

Avascular Necrosis of Femoral Head in Bone Scintigraphy with Concurrent Parathyroid Adenoma Diagnosed by Parathyroid SPECT/CT- A Case Report

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ABSTRACT

Avascular necrosis is a degenerative bone condition that occurs due to an interruption of the subchondral blood vessel. It is categorized as traumatic or non-traumatic based on risk factors, with a hypercoagulable state being one of them. Several studies indicate that hypercoagulability may be linked to hypercalcemia, a significant feature of hyperparathyroidism. Although it is an irreversible condition, early diagnosis can mitigate disability rates. Diagnosis of avascular necrosis and finding out its cause are clinical challenges. Investigative strategies are essential for the diagnosis of diseases and to the etiology behind this. But imaging tests, including nuclear imaging tests, have made it even easier. In this case report, bone scintigraphy played a crucial role in aiding the diagnosis of avascular necrosis, while a parathyroid scan proved instrumental in identifying associated risk factors.

Keywords: Avascular necrosis, bone scan, hypercoagulable state, hyperparathyroidism, hypercalcemia.

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INTRODUCTION

Avascular necrosis, also known as osteonecrosis, aseptic necrosis, and ischemic bone necrosis, is a degenerative bone condition which occurs due to an interruption of the subchondral blood vessel (1, 2). On a broad heading, this is classified as traumatic and non-traumatic on the basis of the risk factor that causes avascular necrosis. Although it is an irreversible condition, early diagnosis can decrease the rate of disability. Numerous non-traumatic factors are linked to avascular necrosis, with a hypercoagulable state being a notable risk factor (3). Some studies indicate that hypercoagulability may be triggered by hypercalcemia which is one of the most important features of hyperparathyroidism (4, 5).

Diagnosis of avascular necrosis and finding out its cause are clinical challenges. In this context, a case of avascular necrosis is presented, where the diagnosis was facilitated by a ^{99m}Tc-MDP bone scintigraphy. Furthermore, a parathyroid scan played a crucial role in identifying the associated risk factors.

CASE REPORT

A 66-year-old female presented with an abrupt-onset of continuous, non-radiating left groin pain for 08 months, which was exacerbated by walking and alleviated by rest. The Pain was not associated with fever and swelling, lacked history of trauma or fall. She had no history of diabetes, hypertension or any other chronic disease. She had not been on any form of medication, prior to the onset of pain.

Initial X-ray of left hip joint and lumbosacral region revealed no abnormality. Conservative treatment with Non-Steroidal Anti-Inflammatory Drugs (NSAID) proved ineffective, and symptoms progressed to generalized bone pain. Then she was referred for whole body bone scan. Scanning was done in anterior and posterior views 3 hours after administration of 20 mCi ^{99m}Tc- methylene diphosphonate (MDP). Delayed static image showed photon deficient area with rim of increased radiotracer concentration in left femoral head with diffuse increased uptake in 4th and 5th lumbar vertebrae. Rest of the skeletal system showed symmetrical tracer distribution (Figure 1).

