Skeletal Metastatic Mimicry in Ovarian Cancer: A Case Report on the Diagnostic Challenges of Osteopetrosis and Metabolic Bone Disease

[1] Khandaker Samia Shohana, [2] Nasreen Sultana, [3] Shamsun Nahar Bailey, [3] Papia Akhter, [4] Shimul Sarkar, [5]A.K.M. Fazlul Bari

[1]MD phase B resident, [2]Professor & CMO, [3]Assistant Professor & SMO, [4]Medical officer,[5]Professor & Director, National Institute of Nuclear Medicine & Allied Sciences (NINMAS).

Correspondence Address: Dr. Khandaker Samia Shohana, MD Resident (Nuclear Medicine), NINMAS, Block-D, BMU, Dhaka
Email: samia.tultuly@gmail.com

ABSTRACT

Ovarian carcinoma is a significant malignancy in women, frequently requiring comprehensive follow-up to detect metastasis. Skeletal involvement is often assessed via anatomical imaging like CT and MRI; however, these modalities can occasionally encounter "metastatic mimics." Reported case entails a 43-year-old woman with a history of ovarian cancer whose follow-up contrast enhanced CT (CECT) and magnetic resonance imaging (MRI) suggested widespread osteoblastic metastases. Subsequent functional imaging (bone scintigraphy) and laboratory investigations inclined toward metabolic bone disease rather than malignancy. A CT-guided core needle biopsy of the rib ultimately confirmed the absence of malignant cells, identifying the dense skeletal lesions as a combination of osteopetrosis and severe vitamin D deficiency (osteomalacia). This case highlights the necessity of multimodality imaging and histological confirmation to prevent the misdiagnosis of metastatic disease.

Keywords: Ovarian carcinoma, Osteopetrosis, Metastatic mimic, Bone scintigraphy, Vitamin-D deficiency.

Bangladesh J. Nucl. Med. Vol. 28 No. 2 July 2025

DOI: https://doi.org/10.3329/bjnm.v28i2. 89184

INTRODUCTION

Ovarian cancer remains a leading cause of gynecological cancer-related mortality. Standard management involves a combination of cytoreductive surgery, such as total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH+BSO) and chemotherapy. During post-treatment surveillance, clinicians rely heavily on imaging to detect recurrence. While bone metastasis in ovarian cancer is relatively uncommon compared to other cancers, its presence significantly alters staging and prognosis.

Distinguishing between true osteoblastic metastasis and benign sclerotic conditions such as osteopetrosis or metabolic bone diseases is known diagnostic pitfall. While anatomical imaging (CT/MRI) provides high spatial resolution, it can sometimes be misleading. Functional imaging, such as bone scintigraphy, provides metabolic context that is often vital in differentiating systemic bone disorders from localized malignant deposits.

CASE REPORT

A 43-year-old woman of known ovarian carcinoma underwent thorough treatment regimen including neoadjuvant chemotherapy (NACT), TAH+BSO and radiotherapy. In 2026, during a routine follow-up, imaging was performed to monitor for recurrence MRI lumbar spine revealed diffuse hypointense signal changes across vertebral bodies and pedicles. CECT reported multiple "osteoblastic deposits" in all visualized bones, raising high suspicion for skeletal metastasis and also revealed a hepatic lesion was noted, but cytology suggested a benign cystic lesion with no malignancy. To resolve the clinical suspicion, bone scintigraphy was conducted. Bone scintigraphy showed intense, symmetric radiotracer concentration throughout the skull, ribs, vertebrae, and appendicular skeleton. This "super scan-like" appearance was characteristic of a metabolic process rather than the asymmetric, "hot spot" pattern typically seen in osteoblastic metastasis. After reviewing the bone scintigraphy findings, metabolic bone disease was suspected. On further clinical inquiry, the patient presented with frontal bossing and reported localized right-sided chest pain.

