Improving Specificity of Bone Scintigraphy: SPECT/CT Evaluation of Degenerative Spinal Uptake in 99mTc-MDP Bone Scintigraphy Mimicking Metastases

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ABSTRACT

Bone scintigraphy is highly sensitive for detecting skeletal lesions. However, it is still difficult to differentiate metastases from degenerative bone disease, especially in older cancer patients. Here, two cases are presented with chronic back pain in the background of history of cancer in which whole-body bone scans showed focal "hot spots" suspicious for metastasis. Hybrid SPECT/CT imaging clarified that these findings consistent with degenerative disease. This distinction significantly altered clinical management, avoiding unnecessary investigations and further oncologic treatment. These cases highlight the critical role of SPECT/CT in enhancing diagnostic specificity and guiding appropriate patient care.

Keywords: Bone scintigraphy, Metastasis, Degenerative disease, SPECT/CT, Oncology

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INTRODUCTION

Bone scintigraphy with technetium-99m methylene diphosphonate (99mTc-MDP) is widely used for detecting skeletal metastases due to its high sensitivity. Planar imaging often raises concerns regarding metastasis but lacks specificity, making it challenging to distinguish between metastatic bone lesions and degenerative bone disease, particularly in older cancer patients. This overlap can lead to misinterpretations, as both conditions may exhibit similar imaging characteristics and increased tracer uptake. Hybrid SPECT/CT enhances diagnostic precision by correlating anatomical details with scintigraphy findings, effectively differentiating degenerative conditions from metastatic disease and aiding in proper patient management.

CASE REPORTS

CASE 1

A 50-year-old woman with histopathological confirmed breast carcinoma was referred to the nuclear medicine department for evaluation of possible skeletal metastasis due to persistent back pain. She had undergone prior definitive management including Right sided MRM surgery, followed by chemotherapy and ongoing hormonal therapy. Her past medical history was unremarkable. Whole-body bone scintigraphy was performed three hours after intravenous administration of 99mTc-MDP. The planar images demonstrated focal intense tracer uptake in the right 5th cervical vertebrae, raising suspicion for metastatic involvement. To further characterize the lesion, SPECT/CT of the cervical spine was performed. The hybrid images localized the tracer uptake to the facet joint with degenerative changes, consistent with facet arthropathy, a benign disease rather than metastatic disease.

