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Case report

Sacral insufficiency fracture after pelvic radiotherapy: A diagnostic challenge for a radiologist

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ABSTRACT

Sacral insufficiency fractures can occur as a complication after pelvic radiotherapy. Despite several recent studies showing high incidence of sacral insufficiency fractures in elderly women after pelvic radiotherapy this condition still remains underdiagnosed. We present a case of sudden onset of low back pain in a female patient with a history of cervical cancer radiotherapy. Initial diagnostic imaging misinterpreted SIF for metastasis. Bone scan and single-photon emission-computed tomography with low-dose computed tomography revealed the correct diagnosis. Due to the reasons that sacral insufficiency fractures still remain underdiagnosed this report is important to practical routine work of oncologists and radiologists.

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1. Introduction

Although relatively common in elderly and other patients with structurally weakened bones and low back or pelvic pain, sacral insufficiency fractures still remain underdiagnosed. Sacral insufficiency fracture (SIF) is a type of fracture which occurs within normal stress on bone, weakened by demineralization or decreased elastic resistance of bone matrix due to osteoporosis, previous radiotherapy, rheumatoid arthritis, prolonged use of corticosteroids, diabetes or renal failure [1,2].

Since the first description by Lourie in 1982 [3], SIF has been considered as relatively uncommon. Exact incidence of SIF still remains undetermined, however several recent studies revealed that in risk group patients such as pelvic radiotherapy, insufficiency fractures prevalence is 9.5%–11.4% [1,4,5]. These fractures can present as low back and sacral pain, radiating into the buttock or leg. Infrequently patients with SIFs can be asymptomatic. In oncologic patients after radiotherapy SIF can be misinterpreted as bone metastases. Incorrect diagnosis can lead to unnecessary expensive diagnostic tests and chemotherapy, whereas delayed diagnosis and treatment of SIFs can lead to immobility and

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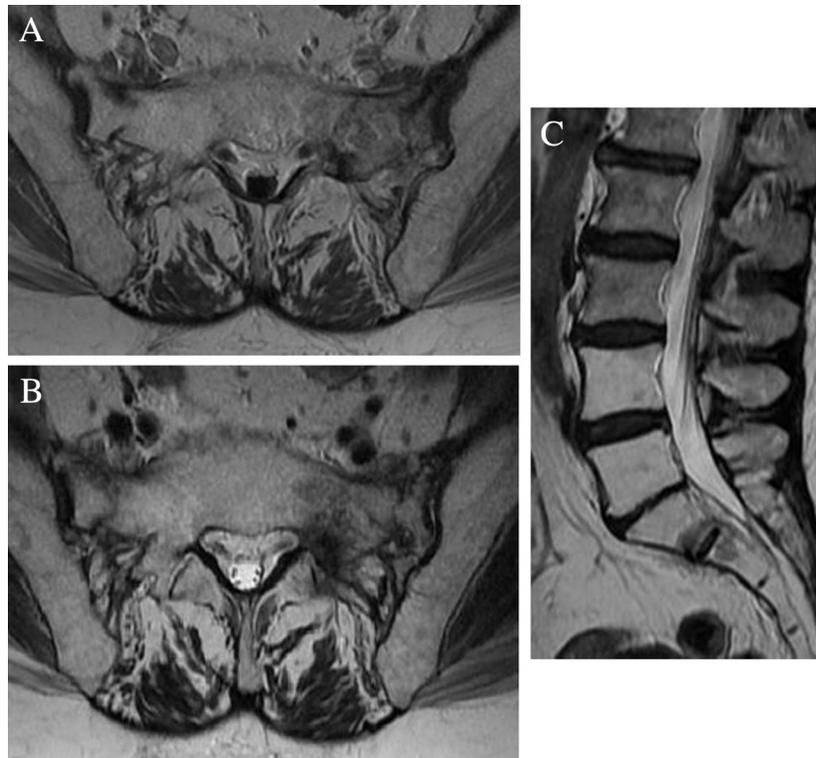


Fig. 1 – Focally heterogeneous signal is seen on magnetic resonance T1-weighted (A), T2-weighted (B) axial images in the left lateral part of the sacrum. Diffuse signal change in L4-5 and the sacrum on sagittal T2-weighted (C) image due to fatty infiltration of bone marrow after radiotherapy.

complications [6]. We would like to present a clinical case to emphasize the awareness of this condition, which is particularly important for radiologist to avoid misinterpretation of SIFs in the setting of concomitant oncologic disease.