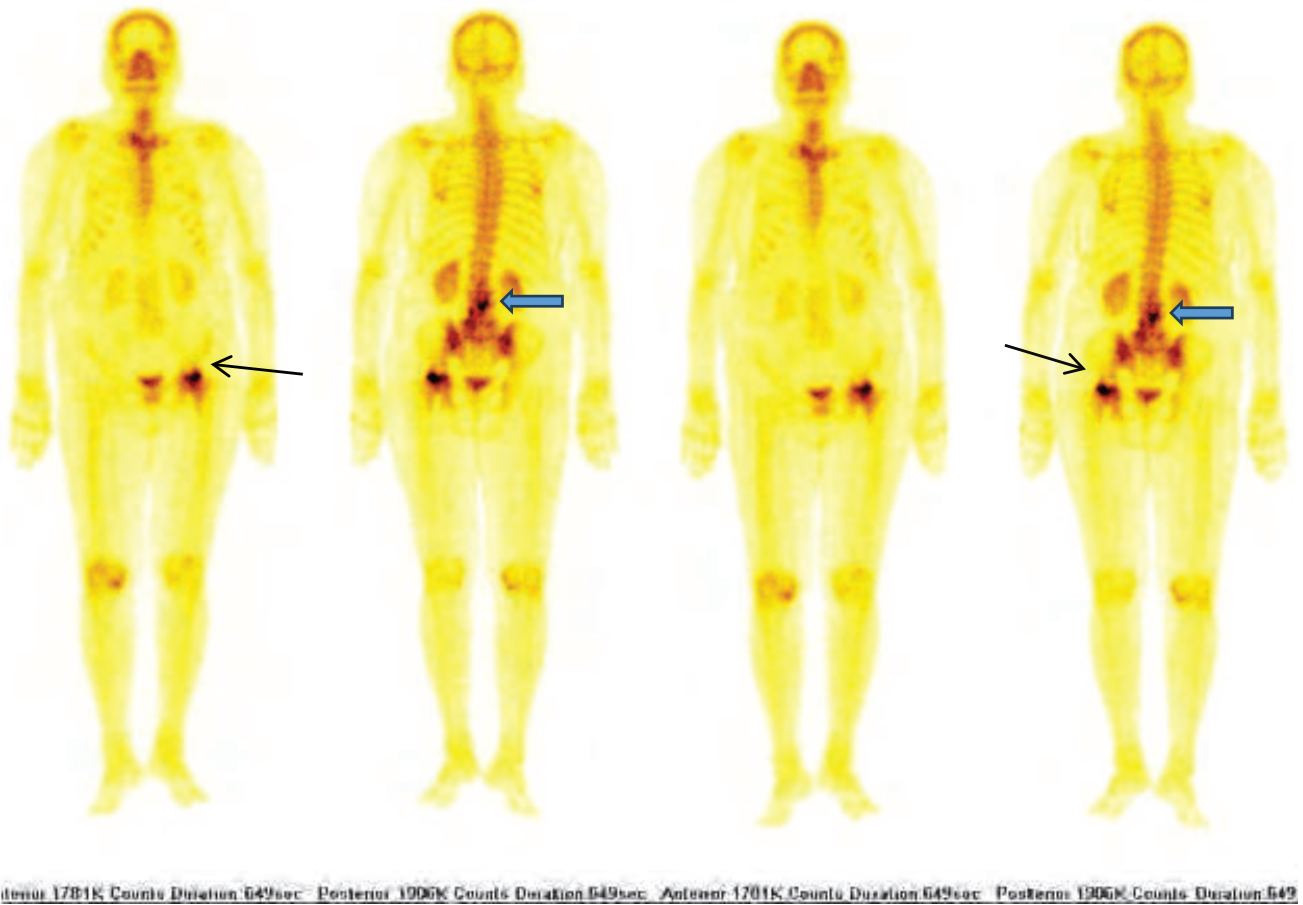


Figure 1: ^{99m}Tc -MDP Bone scan image showing photon deficient area with rim of increased radiotracer concentration in left femoral head (black arrow) with diffuse increased uptake in 4th and 5th lumbar vertebrae (blue thick arrow).

Osteoblastic and osteolytic lesions were consistent with avascular necrosis in head of left femur. Subsequent pelvic Magnetic Resonance Imaging (MRI) confirmed avascular necrosis. Then she was admitted in hospital for core decompression surgery. But her bone pains had started flaring up. Laboratory investigations during the assessment of generalized body ache unveiled elevated calcium level of 11.6 mg/dL (reference range 8.3-10.6 mg/dL), vitamin D3 level within normal range of 40.7 ng/mL (reference range 30-100 ng/ml); slightly decreased serum phosphorus level 2.3 mg/dL (reference range 2.4-4.5 mg/dL), increased creatinine level was 1.3 mg/dL (reference range 0.4-1.2 mg/dl). Additionally, serum parathormone (PTH) level was elevated which was 112 pg/ml (reference range 18.5-88 pg/ml). Then ^{99m}Tc -sestamibi scanning was recommended for

parathyroid evaluation which revealed features suggestive of parathyroid adenoma adjacent to the lower pole of right lobe of thyroid gland (Figure 2).