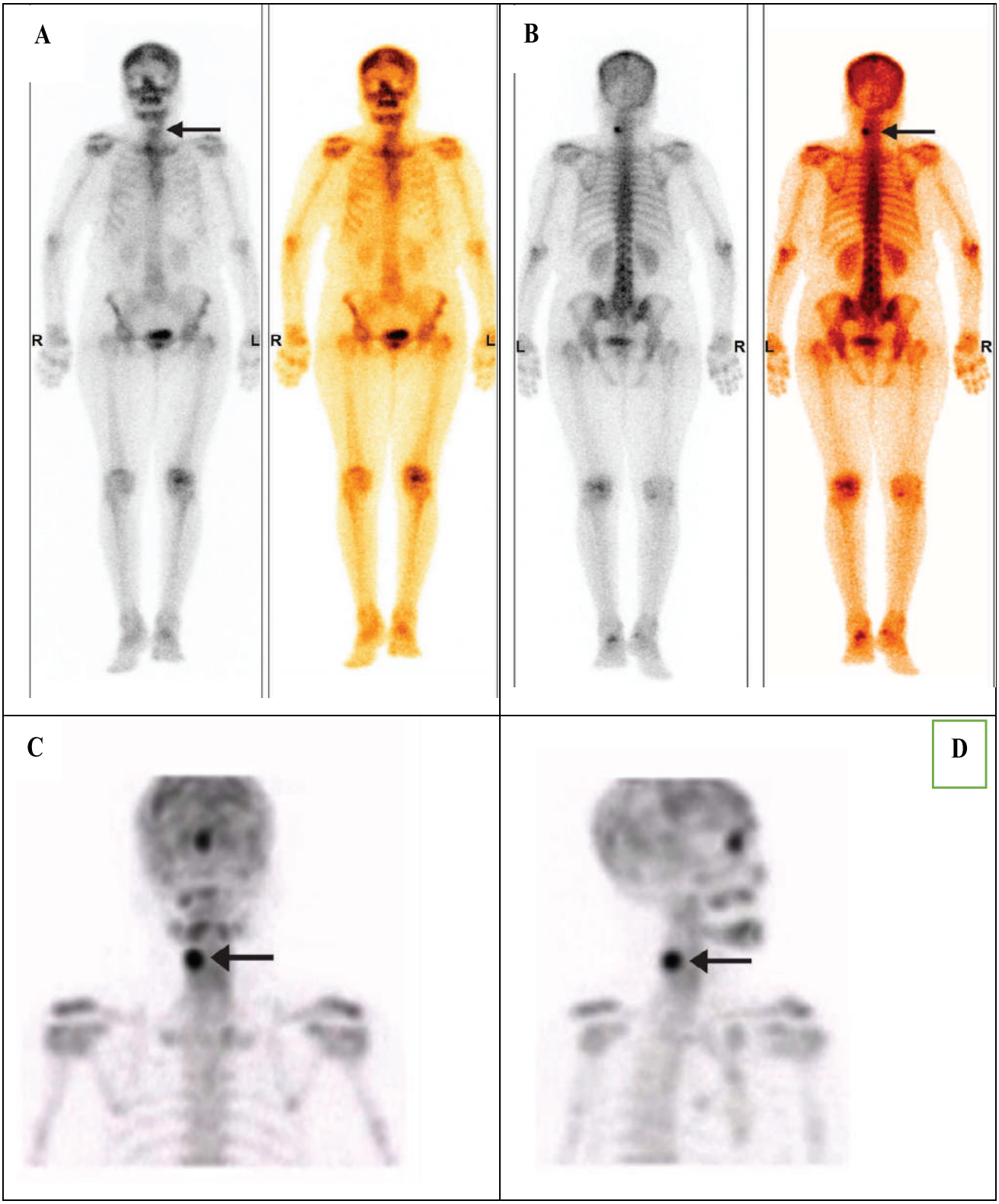

Figure-1: 50-year-old woman with breast cancer after surgery and chemotherapy, who was referred for suspected bone metastasis. The whole-body scan (A, anterior, B, posterior) demonstrated 99mTc-MDP uptake in right 5th cervical vertebra suspicious for metastatic involvement. Static view of 99mTc-MDP planar bone scintigraphy (C-coronal and D-sagittal) demonstrating focal increased tracer uptake in the right 5th cervical spine. The intensity of uptake strongly suspicious for metastatic disease.

