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Case Report

Gradual normalization of superscan in prostate cancer: A case report and literature review ☆,☆☆,★

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ABSTRACT

This report presents the imaging findings in a patient with advanced prostate cancer and bone metastases. A superscan pattern on the initial whole-body bone scan suggested extensive disease. The patient responded well to definitive treatment, exhibiting clinical improvement based on decreased PSA levels and CT findings in 6-month follow-up. However, serial follow-up bone scans showed normalization in about 18 months. This paper aims to discuss the limitations of bone scintigraphy in evaluating treatment responses in patients with prostate cancer.

Introduction

Prostate cancer (PCa) is the most common noncutaneous cancer in men. Upon diagnosis, patients are risk-stratified based on PSA levels, Gleason score, and clinical staging. Advanced PCa commonly metastasizes to the bone, particularly the spine, pelvis, and long bones [1]. Bone scintigraphy (BS), also referred to as bone scan, has conventionally been considered a gold standard for assessing osteoblastic bone metastases due to its relatively low cost, high sensitivity, and availability. However, this modality exhibits poor specificity and is unreliable in evaluating treatment response [1–3]. Furthermore, the sensitivity of BS is relatively low when evaluating patients with low PSA levels [3,4].

We highlight serial bone scans from a patient with advanced PCa presenting with a superscan pattern on their initial scan. Superscan pattern is seen in patients with extensive bone metastases. This is characterized by diffuse, intense uptake throughout the axial skeleton with faint uptake in the soft tissues and urinary system. Despite clear clinical evidence of favorable treatment response, the patient's bone scan findings did not normalize until after 18 months. The accurate assessment of treatment response is crucial to facilitating

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optimal therapeutic outcomes. The purpose of this report is to highlight the inherent limitations of BS for assessing treatment response. Recognizing these limitations is essential to ensure informed clinical decision-making and prevent potential misinterpretation of imaging findings.

Case report

Patient presentation

A 69-year-old male was referred to the urology clinic following recent findings of sclerotic bone lesions, microcytic anemia, and an elevated PSA measurement. At the clinic, their PSA was remeasured to be 695 ng/mL, prompting a prostate biopsy to be performed. The results of the biopsy revealed group 5 (Gleason score of 8-10) anaplastic adenocarcinoma. A CT abdomen and pelvis was performed which showed extensive osteoblastic bone metastases involving the axial skeleton. Enlarged retroperitoneal para-aortic and common iliac lymph nodes were also noted (Figs. 1A and B). These findings were suggestive of metastatic PCa. A BS at the time of diagnosis revealed a superscan pattern of uptake with diffuse osteoblastic bone disease involving the axial skeleton, shoulder girdles, and pelvis (Fig. 2A).

Treatment and follow-up

A treatment course comprising Lupron injections and docetaxel was initiated. After 8 months, the patient's PSA level was found to have dropped below normal to 1.1 ng/mL. The follow-up CT of the abdomen and pelvis revealed significant interval improvement of the retroperitoneal para-aortic and common iliac lymph nodes. Additionally, the patient reported resolution of their bone pain and urinary symptoms. These observations collectively suggested a favorable response to therapy. However, the follow-up BS at this time depicted persistent diffuse osteoblastic bone metastases with only marginal improvement (Figs. 1C and D). At the 12 and 18-month follow-ups, PSA levels continued to decline to 0.6 and 0.4 ng/mL, respectively. However, the bone scans noted more gradual improvement with near normalization by month 18 (Figs. 2B–D).

Discussion

The presence of bone metastasis serves as an independent prognostic indicator in patients with PCa [3]. Bone scintigraphy has classically been used to evaluate metastatic bone lesions. BS utilizes technetium-99 labeled bisphosphonates

