

Received: 2012.10.21  
Accepted: 2012.12.10

## Radiation-induced sarcoma in spine

Lok Sang Kam, Marina Portia Anthony, H. Shek

The University of Hong Kong, Hong Kong, China

Author's address: Lok Sang Kam, The University of Hong Kong, Hong Kong, China, e-mail: ballack0987@yahoo.com.hk

### Summary

Although radiotherapy is a part of treatment in cancers, it can also induce malignancy as a late complication. The presence of radiation-induced sarcomas in bone, although not very common, is acknowledged. The onset of radiation-induced sarcoma in the spine however, is not well recognized. We present here a case of radiation-induced fibrosarcoma in the T1 lamina and spinous process in a patient with a history of breast cancer treated with radiotherapy 30 years prior.

**Key words:** radiation • radiotherapy • sarcoma • fibrosarcoma • spine

**PDF file:** <http://www.polradiol.com/fulltxt.php?ICID=883770>

### Background

Since the beginning of its use, radiation in medical practice has raised concerns regarding the risk of inducing cancers in treatment recipients. Today, it is well recognized that radiation can induce malignancy, and common examples include breast (female), thyroid, lung and leukemia [1]. Radiotherapy-induced bone tumor has also been reported but the incidence is below 1% in 5 years after treatment [2–4], which is much lower than that of the common ones. The data for determining the exact incidence of the induced bone tumor is incomplete due to the apparently low incidence rate [5] but it is believed that the risk depends on the age at which the patient receives the radiation (risk increases with younger age), size of the radiation field and the dose of radiation received. In children receiving total body irradiation, the incidence can reach as high as 29% [6]. The typical types of bone tumors induced include benign osteochondroma and malignant sarcoma, of which osteosarcoma is the most common.

As for other types of radiation-induced cancers, radiotherapy-induced sarcoma has a latent period ranging from a couple of years to decades, with the mean lying between 10 to 20 years [7]. The site of cancer development usually lies on the periphery of the radiation field [8]. Here, we present an elderly female with previous radiotherapy for breast cancer, 30 years prior, subsequently developing a fibrosarcoma in the spine.