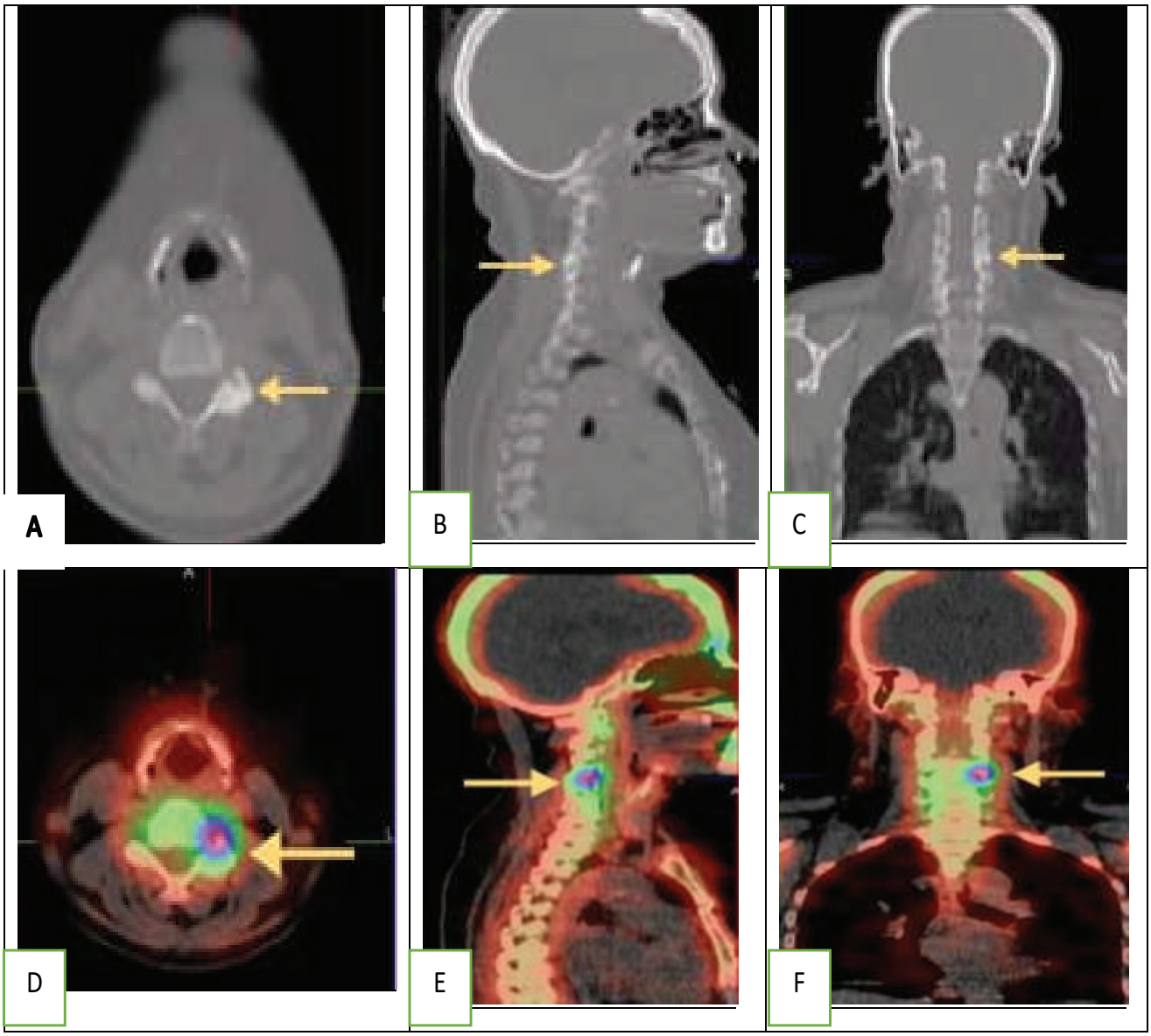

Figure-3: Axial (A), Sagittal (B), Coronal (C) CT image showing sclerotic change in right 5th cervical vertebra (yellow arrow). Fused SPECT/CT image of the same patient; Axial (D), Sagittal (E), Coronal (F) SPECT/CT images showing increase 99mTc-MDP uptake (yellow arrow) in the right 5th cervical vertebra corresponding to degenerative facet joint arthropathy.

CASE 2

A 65-year-old male with prostate carcinoma presented with chronic low back pain and underwent whole-body bone scintigraphy for metastatic evaluation.

Planar scintigraphy revealed multiple focal radiotracer uptake in the lateral margin of lower thoracic and upper lumbar vertebrae, which initially raised concern for possible metastatic lesions.

Subsequent SPECT/CT imaging demonstrated that the uptake corresponded to vertebral osteophyte formation without destructive bone lesions. The CT component showed sclerotic degenerative changes typical of osteoarthritis, confirming the benign nature of the uptake.

The findings excluded skeletal metastasis, thereby preventing unnecessary escalation of oncologic therapy.