Then parathyroidectomy was done and histopathology confirmed parathyroid adenoma. After parathyroidectomy serum PTH concentration was 45 pg/ml and the serum calcium concentration was 8.4 mg/dL; both were within the reference value on the second day after surgery. The patient recovered well and was discharged after one week. Six months later, Core decompression surgery was done for avascular necrosis. This case underscores the complexity of diagnosing multifactorial conditions, emphasizing the importance of a systematic approach and interdisciplinary collaboration for optimal patient management.

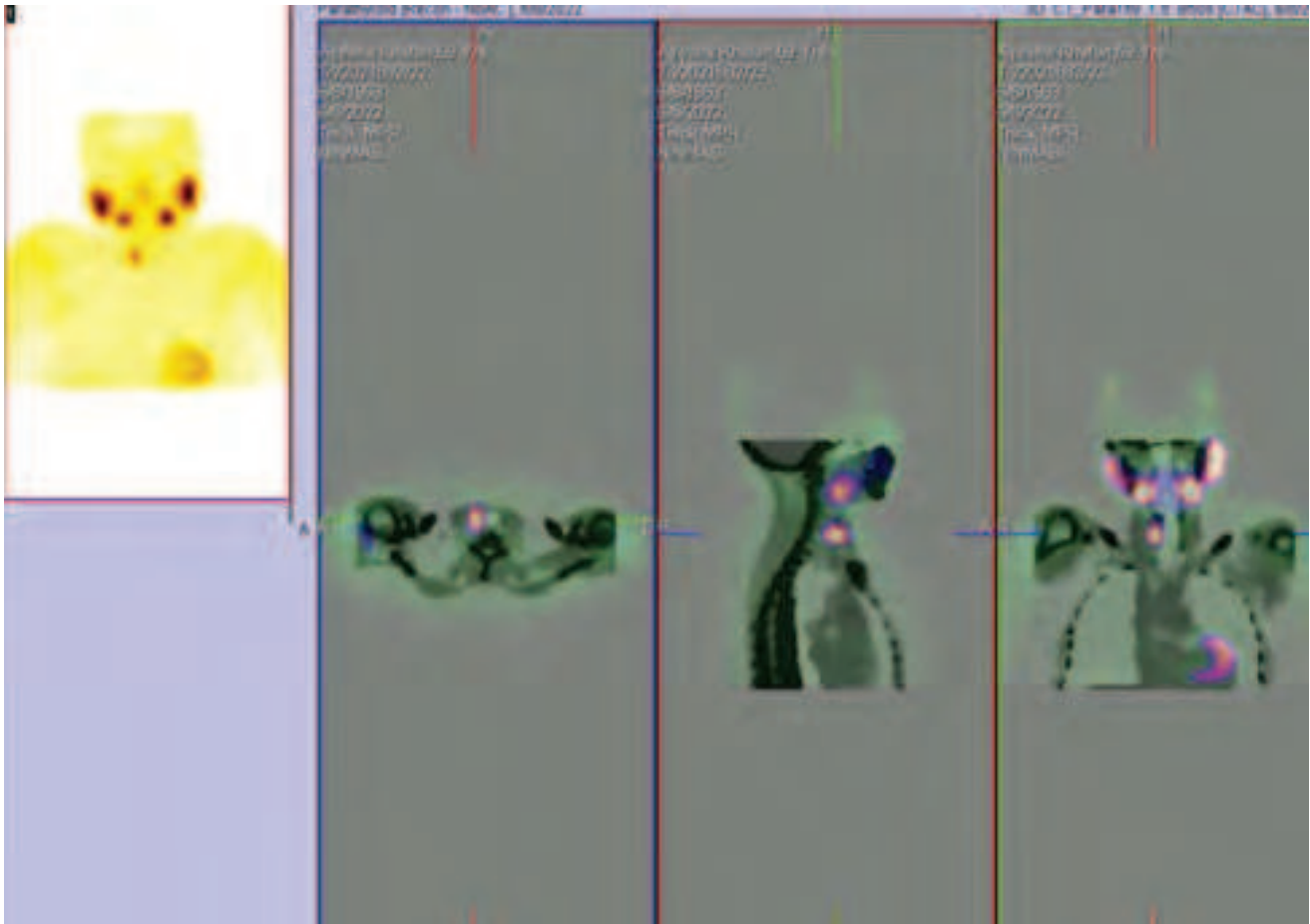


Figure 2: Trans-axial, coronal and sagittal ^{99m}Tc -sestamibi SPECT image showing focal area of increased radiotracer concentration in lower pole of right thyroid bed (black arrow).

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DISCUSSION

Avascular necrosis is characterized by cytotoxic necrosis or ischemia affecting the cellular components of the epiphyseal bone. Avascular necrosis can be either unifocal or multifocal. It may have a systemic origin. In almost

75% of the cases, femoral head avascular necrosis is involved (1). Even though avascular necrosis cannot be reversed, identifying its underlying causes is crucial. It occurs due to traumatic or non-traumatic causes. Non-traumatic causes include use of steroid, alcohol; some hematologic disorders like sickle cell anemia, myeloproliferative disorder, metabolic disorder like Gaucher disease; some conditions such as hypercholesterolemia, pregnancy, chronic renal failure, hyperparathyroidism, Cushing's disease etc. (1, 2). In around 30% of the cases, the cause of non-traumatic avascular necrosis of femoral head (AVNFH) remains unknown; hence, these cases are referred to as idiopathic (3).

Although the exact pathophysiology of avascular necrosis remains unclear, some studies suggest that elevated intravascular coagulation could be a contributing factor.

