECT CT with Tc99m - MDP. Bone scan usually present the flare phenomenon in those patients who have been irradiated and generate false positives in the control study, however with the use of Tc99m - PSMA we reduce false positives by evidencing the avidity of PSMA active tumor cells that over express it, avoiding unnecessary treatment.

## Introduction

Prostate Cancer (PCa) is the most frequent cancer diagnosis in men, and the third most common cause of cancer-related death in men in Peru [1]. In the last decade, Positron Emission Tomography (PET) targeting Prostate-Specific Membrane Antigen (PSMA) has become a substantial part of CaP imaging [2]. It is the method of choice for primary tumor staging, evaluation of lymph nodes and bone metastases, as well as in the identification of tumors in biochemical relapse and as a mandatory study prior to radionuclide therapy targeting PSMA [3,4]. However, PET/CT is not widely available, and the number of SPECT/CT gamma cameras worldwide exceeds the number of PET/CT scanners, and the overall instrumentation and radionuclide costs are higher than those of SPECT/CT, which has prompted the development of Tc99m-labeled PSMA-targeted

tracers as a cost-effective alternative for both imaging and radioguided surgery [5-7].

## Case Presentation

Male, 83 years old, diagnosed with prostate cancer, Gleason 7/10 since 5 years ago. He was treated with hormonal blockade and orchiectomy. The patient presents with pain in the left hip and lumbar region, PSA: 77.73 ng/ml, bone scan with Tc99m-MDP shows multiple metastatic foci in costal arches, dorsolumbar spine and pelvis. He started abiraterone acetate and received radiotherapy (50 Gy) in the lumbar spine and pelvis. In the follow-up a decrease in PSA was observed: 2.98 ng/ml and the control scintigraphy showed no significant changes. Six months later there was an increase in PSA: 10.9 ng/ml and bone scintigraphy showed increased uptake in lesions located in the left scapula, costal arches and dorsal spine; there were no significant changes in the lesions of the pelvis and lumbar spine **(Figure 1)**. A scintigraphic study was performed with Tc99m-PSMA which revealed positive findings concordant with the lesions located in the scapula, costal arches and dorsal spine, the uptake foci in the lumbar spine and pelvis seen in the bone scintigraphy were negative, no lymph node or visceral disease was evidenced **(Figure 2)**.

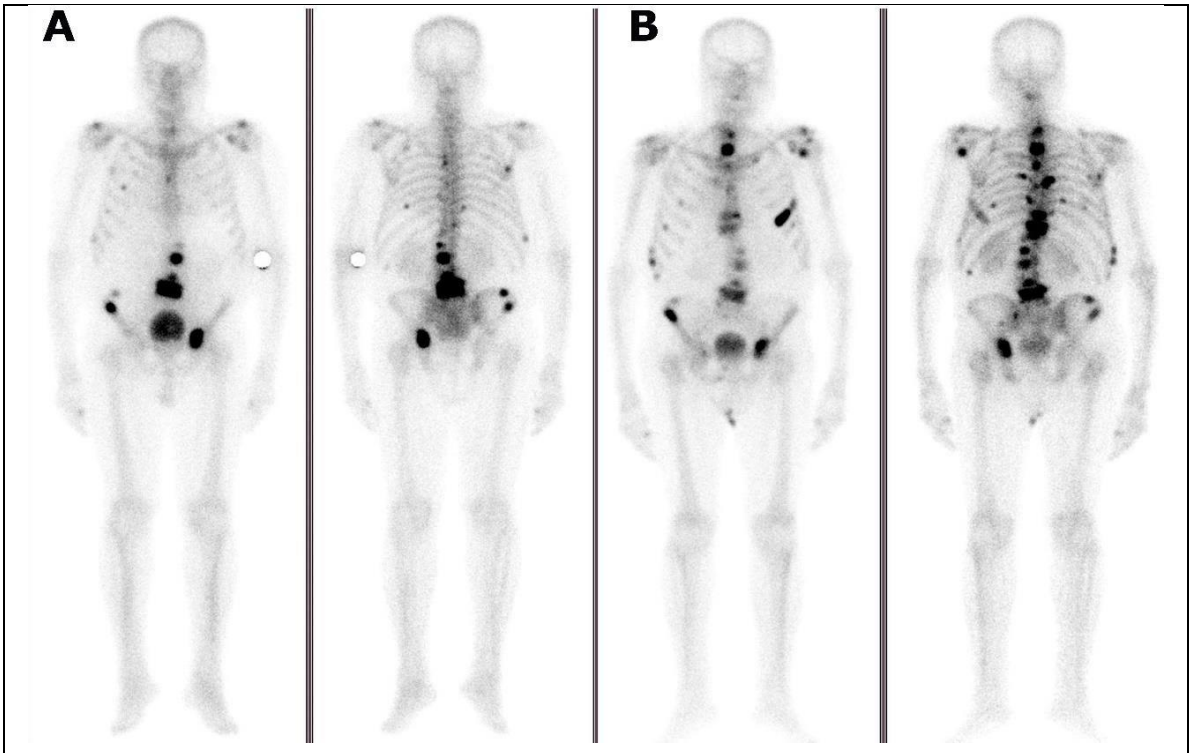


**Figure 1:** A) Control bone scan (BG) with PSA of 2.98 ng/ml, showing lesions in costal arches, pelvis and lumbar spine. B) Control GO with PSA at 10.9 ng/ml, showing an increase in the number of lesions with new foci in costal arches, scapulae and dorsal spine.

