

# Utility of Bone Scintigraphy for Detection of Primary Malignant Mesenchymal Tumor: A Case Report

<sup>1</sup>Fariha Zerine, <sup>2</sup>Md. Sunny Anam Chowdhury, <sup>1</sup>Md. Nazmul Hossain, <sup>1</sup>Sujon Mahmud, <sup>3</sup>Bahalul Hasan, <sup>4</sup>Puja Bhattacharjee

<sup>1</sup>Medical Officer, <sup>2</sup>Director & PMO, <sup>3</sup>Scientific Officer, Institute of Nuclear Medicine and Allied Sciences (INMAS), Kushtia

<sup>4</sup>Senior Medical Officer, INMAS, Mohakhali, Dhaka

**Correspondence Address:** Dr. Fariha Zerine, Medical Officer, INMAS, Kushtia, Kushtia Medical College & Hospital Campus,  
Email: farihazerinipinki@gmail.com

## ABSTRACT

Primary malignant mesenchymal tumors are heterogeneous group of tumors arising from bone, cartilage and other connective tissues. The aggressive nature of these tumors requires prompt diagnosis and multidisciplinary approach for best possible outcome for the patients. Bone scintigraphy being an excellent modality to detect osteoblastic bone activity can help in early detection of primary bone tumors as well as staging, localizing of lesion and aiding in multidisciplinary management alongside other imaging facilities. The reported case demonstrates a 22-year-old male patient with pain and swelling in left hip and upper thigh for four months. Initial radiograph revealed a large expansile mixed lytic and sclerotic lesion of femur. However, bone scintigraphy precisely localized the lesion involving femoral head and proximal part, excluding any distant skeletal metastasis. Finally, histopathological findings confirmed the tumor to be a malignant one with mesenchymal origin, likely an Osteosarcoma. This case once again proves that nuclear medicine techniques including <sup>99m</sup>Tc-MDP Bone Scintigraphy has now become an integral part for diagnosing and staging of primary malignant mesenchymal tumors alongside conventional radiographs.

**Keywords:** Primary bone tumor, Malignant mesenchymal tumor, Bone Scintigraphy

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## INTRODUCTION

Malignant Mesenchymal Tumors (MMT) consists of a group of diverse and aggressive neoplasms originating from bone, muscle, cartilage and fat (1). Such tumors mostly harbor mutations in key regulatory genes including TP53, RB1, PTEN and alter oncogenes like MYC and KRAS (2). Amidst the varieties, primary bone tumors of mesenchymal origin encompass wide range of histological subtypes including high grade sarcomas such as Osteosarcoma, Ewings sarcoma, Chondrosarcoma (3). Most performed nuclear

medicine procedure to assess these tumors is Bone Scintigraphy with <sup>99m</sup>Tc-MDP (Technetium-99m Methylene Diphosphonate) (2,3). The present case report demonstrates the usage of bone scan for detection of primary MMTs of both bone and extraosseous origin.

## CASE SUMMARY

A previously healthy 22-year-old male attended the Scintigraphy division of INMAS, Kushtia with the complaints of pain and tenderness over left hip region for past 4 months. Pain was severe in nature, radiated towards left thigh and mild swelling was noted around left hip and upper thigh. The ensuing pain and tenderness sometimes caused him limp for several days. He also complained about loss of appetite, nausea and significant weight loss. His past medical history and family history was unremarkable. Biochemical examination revealed decreased Hb%, a raised Alkaline Phosphatase (ALP) level and serum calcium in normal range.