### Case Report

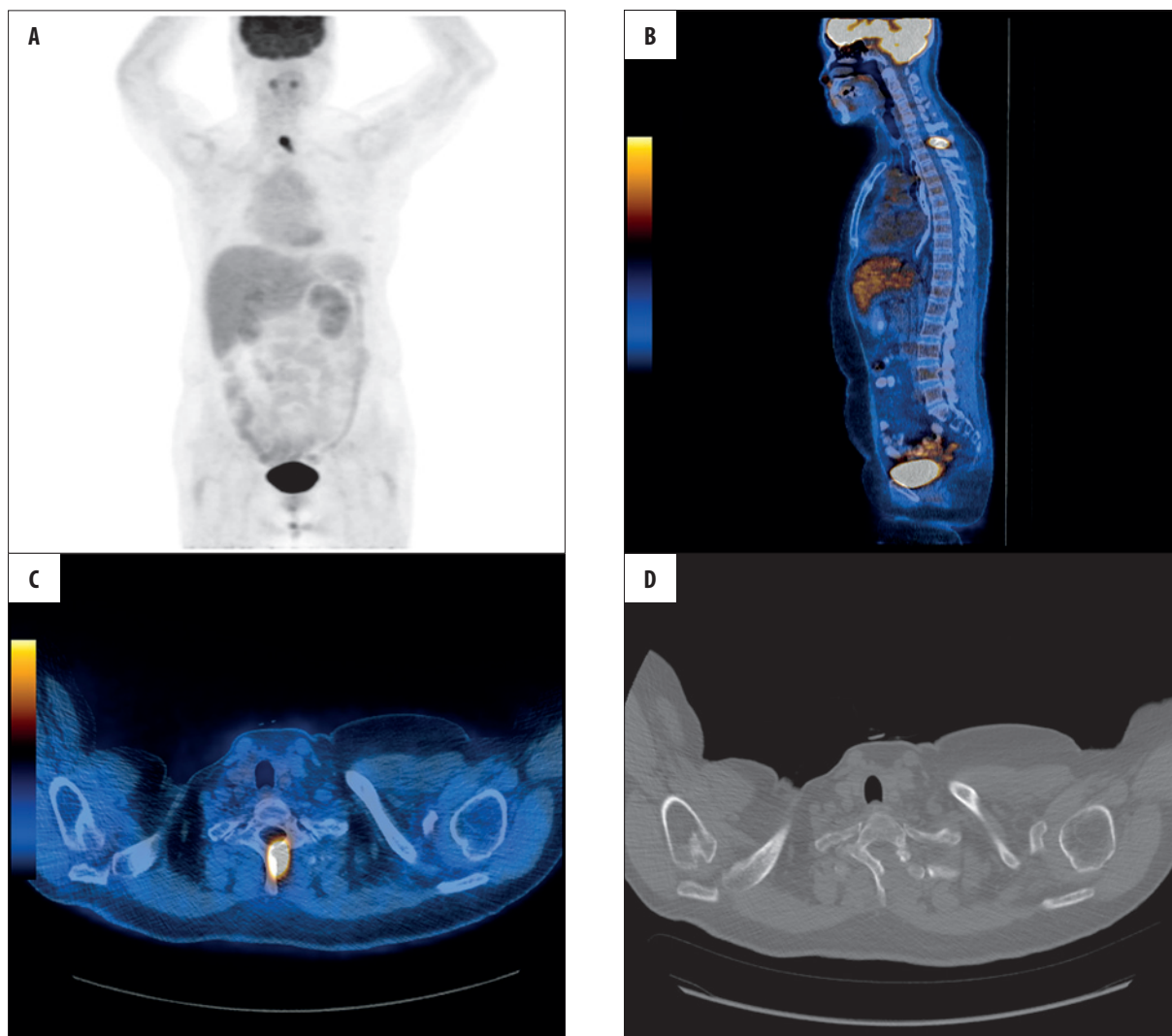
A 68-year-old female with a history of carcinoma of the right breast (pT2N0, unknown hormonal status) 30 years

**Table 1.** Adjuvant locoregional radiotherapy given.

Field	Dose
Tangential opposite field (right)	4.5 Gy/fr, 3 fr/wk, ×11 fr
Anterior photon (right SCF & axilla)	3.5 Gy/fr, 3 fr/wk, ×13 fr
Posterior photon (right axilla)	3.5 Gy/fr, 3 fr/wk, ×13 fr
Direct internal mammary field	3.5 Gy/fr, 3 fr/wk, ×15 fr

Gy – gray; fr – fraction; wk – week; SCF – supraclavicular fossa.

prior treated with right total mastectomy and adjuvant locoregional radiotherapy (Table 1) and ovarian radiation. The patient recovered and remained well after treatment until 6 years ago when her tumor marker CA15.3 rose to a high normal range of 22. The patient was asymptomatic and continued monitoring CA15.3 level with regular follow-ups. The level of CA15.3 was maintained at a range between 21 and 23 until last year, when CA15.3 increased to 28. Subsequently, an FDG-PET/CT scan was performed revealing a hypermetabolic (SUVmax 6.7) mass in the left lamina and spinous process of T1 causing cortical destruction (Figure 1). An osseous metastasis was suspected at that time. There was another lesion in the left frontal bone where the inner table was breached, which was eumetabolic. The possibility of a further metastasis to the skull was raised, but considered unlikely. Being a routine scan, the distal lower limbs were not included. MRI showed a 2.4cm enhancing mass of the T1 left lamina and spinous process, with posterior extension into the adjacent left erector spinae muscle, again suggestive of a bony metastasis (Figure 2). There was no intraspinal extension.



**Figure 1.** Whole body MIP FDG-PET (A) and sagittal (B) and axial (C) fused FDG-PET/CT images revealing a hypermetabolic T1 lesion with SUVmax 6.7. Axial CT (D) reveals bone destruction by the mass.

