[^{99m}Tc]Tc-MDP uptake in the prostate gland confirmed by SPECT/CT

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ABSTRACT
Prostate cancer remains a leading cause of cancer-related mortality among men worldwide. Technetium-99m methylene diphosphonate ([^{99m}Tc]Tc-MDP) bone scintigraphy is commonly employed to detect skeletal metastases due to its high sensitivity in identifying osteoblastic activity. However, [^{99m}Tc]Tc-MDP uptake in soft tissues, particularly in the prostate gland, is exceedingly rare. Here, we present a case of a 70-year-old male with acinar prostate adenocarcinoma (Gleason score 7/10) and persistent lower back pain. [^{99m}Tc]Tc-MDP scintigraphy demonstrated abnormal radiotracer uptake in the prostate gland without any evidence of bone metastases. Further evaluation through performing SPECT/CT confirmed the radiotracer uptake in the prostate gland without evidence of calcification. This rare finding emphasizes recognizing atypical imaging patterns and accurately interpreting them, which are important for clinical decision-making. We evaluate the patient regarding the potential mechanisms for such uptake, including dystrophic calcification and localized osteoblastic activity, and discuss the diagnostic implications and future research directions in prostate cancer imaging.

Keywords: Prostate cancer; [^{99m}Tc]Tc-MDP; Bone scintigraphy; Soft tissue uptake; Pitfall

INTRODUCTION
Prostate cancer is one of the most common malignancies and a significant cause contributing to cancer-related mortality in men worldwide. [1, 2]. Although incidental uptake of radiotracers in soft tissues is rare, it can interfere with diagnostic interpretation and patient management.

[^{99m}Tc]Tc-MDP uptake in the prostate gland is uncommon. This may indicate underlying pathological processes necessitating further investigation [3].
This report describes an unusual case of [^{99m}Tc]Tc-MDP uptake in the prostate gland of a patient suffering from acinar prostate adenocarcinoma without evidence of prostatic calcification in the SPECT/CT images. This report elaborates on clinical and imaging findings, potential mechanisms, and implications for diagnosis and treatment.

CASE PRESENTATION

A 70-year-old male holding a history of acinar prostate adenocarcinoma (Gleason score 7/10, 4+3 pattern) presented with persistent lower back pain (LBP), which lasted one month. The patient had no history of TUR-P or other pelvic surgical interventions. He described his pain as dull, non-radiating, and resistant to over-the-counter analgesics. He also denied any urinary complaints, bloody urine, fever, weight loss, or other systemic symptoms.
A transrectal ultrasound-guided biopsy had previously confirmed the diagnosis of acinar prostate adenocarcinoma. A [^{99m}Tc]Tc-MDP whole-body bone scintigraphy (Figure 1) was conducted to evaluate for potential skeletal metastases, which revealed abnormal radiotracer uptake in the pelvic region, without any abnormal skeletal uptake. Post-void planar imaging was performed to confirm that the uptake is not from urinary activity in the prostatic urethra. Subsequent SPECT/low-dose CT imaging (Figure 2) showed the radiotracer uptake in the prostate gland. The prostate gland appeared slightly enlarged but showed no calcifications.
[^{99m}Tc]Tc-MDP is primarily employed to detect osteoblastic activity associated with bone metastases. Its accumulation in soft tissues-particularly within the prostate is exceedingly rare. When extraosseous uptake does occur, it is typically incidental and may be attributed to mechanisms such as dystrophic calcification, chronic inflammation, expansion of extracellular fluid, or localized osteoblastic activity [4, 5]. The rarity of this phenomenon in the prostate gland complicates its clinical interpretation. Zhang et al. reported a 0.6% incidence of [^{99m}Tc]Tc-MDP uptake in extraosseous neoplasms among 7,380 patients undergoing bone scintigraphy, with localization commonly seen in the breast, liver, and lung [4].
A report by Zucker et al. described significant [^{99m}Tc]Tc-MDP uptake in the prostate gland following cryoablation for prostate cancer, suggesting that localized tissue changes can lead to increased radiotracer accumulation [6]. Two additional reports described similar findings in the prostate cancer patients, where SPECT/CT imaging revealed prostatic calcifications corresponding to areas of radiotracer accumulation [7, 8]. Although soft tissue uptake of bone-seeking radiopharmaceuticals is generally considered incidental, it can hold diagnostic value. For instance, elevated scrotal uptake ratios on bone scans have demonstrated high diagnostic accuracy for detecting pelvic lymph node metastases in newly diagnosed prostate cancer patients [9].
Other documented cases of non-osseous [^{99m}Tc]Tc-MDP uptake—including malignant ascitic fluid, malignant pleural effusion, gynecomastia, and amyloidosis—highlight the diverse spectrum of such findings and underscore the importance of a multimodal diagnostic approach [10, 11].
In this instance, the lack of calcifications in the prostate gland on SPECT/CT imaging raises the possibility that non-calcified osteoblastic activity or other microenvironmental alterations may be involved in the uptake mechanism. Understanding these patterns is essential for preventing misdiagnosis and accurately interpreting imaging results. This case further emphasizes how crucial it is to correlate imaging results with pathological and clinical information to properly direct patient care.