Physical examination revealed localized tenderness over the right ninth rib. The pain was non-progressive in nature and was not associated with nocturnal exacerbation, findings that made metastatic bone pain less likely. After multidisciplinary discussion with the treating physician, a decision was made to perform a bone biopsy from the right ninth rib for definitive evaluation. Histopathological examination of the biopsy specimen showed no evidence of malignancy. Laboratory results further complicated the picture, showing severe vitamin D deficiency (11.1 ng/ml), both calcium (8.99 mg/dl) and PTH level (47.3 pg/mL) are also normal. To reach a final conclusion, a CT-guided core needle biopsy of the right 9th rib was performed. Microscopic examination showed fragments of trabecular bone and fibrocollagenous tissue with minor inflammatory cells. Crucially, no malignant cells were identified, confirming that the dense lesions were not metastatic.

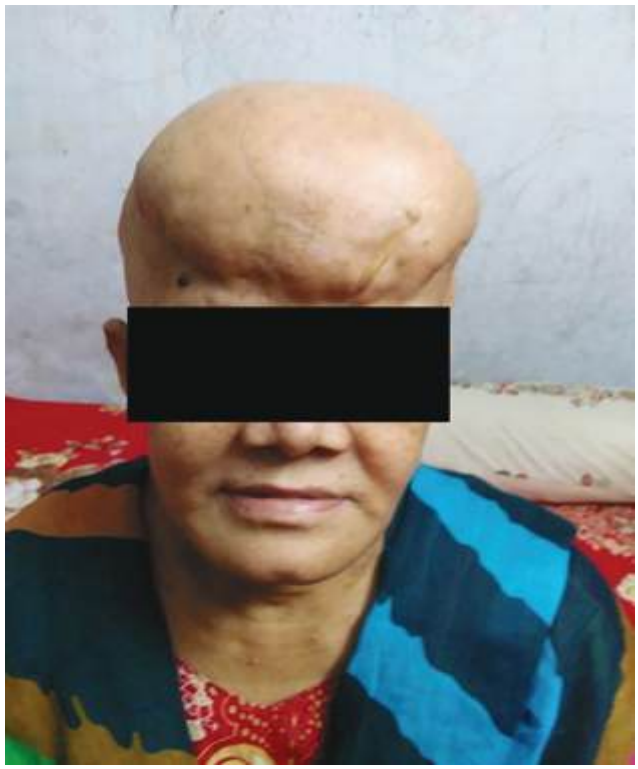
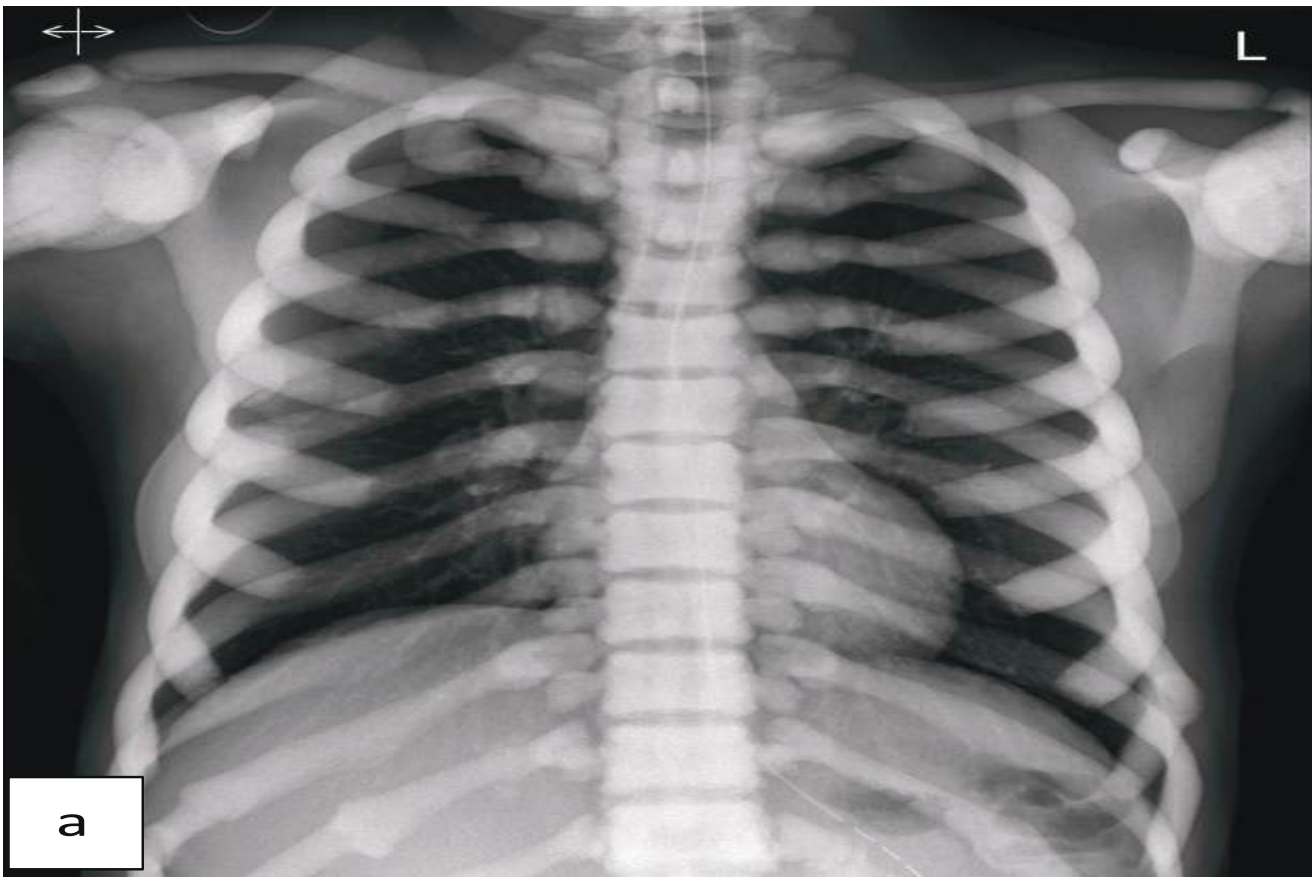