Upon review of the radiological images, a CT-guided biopsy, which failed, and subsequently an open biopsy of the spine lesion were performed. Pathological findings of the open biopsy revealed features of intermediate-grade sarcoma in the T1 spinous process with spindle cell tumor and smooth muscle actin positive. However, the subtype of the sarcoma could not be determined.

Because of the frontal bone lesion and the incomplete exposure of the lower limbs, an FDG-PET/CT scan was repeated after 3 months. The frontal bone lesion remained static, confirming chronic incidental nature of the lesion rather than metastasis. Two mildly hypermetabolic foci in the left knee were considered degenerative only.

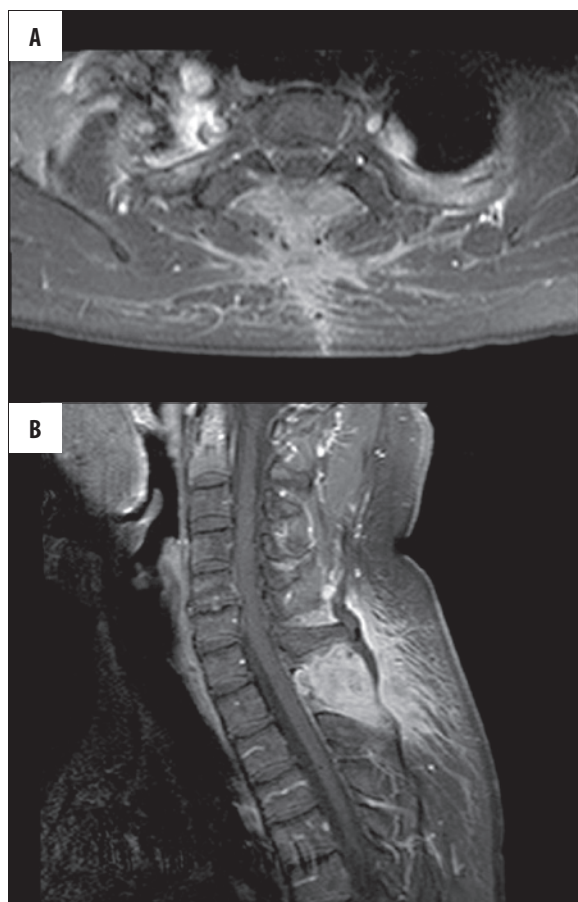
As the imaging findings supported that the involvement of the tumor was limited to the vertebra and paraspinal structures, radical resection was suggested. A preoperative MRI showed more extensive paraspinal involvement as compared to previous scans. Radical resection of the spinal tumor together with the laminae of C6-T3 and the paraspinal muscle was performed. Histopathology revealed

pleomorphic tumor cells on a background of fibromatosis (Figure 3). The tumor was thus subtyped as fibrosarcoma. In view of the history of radiotherapy and location of the tumor, the fibrosarcoma was considered most likely to be induced by the radiotherapy.

The sarcoma is formed by fascicles of spindly tumor cells with significant nuclear pleomorphism.

## Discussion

Spinal tumors are most commonly metastatic. At the first PET/CT scan where a suspicious lesion was identified in the spine with a high normal level of CA15.3 in a patient with history of breast cancer, the first impression was spinal metastasis secondary to breast cancer. The pathological finding of a fibrosarcoma however, which is histologically different from breast cancer, diagnosed a primary lesion. Primary malignant bone tumor is rare, especially in the elderly population, and the spinal location makes it even more exceptional. Thus, based on the usual low incidence and atypical site of the fibrosarcoma, an underlying