CONCLUSION

This case underscores the need to recognize atypical patterns of [^{99m}Tc]Tc-MDP uptake in soft tissues, particularly in prostate cancer patients. While rare, such findings can provide valuable insights into the tumor microenvironment and underlying pathological processes. To accurately interpret these imaging abnormalities, a multimodal diagnostic approach, including advanced imaging techniques, should be adapted. Moreover, a careful clinical correlation must be considered. Future research should focus on elucidating the mechanisms of soft tissue radiotracer uptake and exploring its potential role in prostate cancer diagnostics and management. Recognizing this pattern may prevent unnecessary interventions, improve staging accuracy, and guide appropriate follow-up strategies for prostate cancer patients

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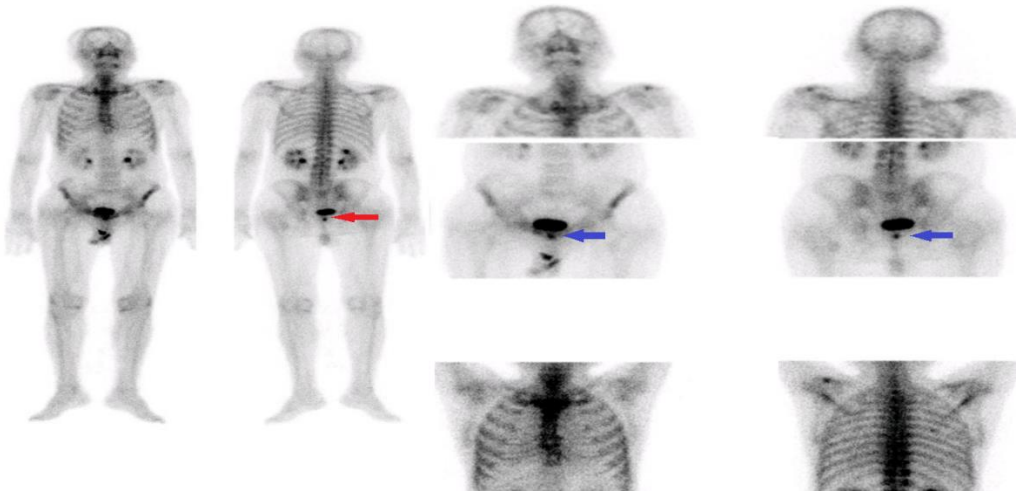

Figure 1. Three hours after Intravenous injection of 20 mCi [^{99m}Tc]Tc-MDP, anterior and posterior whole-body images were acquired. Delayed whole-body images revealed focal increased radiotracer uptake in the pelvic region, without any abnormal skeletal uptake

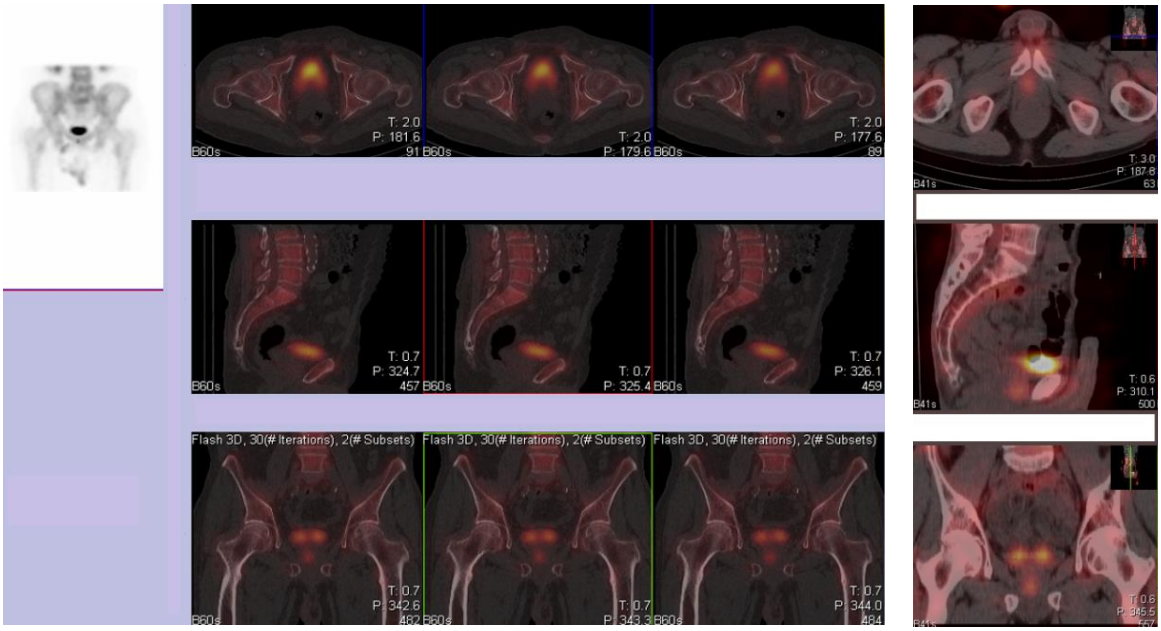

Figure 2. SPECT/low-dose CT imaging of the pelvis. The fused SPECT/CT images demonstrate focal radiotracer uptake localized to the prostate gland. The prostate appears mildly enlarged, but no evidence of calcifications is observed on the CT images