Hypercalcaemia is one of the risk factors for thrombosis because ionized calcium is a clotting factor. Pathophysiologic process that connects calcium and thrombosis is not completely understood, however, several potential mechanisms have been proposed. Among them are the effects of calcium on vascular smooth muscle, which causes vasoconstriction and activates many clotting system components as well as enhanced platelet aggregation. Additionally, renal disturbances caused by hypercalcemia, including disrupted sodium and water reabsorption, may result in a hypercoagulable state. Also non-compensated polyuria due to nausea and anorexia can lead to dehydration and hypercoagulable state. Moreover, elevated calcium levels may induce cytotoxic effects, triggering cell death and thrombosis (4).

The most common cause of hypercalcaemia is primary hyperparathyroidism. Primary hyperparathyroidism (PHPT) is a systemic disease caused by lesions of the parathyroid gland such as parathyroid adenoma, parathyroid hyperplasia, and parathyroid carcinoma. PHPT causes hypersecretion of parathyroid hormone which ultimately increases calcium level. It is most often identified in postmenopausal women with hypercalcaemia and parathyroid hormone (PTH) levels that are either frankly elevated or inappropriately normal (5).

Diagnosing avascular necrosis typically involves various imaging modalities, including routine plain radiographs, ^{99m}Tc-MDP bone scans, Single Photon Emission Computed Tomography coupled with low-dose CT scans (SPECT/CT), and magnetic resonance imaging (MRI). MRI is considered the gold standard for avascular necrosis diagnosis, while bone scans are primary for detection. Bone scan also helps to perform skeletal survey for skeletal metastasis detection of hyperparathyroidism due to parathyroid adenoma (6, 7). On the other hand, SPECT/CT sestamibi parathyroid scan is gold standard for diagnosis of primary hyperparathyroidism (8, 9).

CONCLUSION

When a patient presents with bony pain, it is crucial to consider uncommon causes beyond the conventional ones. Investigative strategies are essential for accurate disease diagnosis and identifying underlying etiologies. The diagnosis of osteonecrosis, along with its causes, poses a clinical challenge, but the utilization of imaging tests, including nuclear imaging, has significantly facilitated the diagnostic process.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding publication of this paper.

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