## Discussion

PSMA, also known as glutamate carboxypeptidase II, is a type II transmembrane glycoprotein [8], and in prostate cancer, it is highly overexpressed at the level of cancer cells compared to normal prostate tissue. Its level of expression correlates with the aggressiveness of the disease, the degree of refractoriness and distant extension, making it an attractive target for molecular imaging and therapeutic [9]. In

prostate cancer patients, bone metastasis is the most common distant metastasis and bone scintigraphy with Tc99m-labeled bisphosphonates is routinely used for its detection, however, false positive results are common due to a variety of benign bone lesions and post treatment pathophysiological changes, generating a low overall specificity [10]. Zhang et al. [11] evaluated 74 patients with PCa, and found that 99mTc-PSMA SPECT/CT was superior to 99mTc-MDP SPECT/CT in detecting bone metastases, especially in small lesions and in patients with low PSA levels, and demonstrated additional benefit in providing information on extra skeletal metastases. Orunmuyi et al. [12] evaluated five patients with low, intermediate and high risk PCa and a mean PSA of 175 ng/ml, compared images acquired with 99mTc-PSMA vs. bone scan, 99mTc-PSMA images confirmed a complete radiological response to treatment when the bone scan was falsely positive. Rathke et al. [13] evaluated twenty-one patients with known metastatic disease, staged with both conventional bone scintigraphy and PSMA ligand scintigraphy. PSMA scintigraphy provided a clear advantage over bone scintigraphy by reducing the number of equivocal findings in most patients. In our patient we observed increased uptake of lesions in the non-irradiated areas being concordant in the studies with Tc99m-PSMA and Tc99m-MDP, unlike the irradiated areas where no uptake is observed in the scintigraphy with Tc99m-PSMA in comparison with Tc99m-MDP where an increased uptake is maintained.

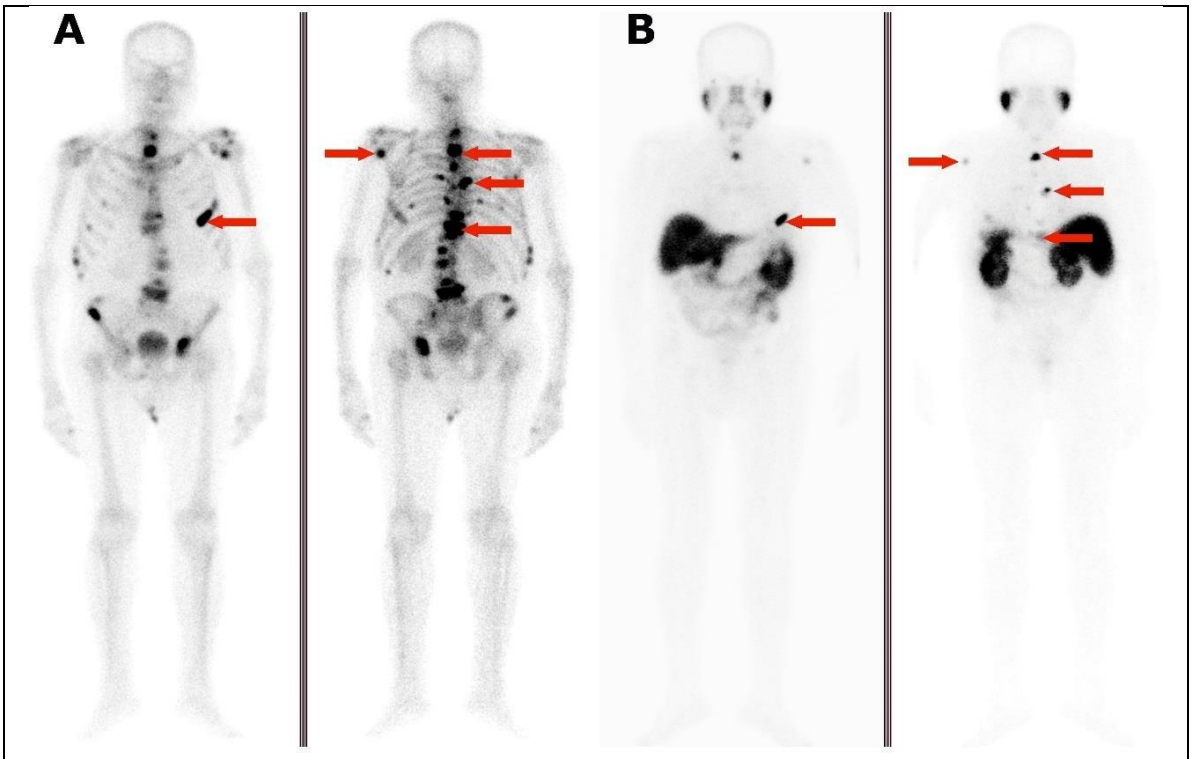


**Figure 2:** (A) Control bone scintigraphy (GO) shows multiple foci of osteoblastic activity post treatment, evidencing new foci of uptake (red arrows). (B) Tc99m-PSMA scintigraphy shows activity in new foci seen in the GO, but not in old lesions already treated.

By correlating the patient's therapeutic history and both nuclear imaging studies, we can infer that the findings in the bone scintigraphy at the pelvis and lumbar spine level are false positives

due to the pathophysiological phenomenon called "flare", which is caused by an increase in hydroxyapatite turnover as part of the healing process after radiotherapy **[14]**. This evidences the strong specific binding of Tc99m-PSMA to tumor cells, which may lead to a reduction of false positive findings and improve the time to evaluate the therapeutic effect of radiotherapy in contrast to Tc99m-MDP scintigraphy.

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