Fig. 2 – Axial CT images show focally decreased bone density, patchy sclerosis and loss of cortical bone integrity in the left part of S1.

2. Case report

A 72-year-old woman presented with a new onset of low back pain and had a previous history of cervical cancer. Two years ago patient had a diagnosis of cervical cancer T3bN0M0 and she received radiotherapy with total dose of 61.2 Gy. Neither surgery nor chemotherapy was applied due to numerous associated diseases such as bronchial asthma, hypertension, gastric ulcer and morbid obesity.

Regarding to the new onset of low back pain and previous oncologic history, bone metastases were initially suspected. The patient was referred to magnetic resonance imaging (MRI) of the lumbar spine in another institution (Fig. 1). This examination revealed changes in the sacrum which were described as possible metastasis and computed tomography (CT) of the lumbar spine was recommended to specify MRI findings (Fig. 2). CT was performed 3 weeks later and findings were reported as focal destruction in the left lateral part of the sacrum.

The patient was referred to an oncologist in the Institute of Oncology, Vilnius University, to assess possible relapse of cancer and assign chemotherapy. In addition the patient was referred to the Department of Nuclear Medicine to undergo a bone scan for evaluation of changes in the sacrum and detection of possible metastases in other bones. The patient received an intravenous injection of 640 MBq of Technetium-99m-methylene diphosphonate (99mTc-MDP) and an initial

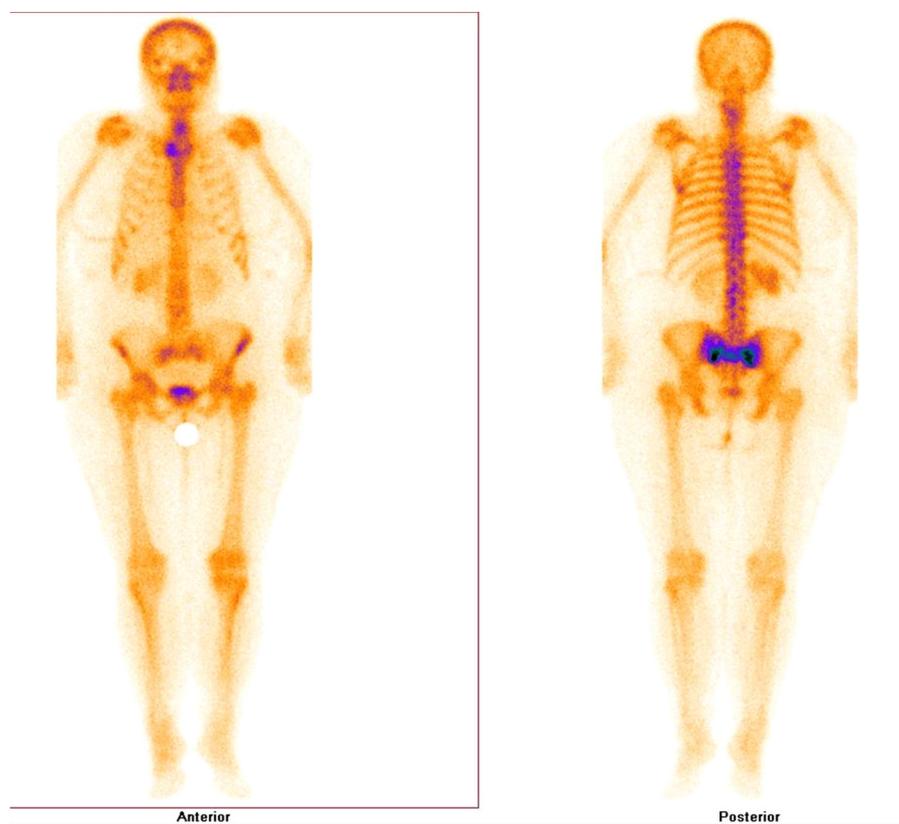


Fig. 3 – ^{99m}Tc -MDP bone scan shows bilaterally increased osteoblastic activity in lateral parts of the sacrum.