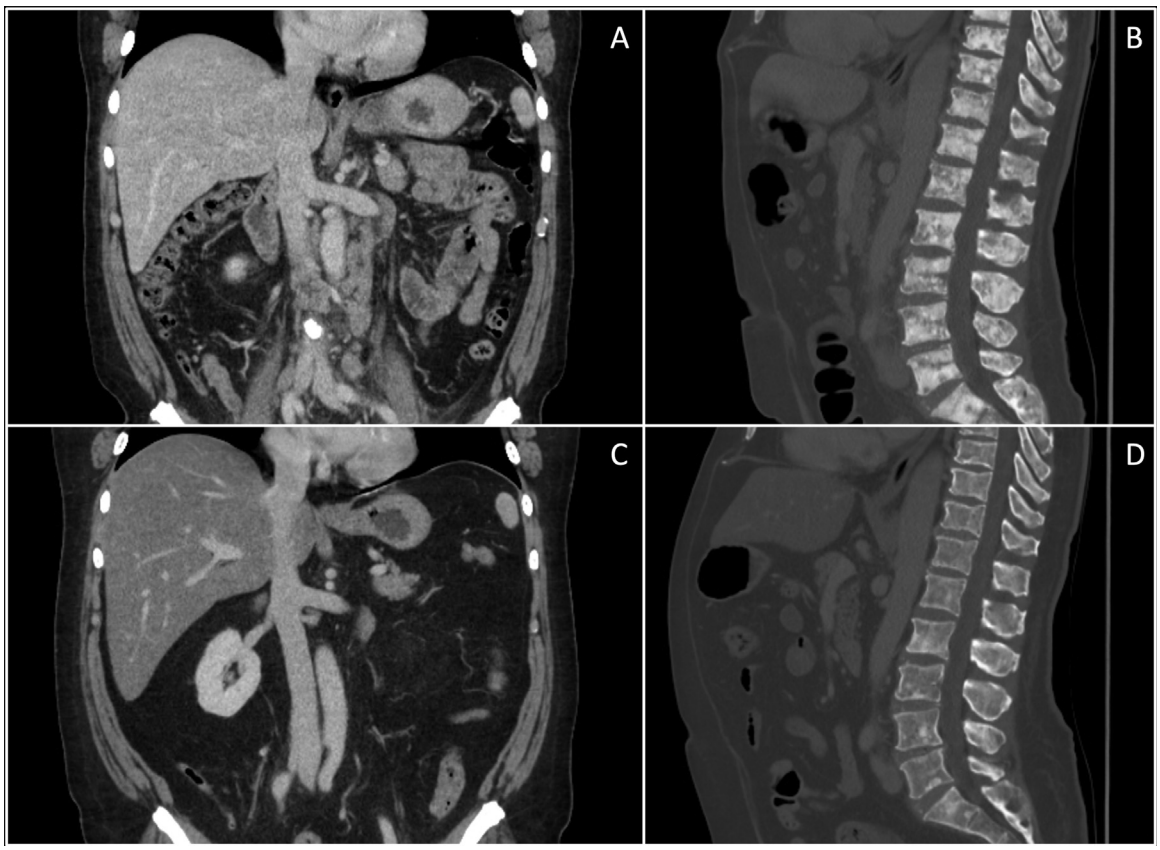

Fig. 1 – Coronal and sagittal images (A and B) from the staging CT, showing retroperitoneal paraaortic lymphadenopathy, and multifocal sclerotic bone metastases. The PSA at the time of the diagnosis measured 695 ng/mL. Six-month post-treatment images (C and D) at the same levels, show resolution of lymphadenopathy and marked improvement in bone lesions. The PSA at this time measured 1.1 ng/mL.

