Case 12593

Radiation-induced changes in the bone marrow
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Section: Musculoskeletal system
Area of Interest: Bones Musculoskeletal system
Procedure: Radiation therapy / Oncology
Imaging Technique: MR
Special Focus: Oedema Case Type: Clinical Cases
Patient: 52 years, female

Clinical History:

A 52-year-old female patient presented for the first follow-up 6 months after she had been treated for a mucoid liposarcoma anterior to the proximal medial tibia. The treatment included surgery and radiotherapy (50?Gy in 2?Gy fractions). The patient was asymptomatic.

Imaging Findings:

MR imaging of the lower extremity at the site of previous operation and irradiation was performed. Multiple focal changes with intermediate signal on T1-w (Fig. 1), moderately increased signal on fluid sensitive sequence (Fig. 2) and moderate enhancement on fat-suppressed contrast enhanced T1-w images (Fig. 3) were disclosed.

Discussion:

A. Radiation-induced changes in the bone marrow are very common and include fatty replacement, pathologic fractures, avascular necrosis, focal lesions of abnormal signal on MR imaging and rarely development of sarcoma [1, 2, 3]. Depending on the age of the patient and the amount of radiation, some changes may be reversible or not [4].

B. Clinical symptoms are usually absent with the exception of insufficiency fractures which occur in about 6% of cases [5]. The radiation-induced changes are mostly found during follow-up imaging. Careful attention should be paid to rule out the possibility of metastases.

C. MR imaging is the method of choice for assessing the bone marrow. During the first three days following irradiation (acute phase) the bone marrow undergoes excessive oedema which results in areas of reduced signal in T1-w and high signal on fluid sensitive MR images [4]. Between the third and the sixth week the bone marrow appears heterogeneous on T1-w MR images due to fatty replacement. After the sixth week, the lesions appear with high signal on T1-w images (in older patients), or with a region of central high signal and a peripheral intermediate one, due to haematopoietic regeneration (in younger patients) [6]. Many of those lesions may raise suspicion of recurrence. However, the absence of signs typical for metastatic deposits matched with the clinical picture of the patient, should help the radiologist to arrive at a final diagnosis of treatment-related changes. In inconclusive cases, a biopsy might be required, which, however, is invasive and may be complicated with fracture or infection [7]. In our case, the consecutive follow-up MR imaging studies up to 24 months after radiation showed no differences in the bone marrow changes suggesting the correct diagnosis.

D. No therapeutic procedure is needed. Nevertheless, follow-up MR imaging of the affected area must be required in
inconclusive cases, in order to confirm their benign nature.

E. It is essential to recognize and differentiate post-radiation changes in the bone marrow from metastatic deposits in order to avoid unnecessary diagnostic tests and potentially harmful treatment.

**Differential Diagnosis List:** Radiation-induced lesions of the bone marrow., Metastatic lesions, Bone marrow minimal ischaemia, Red marrow islands

**Final Diagnosis:** Radiation-induced lesions of the bone marrow.

**References:**

Figure 1

Description: Sagittal T1-w MR image shows multiple foci of intermediate signal intensity (arrows).

Origin: Department of Medical Imaging, Heraklion University Hospital
Description: Axial T1-w MR image shows a focus of intermediate signal intensity within the bone marrow (arrow). Origin: Department of Medical Imaging, Heraklion University Hospital
**Description:** Sagittal fat-suppressed PD-w MR image shows multiple foci of increased signal intensity within the bone marrow (arrows). The high signal intensity of the subcutaneous tissue represents postradiation oedema (open arrows). **Origin:** Department of Medical Imaging, Heraklion University Hospital
Description: Axial fat-suppressed PD-w MR images show multiple foci of increased signal intensity within the bone marrow (arrows). The high signal intensity of the subcutaneous tissue represents postradiation oedema (open arrow). Origin: Department of Medical Imaging, Heraklion University Hospital
**Description:** Sagittal contrast-enhanced fat-suppressed T1-w MR image shows moderate enhancement of the bone marrow changes (arrows). **Origin:** Department of Medical Imaging, Heraklion University Hospital
Description: Axial contrast-enhanced fat-suppressed T1-w MR images show moderate enhancement of the bone marrow changes (arrows). Enhancement is also seen in the subcutaneous tissue (open arrow). Origin: Department of Medical Imaging, Heraklion University Hospital