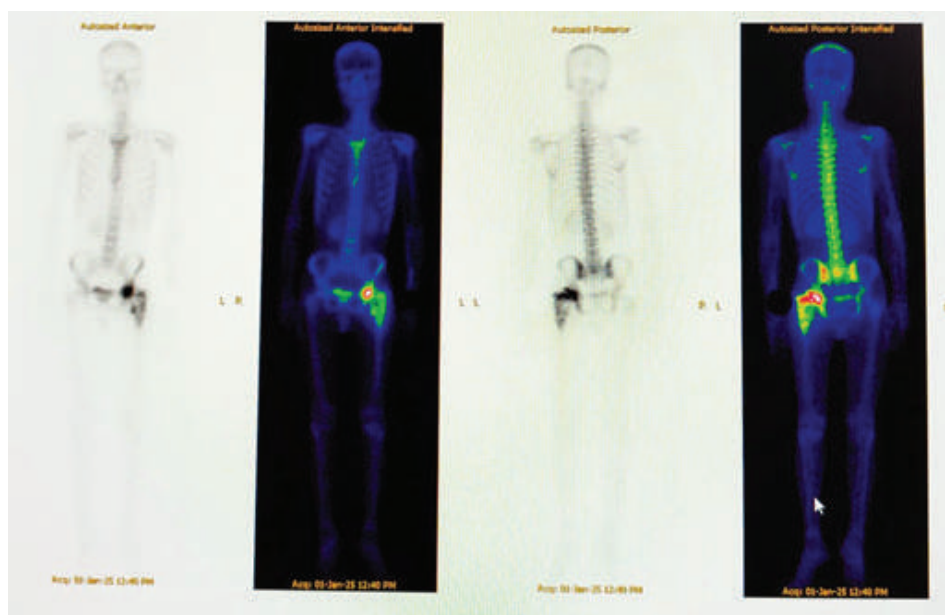
Initial pelvic x-ray showed a large, expansile, mixed sclerotic and lytic lesion arising from proximal meta-diaphyseal region of left femur. The lesion was associated with a large soft tissue component having wide transition zone. Codman's triangle type periosteal reaction was also noted, without any cortical breach (figure 1). Whole body Tc-99m MDP bone scan demonstrated focal increased radioisotope accumulation

in upper part of left femur including head of femur, suggesting a primary bone tumor (figure 2). A subsequent MRI revealed a large, expansile, T1W hypointense, T2W and STIR heterogeneously hyperintense lesion arising from proximal metadiaphyseal region of left femur, extending up to

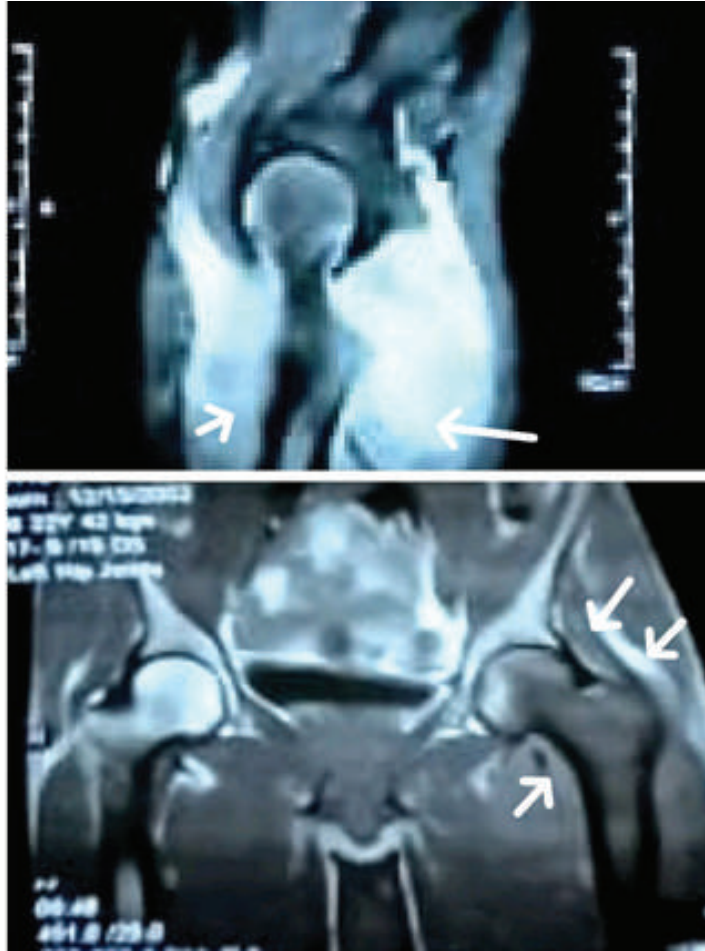
femoral head. After I/V contrast, heterogeneous enhancement of the lesion was present. Both hip joints and visualized other bones appeared normal in signal intensity. These typical findings align with osteosarcoma (figure 3). Further FNAC from the lesion concluded it to be a primary MMT of bone origin, likely Osteosarcoma.