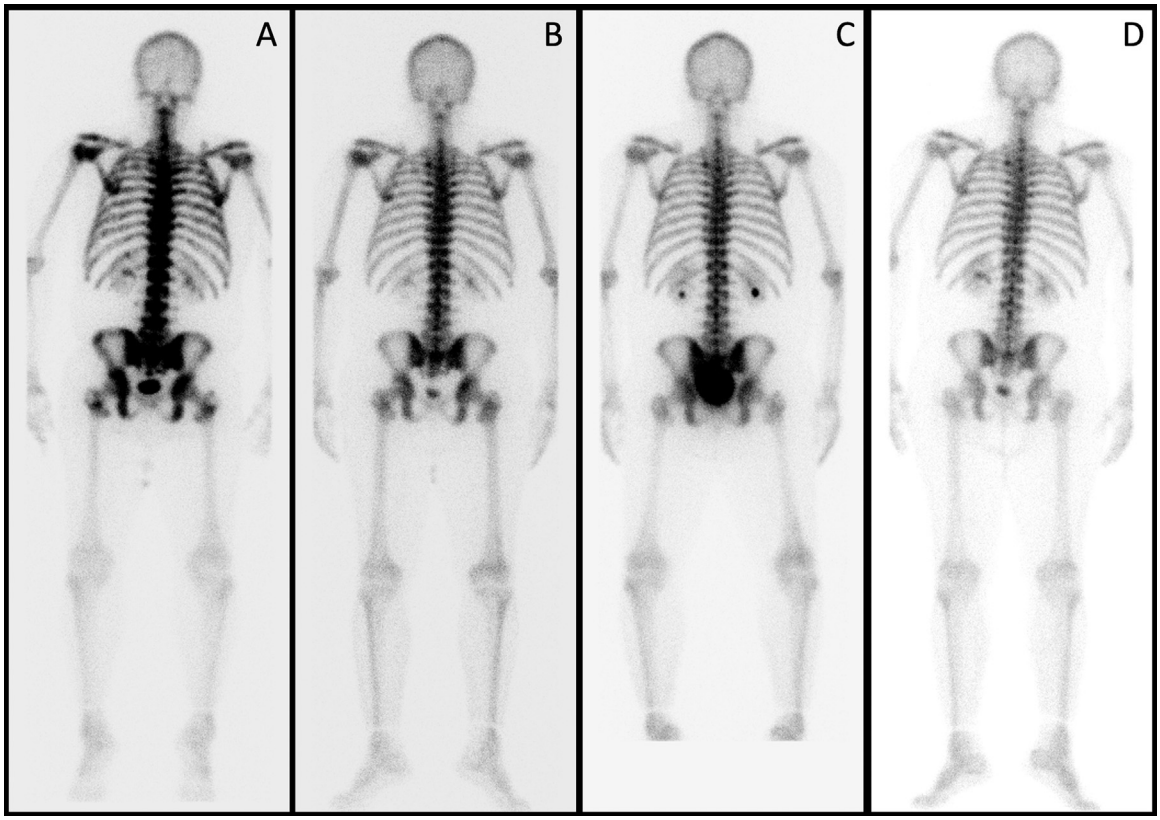

Fig. 2 – Whole body bone scan images, in posterior projection only, showing superscan pattern at the time of diagnosis (A) and gradual improvement at 6, 12, and 18-month follow up (B, C, and D). The PSA at these time points measured 695, 1.1, 0.6, and 0.4 (ng/mL) respectively.

which bind hydroxyapatite at sites of active osteoblastic bone formation [5]. Due to the rapid multiplication of cancer cells, areas of bone metastasis exhibit heightened bone metabolism and bone repair activity. This presents BS as focal areas of increased uptake distributed randomly throughout the skeleton [5–8]. In patients presenting with a markedly elevated PSA level and extensive bone metastases, a superscan pattern can be seen on BS. A superscan is a rare imaging appearance characterized by a high ratio of skeletal to soft tissue radionucleotide uptake with minimal activity in the kidneys and bladder [4,5,9]. PCa is the most common cause of metastatic superscans. Metastatic superscans are typically indicative of extensive bone metastasis. However, the uniformity of tracer accumulation and the absence of discernible hot spots in these scans can lead to misinterpretation as normal. Despite the risk of false negative interpretations in superscans, BS is overall highly sensitive for assessing bone metastases. However, it suffers from inferior specificity due to radiotracer accumulation in benign lesions (such as degenerative changes, trauma, intervention, and infection) leading to false positive results [1,3,10].

Bone scans have been shown to be particularly unreliable in the early stages of treatment, as scintigraphic evidence of healing can take several months or even years to be accurately reflected [1,6,11,12]. Additionally, bone scintigraphy (BS) demonstrates diminished accuracy when assessing patients with low PSA levels. Lower PSA levels are indicative of reduced malignant activity and bone cell turnover thereby diminishing the diagnostic efficacy of BS. Consequently, certain studies advise against the utilization of BS in patients with PSA levels ranging from <10 ng/mL to 20 ng/mL [1,3,10,13].

Newer imaging modalities have emerged that address these issues. PET/CT employs radiotracers like F-18 NaF or PSMA to provide enhanced visualization of bone lesions, offering higher sensitivity and accuracy. This advanced imaging technique can assess metastatic bone lesions at earlier disease stages and in patients with lower PSA levels. These capabilities facilitate improved disease monitoring and treatment assessment [11–14]. Despite its advantages, the relatively high cost and poorer availability of PET/CT limit its use as a routine imaging modality [12]. Nonetheless, when evaluating osseus metastases in PCa patients, the convenience of BS must be weighed against its limitations in accuracy and sensitivity.

Conclusions

Bone scintigraphy is often the first-line modality used to assess osteoblastic bone metastases in PCa patients. Due to nonspecific uptake of the radiopharmaceutical, it has limited sensitivity in the identification of bone metastasis. As seen in this patient, it also has a limited role in follow up of patients with superscan pattern, due gradual normalization

of osteoblastic activity in healing bone lesions. In such cases, a holistic approach, combining PSA and imaging findings on CT imaging should be considered.

Authorship

The authors declare that this is their original work, and they all approve the content of this manuscript. They confirm that this manuscript has not been published previously, in any language, in whole or in part, and is not currently under consideration elsewhere.

Patient consent

A written informed consent was obtained from the patient for the publication of this case report.

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