Figure1: 43 years old female with diagnosed case of ovarian cancer presenting with unusually prominent supraorbital ridging and frontal bossing common in advanced osteopetrosis.



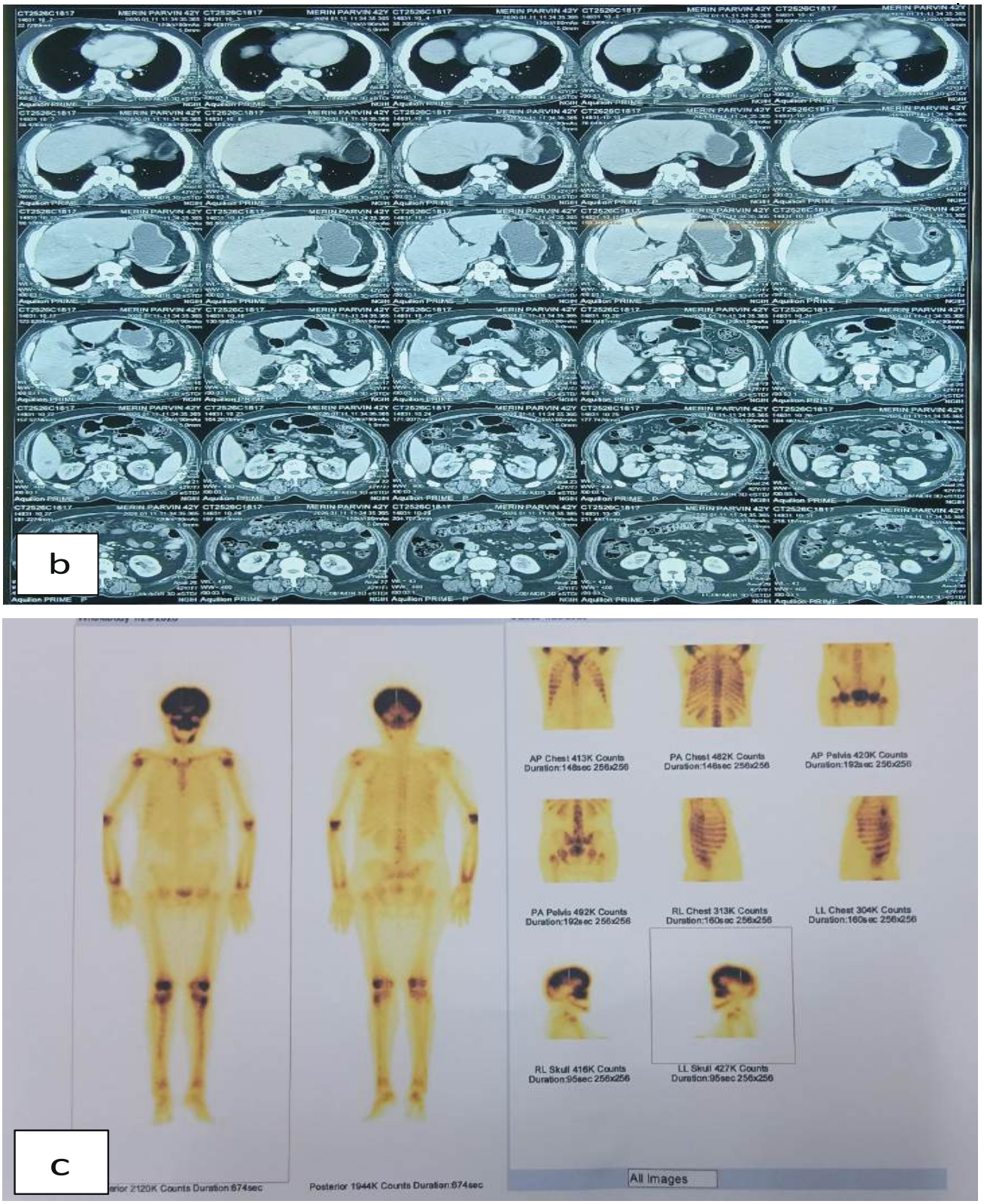


Figure-1: (a) Chest x-ray shows multiple mixed sclerotic and lytic lesion suggesting skeletal metastasis (b) CECT (HBS) shows cortical thickening with multiple osteoblastic deposits in all visible bones suggestive of extensive osteoblastic metastasis, (c) Bone scintigraphy shows nonhomogeneous and diffusely increased radiotracer concentration in appendicular bones suggestive of metabolic bone disease.

A retrospective review of a 2024 Chest X-ray revealed pre-existing increased bone density in the ribs and scapula, suggesting a long-standing condition like osteopetrosis.

Bone scintigraphy is more sensitive than CT, as it can detect early metabolic bone disease before structural changes appear and allows evaluation of the entire skeleton.

DISCUSSION

The central diagnostic challenge in this case was the "metastatic mimicry" wherein benign skeletal pathology closely simulated the imaging appearance of disseminated malignant disease. Ovarian carcinoma, though an uncommon source of bone metastasis relative to breast or prostate cancer, can involve the skeleton in up to 2–6% of advanced cases, and detection of osteoblastic lesions during surveillance inevitably raises alarm (1, 2). In the present case, both CECT and MRI demonstrated diffuse sclerotic changes across the axial and appendicular skeleton, a pattern that radiologically overlaps with osteoblastic metastases from gynecological primaries. However, the key to correct interpretation lay in correlating structural findings with clinical context and functional imaging rather than relying on morphology alone (3). The simultaneous presence of two independent benign conditions, osteopetrosis and severe vitamin D deficiency leading to osteomalacia, produced a composite radiological picture indistinguishable from widespread skeletal metastasis on conventional imaging. This underscores the recognized limitation that anatomical modalities such as CT and MRI reveal structural density rather than pathological behavior (4).