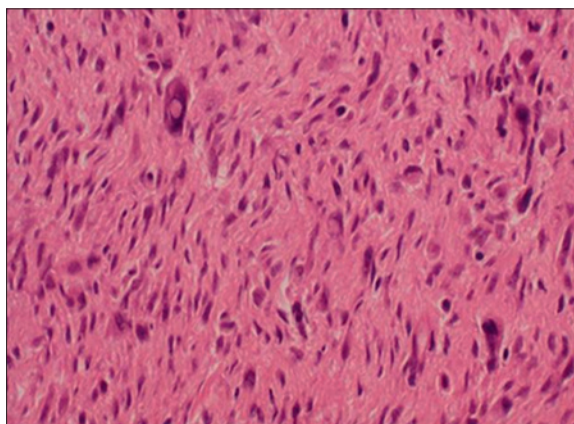
**Figure 2.** Post-contrast axial (A) and sagittal (B) T1 MRI cervicothoracic junction showing a 2.4 cm enhancing mass involving the spinous process and left lamina of T1 vertebra with posterior extension to adjacent left erector spinae muscle.

aetiological factor was suspected, being the radiation from the previous radiotherapy.

The patient had the breast cancer on the right but the fibrosarcoma developed on the left. This is not unexpected however, because the radiation field of the radiotherapy typically covers the spine entirely from ipsilateral to contralateral sides. In addition, the induced sarcoma often appears in the periphery of the radiation field, which further supports the location of the fibrosarcoma in our patient.

## References:

- Roychoudhuri R, Evans H, Robinson D et al: Radiation-induced malignancies following radiotherapy for breast cancer. *Br J Cancer*, 2004; 91(5): 868–72
- Halperin EC, Greenberg MS, Suite HD: Sarcoma of the bone and soft tissue following treatment of Hodgkin's disease. *Cancer*, 1984; 53: 232–36
- Kim JH, Chu FC, Woodard HQ et al: Radiation induced soft tissue and bone sarcoma. *Radiology*, 1978; 129: 501–8
- Smith J: Postradiation sarcoma of bone in Hodgkin disease. *Skeletal Radiol*, 1987; 16: 524–32
- Brady LW: Radiation-Induced Sarcomas of Bone. *Skeletal Radiol*, 1979; 4: 72–78
- Harper GD, Dicks-Mireaux C, Leiper AD: Total body irradiation-induced osteochondromata. *J Pediatric Orthop*, 1998; 18(3): 356–58
- Wiklund TA, Blomqvist CP, Rätty J et al: Postirradiation sarcoma: analysis of a nationwide cancer registry material. *Cancer*, 1991; 68: 524–31
- Davies AM, Sundaram M, James SLJ: *Imaging of Bone Tumors and Tumor-Like Lesions: Techniques and Applications*, Berlin, Springer, 2009; 503
- Weatherby RP, Dahlin DC, Ivins JC: Post radiation sarcoma of bone: review of 78 Mayo Clinic cases. *Mayo Clinic Proceedings*, 1981; 56: 294–306
- Arlen M, Higinbotham NL, Huvos AG et al: Radiation-induced sarcoma of bone. *Cancer*, 1971; 28: 1087–99
- Gane NFC, Lindup R, Strickland P et al: Radiation-induced fibrosarcoma. *Br J Cancer*, 1970; 24: 705–11



**Figure 3.** Specimen of the spinal tumor from radical resection in the left C6.

Although the mean latent period for the sarcoma to develop is around 10 to 20 years, it is not uncommon for the tumor to appear after 30 years, as in our case. Cases of radiation-induced malignancy appearing after 40 to 50 years have also been reported [9].

There is no precise data on the dose required for inducing sarcomas due to the fact that complete information has not been collected owing to the low incidence. From previous reports however, most patients with induced sarcoma had received doses ranging from 1500 rads to 6000 rads [10], compatible with the dose received by our patient.

As mentioned before, the most common type of radiation-induced sarcoma in bones is osteosarcoma. On the other hand, induced fibrosarcoma is more common in soft tissues. Nevertheless, reports of radiation-induced fibrosarcoma in bony structures such as the femur have been previously described [11].

## Conclusions

In conclusion, this case of radiation-induced spinal fibrosarcoma in a patient with a history of breast cancer treated with radiotherapy 30 years prior, highlights the potential long-term side effects of medical radiation and the need for consideration of this differential diagnosis; and illustrates the ongoing need for vigilance in the follow-up of such patients.