bone scan was performed 3 h after injection, according to a standard protocol. In our institution whole body bone scan is performed with dual-headed gamma camera equipped with a low-energy, high-resolution collimator. Acquisition energy window is 140-keV ($\pm 7.5\%$). Whole-body views are obtained in a matrix of 256×1024 and scanning speed of 10 cm/min. Bone scan showed gross focally increased osteoblastic activity bilaterally in lateral parts of the sacrum (Fig. 3). Single-photon emission-computed tomography (SPECT) and low-dose CT of the lumbar spine and pelvis were performed. SPECT acquisition and processing standard parameters are 180° detector spin, number of views 90, time per view 7 s and 128×128 matrix. Low dose CT scanning parameters are 15-mAs current and 130-kV tube voltage, 5-mm slice thickness, pitch of 0.85, X-ray tube rotation speed of 0.6 s, and 2.5-mm image reconstructions. Obvious fracture lines with mottled sclerosis, lucency and cortical breaks were seen in sacral ala bilaterally and in the left transverse process of L5 vertebra (Fig. 4). These imaging findings were diagnostic of sacral insufficiency fracture.

The follow-up CT of the lumbar spine, performed 2 months later, revealed moderate remodeling of healing sacral fractures (Fig. 5).

The patient did not receive any specific surgical or medicament treatment. Despite that, clinical outcome within next several months showed gradual relief of low back pain.

The follow-up bone scan, performed 7 months after the first bone scan, showed a decrease of osteoblastic activity in both

lateral parts of the sacrum as a result of healing (Fig. 6). No other focal sites of increased activity, suspicious for metastases, were found. Follow-up bone scan was sufficient for evaluation of healing sacral fractures and there were no indications for additional SPECT/CT imaging.

The patient is going to be followed up according to the standard protocol.

3. Discussion

SIFs can be a diagnostic challenge for a radiologist, especially when the patient has a previous cancer history, since these fractures occur as a new onset of the low back pain without any significant trauma. Moreover, the radiologist might not be familiar with this condition and the lesion in the sacrum could be misinterpreted as a metastasis.

Different imaging modalities can be used to detect SIFs. Plain films are considered insensitive as only 20%–38% of SIFs and pelvic fractures can be identified [7]. Insufficiency fractures tend not to produce callus and fracture line may not be evident on plain films because of osteopenia and overlying bowel gas [8].

Cross-sectional imaging methods such as CT and MRI are widely used for detection of SIFs. In a study by Cabarrus et al. [9], the ability of both imaging techniques to detect pelvic insufficiency fractures was compared. In their study, 67 sacral

