

CASE REPORT

SINISTER CAUSE OF HIGH BONE MINERAL DENSITY ON DUAL ENERGY X-RAY ABSORPTIOMETRY

Mairah Razi, Aamna Hassan

Department of Nuclear Medicine, Shaukat Khanum Memorial Cancer Hospital and Research Centre, Lahore-Pakistan

Dual energy X-ray absorptiometry (DXA) has an established, well standardized role in the measurement of bone mineral density (BMD). In routine clinical practice, the main focus of bone densitometry is to identify low bone mass for the diagnosis and monitoring of osteoporosis particularly in postmenopausal females and in high risk individuals. Less commonly, elevated BMD can also be seen on routine DXA scanning usually due to degenerative disease. However, a range of other skeletal disorders can also lead to high BMD. Careful recognition of various artefacts and pathologic processes that can falsely elevate the BMD is essential for accurate DXA scan analysis and reporting. We present a case of high BMD in a patient of prostate carcinoma with widespread sclerotic metastases.

Keywords: DXA; high bone mineral density; sclerotic metastases

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INTRODUCTION

DXA is widely accepted as a non-invasive predictor of bone density and plays an important role in the assessment of osteoporosis and fracture risk. In 1994, the World Health Organization (WHO) proposed criteria for assessing BMD¹. Based on it, ‘osteoporosis’ refers arbitrarily to T-scores less than -2.5, ‘osteopenia’ is described as T-scores between -1.0 and -2.5, and T-scores greater than -1.0 are considered ‘normal’. The exact definition for high BMD does not exist currently.

Low bone mass increases the fracture risk, the converse may or may not be true for high BMD since it can also be seen in conditions of increased skeletal fragility. Clinicians frequently encounter BMD results with T-scores of +2.0 or higher and label it as normal based on the WHO criteria. The absence of a T-score cut-off defining high BMD may distract from further investigation and inadvertently mask the underlying pathology. In 2005, Michael Whyte supported a high BMD definition as a Z-score >+2.5 to guide clinicians to pay greater attention and look for a potential underlying pathology causing this elevated BMD level². To our knowledge, only one review exists which describes the

causes of high BMD like osteopetrosis, fluorosis, myelofibrosis etc.³ We briefly describe here a patient with markedly elevated BMD as a result of sclerotic skeletal metastases. The aim of the study is to highlight a not infrequent cause of increased BMD which may otherwise easily be overlooked.

CASE

A 72 year old male was referred to the department of Nuclear Medicine for evaluation of bone densitometry with DXA scan. He was recently diagnosed as prostate adenocarcinoma Gleason score 8 (4+4) without perineural invasion on histopathology and prostate-specific antigen (PSA) level of 234ng/ml (range: 0.0-4.0 ng/ml). Osteoporosis screening with DXA scanning was advised to evaluate bone health before starting androgen deprivation therapy. Analysis revealed high BMD values in the lumbar spine and femoral neck on DXA. Unexpectedly high BMD values (Figure-1, A & B) were further evaluated and extensive skeletal metastases throughout the axial as well as the appendicular skeleton were discovered on whole body bone scintigraphy using Tc-99m MDP (Figure-2).

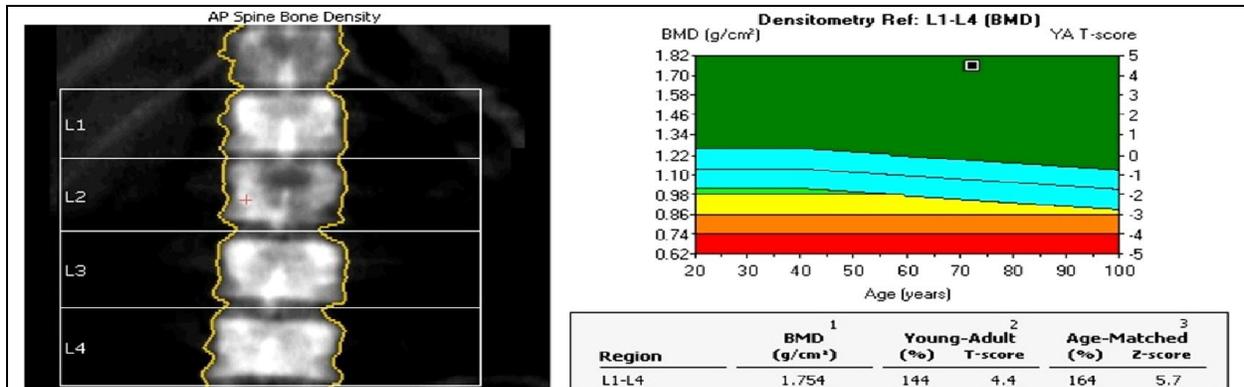


Figure-1: DXA image of 72 year old male. (A) Lumbar spine anteroposterior showing elevated T-scores of L1 (5.6), L2 (0.9), L3 (5.8) and L4 (5.2). (B) Bilateral hip images showing left and right hip total with T-scores of 2.0 and 1.7 respectively.