**Figure 1:** X-ray of both hip joints A/P view showing a mixed lytic and sclerotic lesion at the metadiaphysis of left femur.



**Figure 2:** 99mTc-MDP bone scan images showing increased radioisotope accumulation involving left femoral head and proximal shaft.



**Figure 3: Pelvic MRI sagittal and coronal STIR view showing large expansile heterogenous hyperintense lesion at proximal metadiaphyseal region of left femur.**

## DISCUSSION

Malignant Mesenchymal Tumors (MMT) are highly aggressive tumors originating from connective tissues of various parts of the body. The complexity of these tumors mostly involves genetic mutation as well as chromosomal abnormality, triggered by exposure to carcinogens or genetic syndromes. Early detection of such tumors is very crucial which requires multidisciplinary approach with imaging modalities including plain radiograph, CT scan, MRI, bone scan and PET-CT scan (4).

Conventional radiological modalities mostly depict detailed anatomy and structural abnormalities, whereas nuclear medicine techniques like whole body bone scan focuses on functional perspective of such tumors as well as pointing out any distant metastasis, multifocal bone lesion or skip lesion within a single

whole-body examination (5). Meanwhile bone scan does not replace the utility of other radiological modalities, rather it plays important role in staging, localizing the disease and aiding in multidisciplinary management alongside other imaging facilities.

Technetium-99m labeled methylene diphosphonate ( $^{99m}\text{Tc}$ -MDP) is administered intravenously for bone scintigraphy. MDP absorbs hydroxyapatite crystals in bone by ion exchange and chemisorption thus reflecting osteoblastic activity and regional blood flow. A small change of 5% in bone formation can be detected via bone scan whereas it takes almost 40-50% mineral loss to be identified via radiographs (6). Studies suggested that the uptake of MDP in extraosseous tumors relies upon necrosis and amorphous densities of calcium accumulation in mitochondrial matrix resulting in dystrophic

calcification. Increased blood flow and altered calcium metabolism in tumors cause excessive radiotracer accumulation, although some pitfalls remain in cases of fractures and degenerative changes (7).

In this reported case, a 22-year-old male patient presented with a rapidly growing tumor on left hip, involving the metadiaphyseal region, initially detected through pelvic x-ray. Observing the clinical features and x-ray finding, the initial differential diagnoses included Osteosarcoma, Chondrosarcoma and Ewing sarcoma. Bone scintigraphy showed focal increased osteoblastic activity in left proximal femur involving femoral head, suggesting a primary bone tumor. Bone scan precisely localized the tumor and excluded any distant metastasis or skip lesions. Usually, osteosarcoma shows such intense focal uptake in the above-mentioned area of a long bone (8).

Other entities like chondrosarcomas bone scan shows heterogeneously increased radionuclide uptake often exceeding that of normal bone. In Ewing sarcoma, the lesions are mostly lytic residing within the bone marrow, thus having little to no reactive new bone formation, so changes are not that much evident in bone scan. One study showed sensitivity for bone scan in Ewing sarcoma is almost 50 % compared to 88% for PET -CT (9). Finally, a pelvic MRI and FNAC concluded the tumor to be a primary MMT of left femur, likely osteosarcoma. Unfortunately, the patient had demised before any biopsy specimen could be obtained.

## CONCLUSION

As diagnosis of mesenchymal tumors requires a synergistic integration of anatomical and functional imaging, nuclear medicine techniques specially bone scintigraphy now has become an integral part in detecting skeletal or soft tissue metastasis, localizing the primary heterogenous tumors, staging and aiding in

histopathological report, along with conventional radiological modalities.

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