Osteopetrosis, first described by Heinrich Ernst Albers-Schönberg in 1904, is a rare hereditary disorder of osteoclast dysfunction resulting in defective bone resorption and pathologically increased skeletal density (5). It exists in two principal clinical forms: the severe autosomal recessive (malignant infantile) variant and the milder autosomal dominant (adult) form, the latter often remaining clinically silent until discovered incidentally on imaging (5, 6). The hallmark radiological features include diffuse osteosclerosis, a "bone within bone" appearance, rugger-jersey spine, and thickened cortices with narrowed medullary cavities (6). These features can remarkably mimic osteoblastic metastases, particularly in a patient with a known primary malignancy. In our patient, retrospective review of a 2024 chest radiograph revealing pre-existing increased bone density in the ribs and scapula was a critical finding, confirming that the dense skeleton long predated the oncological diagnosis and was therefore consistent with a constitutional skeletal disorder rather than a metastatic process (5). Such retrospective radiological correlation is invaluable in avoiding the trap of attributing pre-existing skeletal abnormalities to newly developing malignant deposits (3).

Compounding the diagnostic complexity was the concurrent severe vitamin D deficiency (serum 25-hydroxyvitamin D: 11.1 ng/ml), well below the deficiency threshold of 20 ng/ml as defined by the Endocrine Society (7). Vitamin D deficiency leads to impaired intestinal calcium absorption, compensatory secondary hyperparathyroidism, and defective mineralization of osteoid, the clinical and pathological syndrome termed "osteomalacia" (7,8). Radiographically, osteomalacia can produce generalized skeletal haziness, coarsened trabeculation, and pseudo-fractures (Looser zones) that, in the background of an already dense osteopetrotic skeleton, generate a profoundly confusing appearance on CT and MRI (8). The preserved serum calcium (8.99 mg/dL) and normal parathyroid hormone (PTH 47.3 pg/mL) in this patient are consistent with the early compensated phase of vitamin D deficiency osteomalacia, wherein PTH-mediated calcium homeostasis maintains near-normal serum calcium at the cost of ongoing bone mineralization deficit (7). This biochemical profile, atypical for advanced metastatic disease, further supported a metabolic rather than malignant etiology (9).

The pivotal diagnostic contribution was made by bone scintigraphy using technetium-99m methylene diphosphonate (^{99}mTc-MDP). While CT and MRI characterize bone morphology, bone scintigraphy reflects osteoblastic metabolic activity and perfusion, rendering it a functional rather than purely structural tool (10). The characteristic pattern observed in this case that is intense, symmetric, and diffuse radiotracer uptake throughout the skull, ribs, vertebrae, and appendicular skeleton is the hallmark of a "super scan," a recognized scintigraphy pattern of metabolic bone disease including osteomalacia, renal osteodystrophy, and Paget's disease, rather than multifocal malignant deposits (10,11).

The role of CT-guided core needle biopsy in this case cannot be overstated. Despite the compelling functional imaging and biochemical evidence favoring metabolic bone disease, tissue histopathology remains the gold standard for definitively excluding malignancy in a patient with a known primary cancer (12). The biopsy specimen from the right ninth rib demonstrated fragments of trabecular bone and fibrocollagenous tissue with minor inflammatory infiltrate and, critically, the complete absence of malignant cells. This histological confirmation was essential not only to finalize the diagnosis but also to prevent the potentially catastrophic consequences of misclassification, like unnecessary systemic chemotherapy, radiation therapy, or palliative labeling of the patient as having incurable stage IV disease (4, 12). Several analogous cases in the literature have highlighted how aggressive benign conditions such as Paget's disease of bone, fibrous dysplasia, and giant aneurysmal bone cysts have been misinterpreted as skeletal metastases on scintigraphy or cross-sectional imaging, underscoring the need for histological verification before irrevocable treatment decisions are made (13).