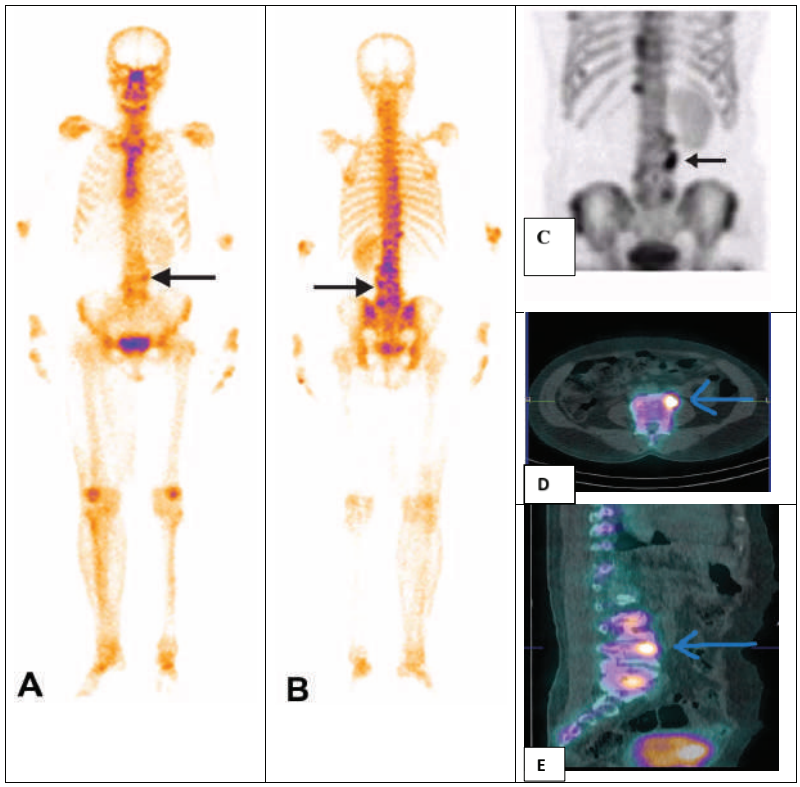

Figure-5: Whole body planar bone scintigraphy (A, anterior, B, posterior views) of a 65 years old man with known carcinoma of prostate demonstrates increased tracer uptake (black arrow) in lower dorsal and lumber spine. The intensity of tracer uptake is highly suggestive of widespread osteoblastic skeletal metastasis. Static view (C) of the lumber spine shows an area of intense radiotracer uptake (black arrow) in L4 vertebra raising strong suspicion for metastatic disease. Fused SPECT/CT image of the same patient Axial (D), Sagittal (E) SPECT/CT images showed increase 99mTc-MDP uptake (blue arrow) in L4 vertebra corresponding to endplate sclerosis and osteophyte formation favoring a benign etiology rather than metastatic disease.

DISCUSSION

Bone scintigraphy (planar and SPECT) is widely used in oncology for detecting skeletal metastases (1). It is relatively inexpensive, allows whole-body screening, and is highly sensitive in the detection of malignant bone lesions. However, its specificity is limited because increased tracer uptake can occur in both malignant and benign conditions (e.g., degenerative joint diseases, fractures, infections, and benign bone tumors) (2).

Degenerative spinal disease is one of the most common causes of false-positive findings, particularly in elderly patients, where osteophytes, facet joint arthropathy, and endplate sclerosis frequently demonstrate increased radiotracer accumulation (3). Approximately 50% of skeletal metastasis patients demonstrate spinal involvement, which may mimic degenerative changes on imaging (4). In oncologic practice, the overlap of metastatic and degenerative features often leads to diagnostic uncertainty and may result in overstating or inappropriate treatment decisions.

In the present cases, focal spinal “hot spots” on planar bone scintigraphy initially suggested metastatic disease. However, subsequent SPECT/CT imaging accurately localized tracer uptake to degenerative structural changes, thereby excluding malignancy. This highlights the limitation of planar imaging, which lacks anatomical detail and may not reliably distinguish benign from malignant lesions (5).

The introduction of SPECT/CT has significantly improved diagnostic accuracy in nuclear medicine. Hybrid imaging provides precise anatomical localization of tracer uptake and allows differentiation between malignant and benign skeletal lesions. Several studies have demonstrated that SPECT/CT improves specificity,

diagnostic confidence, and clinical decision-making compared with planar scintigraphy alone. According to the study, SPECT/CT provides higher sensitivity (~93% vs. 97%) and specificity (~78% vs. 94%) than planar bone scintigraphy (6).

Hybrid SPECT/CT has significantly improved diagnostic accuracy by integrating functional and anatomical information. The CT component enables precise localization and morphological characterization of lesions corresponding to areas of increased tracer uptake. Previous studies have demonstrated that SPECT/CT reduces equivocal interpretations and improves diagnostic confidence. Römer et al. showed that SPECT/CT reclassified a substantial proportion of indeterminate lesions, leading to more accurate diagnoses (7). Similarly, Sharma et al. emphasized its role as a valuable problem-solving tool in differentiating degenerative changes from metastatic disease (8).

Accurate differentiation between degenerative disease and skeletal metastasis is essential, as it directly influences staging, prognosis, and management. Misinterpretation of benign lesions as metastatic disease may lead to unnecessary systemic therapy, additional imaging, or inappropriate alteration of treatment strategy. Conversely, correct identification of degenerative pathology allows appropriate reassurance and conservative management (9).

Reported cases of suspicious “hot spots” on planar bone scans were identified by SPECT/CT as indicative of degenerative changes. These findings highlight the importance of incorporating SPECT/CT into the evaluation of equivocal bone scan findings, particularly in patients with known malignancy and degenerative spinal disease. This highlights the limitation of planar imaging, which lacks anatomical detail and may not reliably distinguish benign from malignant lesions (3).

Although SPECT/CT involves additional radiation exposure and cost, its selective use in patients with equivocal findings on planar scintigraphy is justified by its substantial impact on diagnostic accuracy and clinical decision-making.

CONCLUSION

Hybrid SPECT/CT imaging plays a crucial role in improving the specificity of bone scintigraphy in oncology patients by providing precise anatomical-functional correlation. This approach reduces false-positive interpretations, improves diagnostic confidence, and ensures appropriate patient management.

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