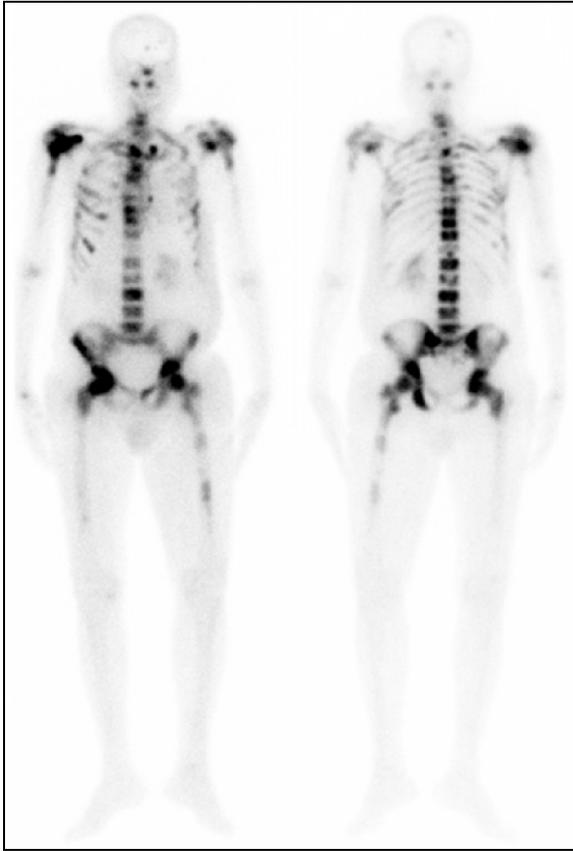


Figure-2: Anterior and posterior images of Tc-99m MDP bone scintigraphy in the same patient show multiple foci of abnormal increased radiotracer uptake throughout the axial and appendicular spine. Increased tracer uptake in the lumbar spine L1–L4 vertebral bodies corresponds to sclerosis on DXA scan and is compatible with osteoblastic metastases.

DISCUSSION

Focal increase in BMD can be due to localized bone disease such as Paget's disease or osteoblastic metastasis.³ Among the most common cause of osteosclerotic metastatic deposits is prostate and breast cancer. In our patient we found that sclerosis in the lumbar vertebral bodies due to osteoblastic metastases secondary to prostate cancer was associated with an increased lumbar BMD.

Hiroyoshi Tanaka *et al.* in a study of 44 patients with prostate cancer reported significantly higher BMD values in patients with osseous metastases than those without metastasis.⁴

Skeletal complications of radiotherapy can increase BMD, e.g. pathological fractures and secondary neoplasms. However, spinal osteoradionecrosis does not generally increase BMD, as marrow is replaced by lower density fat.⁵ High

BMD at an isolated vertebra can be due to a spinal osteoblastoma, Ewing's sarcoma or calcified haemangioma.³

Potential causes of diffuse high BMD value include genetic disorders and a variety of dietary, endocrine, metabolic, infectious and neoplastic diseases. Several uncommon single gene disorders (e.g. Sclerosteosis, *LRP5* mutations) are also associated with markedly elevated BMD.⁶ Routine bone densitometry infrequently displays extremely high bone mineral density in apparently asymptomatic patient.

With increasing age, degenerative changes in the lumbar spine, such as osteophytes and subchondral sclerosis become increasingly common. Such degenerative changes, and undiagnosed vertebral fractures, scoliosis and aortic calcification may cause artificially elevated BMD. Surgical implants and vertebroplasty also result in increased BMD.⁷ The syndesmophytes of ankylosing spondylitis is an important cause of elevated BMD in younger patients.⁸ The abnormal calcium deposition within the DXA region of interest (ROI) leads to the falsely elevated T-score in the lumbar spine.

It is well established that lower cortical BMD is associated with primary hyperparathyroidism. Fredrieck K. W. Chan *et al.* studied a small group of patients with either idiopathic or post thyroidectomy hypoparathyroidism and stated increased BMD with hypoparathyroidism, most notably at the spine. The lower level of bone specific alkaline phosphate (BAP) in patients with hypoparathyroidism supported increased bone mineralization secondary to suppressed bone turnover, resulting in an increase in BMD.⁹

Although patients with high BMD are just as vulnerable as those with low BMD, no clear definition of high BMD exists and BMD results with T-scores above -1.0 are considered normal. High normal BMD as a result of an underlying skeletal disorder may go unrecognized using this criteria. It is imperative to consider further evaluation of elevated bone density on a case by case basis. According to the International Society for Clinical densitometry (ISCD) all male over 70 years of age with no other risk factor for low bone density should have a DXA scan. The incidence of prostate cancer is also high in this age group and it is not uncommon for it to present as unsuspected sclerotic bone metastases.

With improved spatial resolution and high image quality the interpreting physician should treat the DXA image with the same attention given to any other x-ray image, so as not to miss incidental findings.

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Address for Correspondence:

Dr. Mairah Razi, Department of Nuclear Medicine, Shaukat Khanum Memorial Cancer Hospital and Research Centre, Lahore-Pakistan

Cell: +92 321 425 1089

Email: m_sdr@yahoo.com