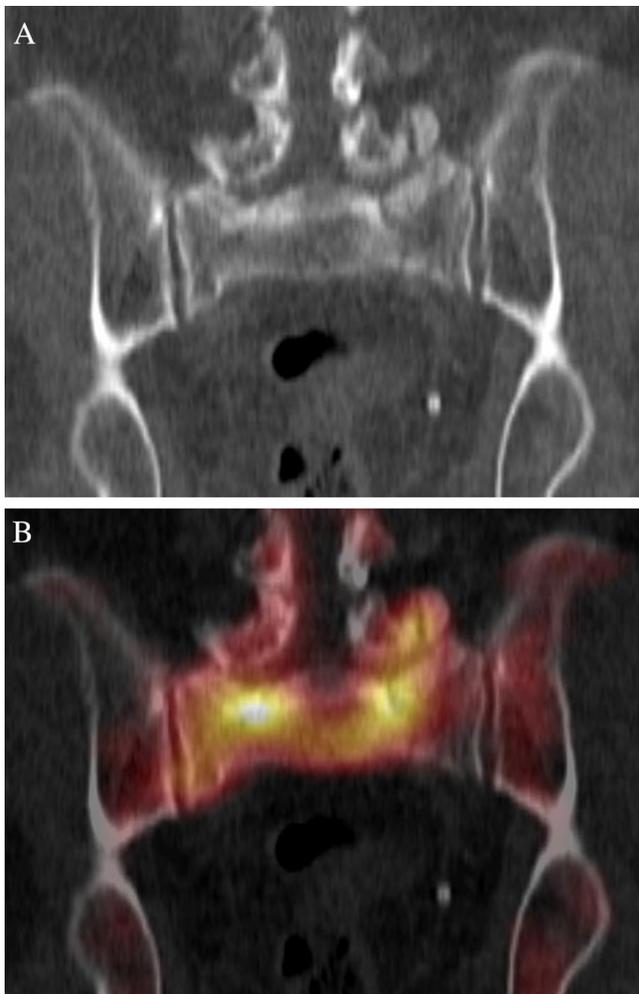


Fig. 4 – Low dose CT (A) and hybrid SPECT/CT (B) images demonstrate increased osteoblastic activity and obvious fracture lines with mottled sclerosis in the left lateral part of the sacrum and transverse process of L5 vertebra.

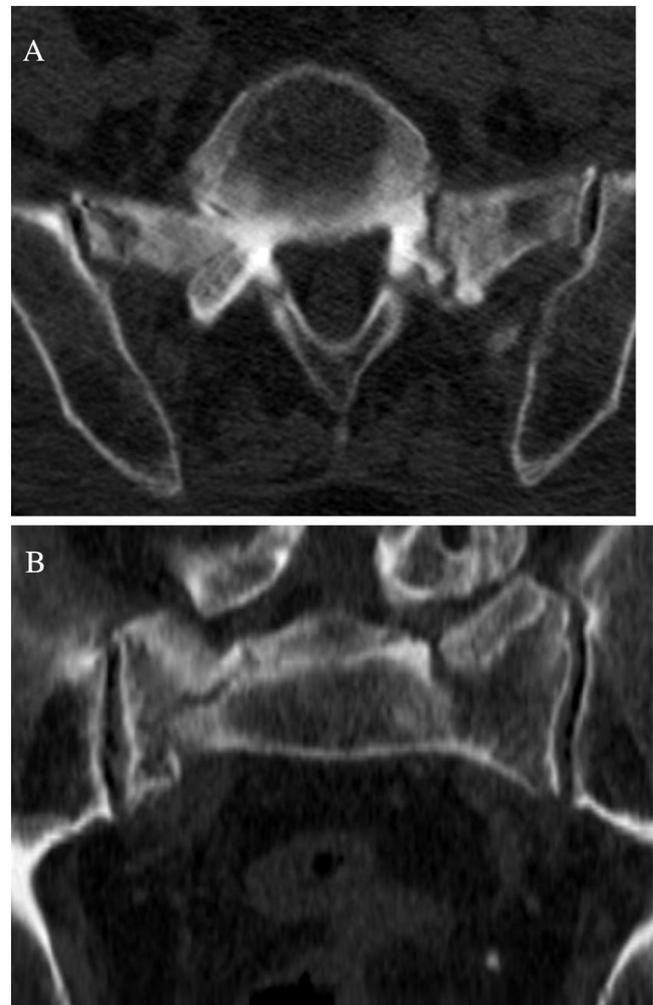


Fig. 5 – Follow-up axial (A) and coronal (B) CT images: remodeling of healing bone is seen as moderately increased sclerosis around clearly visible fracture lines in both lateral parts of the sacrum.

fractures were evaluated, and overall sensitivity of MRI was 100% compared to 74.6% sensitivity of CT. Although the ability of both imaging techniques to detect fracture lines was similar, 95.3% for MRI and 89.7% for CT. MRI was also better in detection of soft tissue lesions.

Bone scan still remains one of the most sensitive examinations in detection of SIFs. The typical so-called “Honda” sign or H-pattern is considered diagnostic of SIF, however it is visible in only up to 40% of cases [10]. Bone scan has a reported sensitivity of 96% for the detection of SIFs [11]. However it might be difficult to differentiate between benign and malignant bone lesions with planar bone scan alone. In a comparative study of planar bone scan, SPECT and SPECT/CT of 42 bone lesions a specific diagnosis was made with planar bone scan in 64% of cases, SPECT in 86%, and SPECT/CT in all cases [12]. In our presented clinical case SPECT/CT was either the examination which confirmed the diagnosis of SIF.