This case report has significant implications for multidisciplinary cancer care and clinical practice in oncological imaging. First, it reaffirms that positive findings on anatomical imaging must always be interpreted within their full clinical context, including the character of symptoms, temporal evolution of lesions, and pertinent laboratory data (9). The non-progressive, non-nocturnal nature of this patient's chest pain and the absence of hypercalcemia were important negative predictors of a metastatic etiology. Second, it demonstrates the indispensable complementary role of functional nuclear medicine imaging in oncology surveillance; bone scintigraphy not only detected early metabolic activity before structural deterioration but also provided a whole-body physiological survey that fundamentally altered the diagnostic impression (10,11). Third, vitamin D deficiency, which is endemic in the South Asian population with reported prevalences exceeding 70–90% in some Bangladeshi cohorts, must always be screened for in cancer patients presenting with diffuse skeletal abnormalities, as it may independently or synergistically amplify imaging artifacts (9). Finally, this case advocates for a structured multimodality algorithm in oncological skeletal assessment: cross-sectional imaging should be followed by functional scintigraphy in equivocal cases, supplemented by targeted laboratory evaluation and, where doubt persists, image-guided biopsy for histological certainty (12). The integration of these modalities is the only reliable safeguard against the dual hazards of under-treatment of true metastasis and over-treatment of benign disease (13).

CONCLUSION

Skeletal involvement in cancer patients is not always what it seems. As demonstrated in this case, the coexistence of osteopetrosis and severe nutritional deficiency can perfectly mimic widespread bone metastasis on conventional scans. A thorough approach utilizing functional imaging and, ultimately, tissue biopsy is essential to ensure patients are not over-treated for a metastatic stage they do not have.

REFERENCES

1. Gould CF, Ly JQ, Lattin GE Jr, Beall DP, Sutcliffe JB 3rd. Bone tumor mimics: avoiding misdiagnosis. Curr Probl Diagn Radiol. 2007;36(3):124–41.
2. Ren G, Esposito M, Kang Y. Bone metastasis and the metastatic niche. J Mol Med (Berl). 2015;93(11):1203–12.
3. Hamaoka T, Madewell JE, Podoloff DA, Hortobagyi GN, Ueno NT. Bone imaging in metastatic breast cancer. J Clin Oncol. 2004;22(14):2942–53.
4. Even-Sapir E, Martin RH, Barnes DC, Pringle CR, Iles SE, Mitchell MJ. Role of SPECT in differentiating malignant from benign lesions in the lower thoracic and lumbar vertebrae. Radiology. 1993;187(1):193–8.
5. Del Fattore A, Cappariello A, Teti A. Genetics, pathogenesis and complications of osteopetrosis. Bone. 2008;42(1):19–29.
6. Stark Z, Savarirayan R. Osteopetrosis. Orphanet J Rare Dis. 2009;4:5.
7. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab. 2011;96(7):1911–30.
8. Bhan A, Rao AD, Rao DS. Osteomalacia as a result of vitamin D deficiency. Endocrinol Metab Clin North Am. 2010;39(2):321–31.
9. Zaman S, Hawlader MDH, Biswas A, Hasan M, Jahan M, Ahsan GU. High prevalence of vitamin D deficiency among Bangladeshi children: an emerging public health problem. Health. 2017;9(12):1680–91.
10. Zuckier LS, Martineau P. Altered biodistribution of radiopharmaceuticals used in bone scintigraphy. Semin Nucl Med. 2015;45(1):81–96.
11. Guglielmi G, Muscarella S, Bazzocchi A. Integrated imaging approach to osteoporosis: state-of-the-art review and update. Radiographics. 2011;31(5):1343–64.
12. Dominguez M, Rayo JI, Serrano J, Sanchez R, Infante JR, Garcia L, et al. Vertebral hemangioma: "cold" vertebrae on bone scintigraphy and fluorodeoxyglucose positron emission tomography-computed tomography. Indian J Nucl Med. 2011;26(1):49–51.
13. Huang TL, Chen WM, Chen WY, Chen TH. Huge aneurysmal bone cyst of iliac bone in a mid-aged female. J Chin Med Assoc. 2004;67(2):99–103.