In recent years, positron emission tomography and computed tomography (PET/CT) is increasingly used to follow up cancer patients and can be as well used to detect SIFs after radiotherapy. SIF might show typical “H” shaped FDG uptake similar to the pattern in a bone scan. In addition, SIF sites tend to have a lower standard uptake value (SUV) than malignant lesions [1].

The major risk factors of SIF include female gender, age more than 75 years, and low bone mineral density score [1]. Pelvic radiotherapy is considered to be a significant risk factor of the SIFs [1,5,13]. Other sites can as well be affected during radiotherapy and result in insufficiency fractures of pubic ramus, acetabulum, femoral neck and ilium. Several studies have found out pubic fractures associated with SIFs occur in up to 33% of cases [1,8,13]. It is advised to make more accurate review of pelvic ring and proximal part of femur in addition to SIFs because of the high incidence of associated fractures.

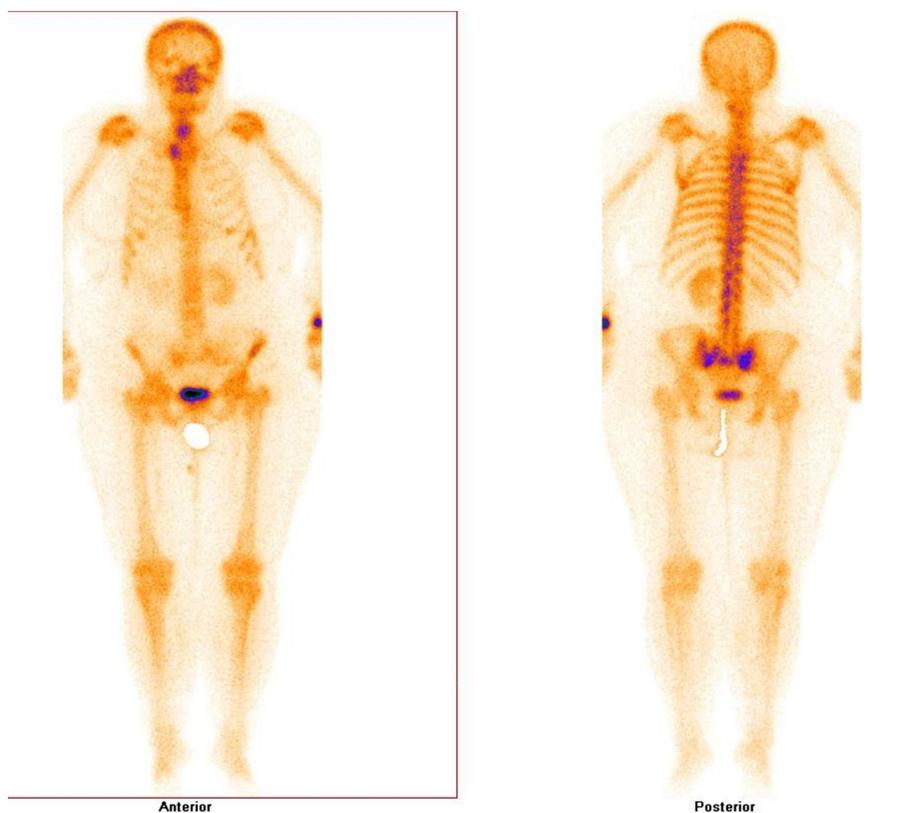


Fig. 6 – Follow-up $^{99m}\text{Tc-MDP}$ bone scan shows decrease of osteoblastic activity in lateral parts of the sacrum.

4. Conclusions

Sacral insufficiency fractures are common, yet underdiagnosed late complication after pelvic radiotherapy. Occasionally fracture lines might not be visible on plain radiographs and CT images. Therefore, it could be a diagnostic challenge for the radiologist. MRI and a bone scan with SPECT/CT are considered the most sensitive and specific imaging modalities to detect SIFs. Precise review of the whole pelvic ring and proximal part of femur is advisable due to high incidence of associated fractures. Adequate diagnosis and pain management of SIF in the setting of concomitant oncologic disease is essential to improve quality of life of patient and prevent them from inappropriate treatment.

Conflict of interest

The authors state no conflict of interest.

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