VIA MEDICA

Nuclear Medicine Review 2019, 22, 2: 85–87
DOI: 10.5603/NMR.2019.0020

ISSN 1506–9680

Clinical vignette

Radiotherapy for breast cancer induced long-term diminished accumulation of radiotracer on bone scan of the irradiated ribs

Andreas Fotopoulos[1], Chrissa Sioka[1], Konstantinos Papadimitropoulos[1], Tzihad Al Boucharali[1], John Kalef Ezra[2]
[1]Department of Nuclear Medicine, University Hospital of Ioannina, Ioannina, Greece
[2]Department of Medical Physics, University Hospital of Ioannina, Ioannina, Greece

[Received 4 II 2019; Accepted 10 IV 2019]

Abstract

Radiotherapy may result in long term effects and composition alterations in bones. Bone scintigraphy after radiotherapy may demonstrate decreased skeletal uptake; however, this is a transient effect with bone scan normalized after a few years. We describe a case of a 31-year-old female patient treated for left breast cancer with chemotherapy and radiotherapy, exhibiting reduced and diffuse diphosphonate uptake in the heavily irradiated sections of left ribs, even twelve years post-treatment. Similarly, quantitative computed tomography indicated altered bone composition. To our knowledge this is the first case describing such a long radiation side effect in breast cancer treatment.

KEY words: Radiation therapy, breast cancer, bone scan, radiological imaging, computer tomography, whole-body BMD

Nucl Med Rev 2019; 22, 2: 85–87

Introduction

Reduced skeletal uptake in the irradiated field is a well-known side-effect attributed mainly to radiation-induced decreased bone-marrow uptake caused by vascular damage [1, 2]. In general, osteonecrosis occurs in 2% to 20% of adult patients treated with 60 to 65 Gy given in 2.0 Gy daily fractions [3]. Such alterations result in increased risk for spontaneous fractures within the treated area with total doses exceeding 50 Gy [3, 4]. Bone scan is an skeletal evaluation imaging method for different diseases, including metastatic disease [5–7]. It is a very sensitive method and can detect metastases early due to alterations in osteoblast function [2].

Case report

A 31-year-old female (current age — 43 years old), with ductal adenocarcinoma in her left breast was subjected to a pretreatment bone scan that was unremarkable. The treatment consisted of bilateral total mastectomy, chemotherapy, and a 60 Gy 6 MV x-ray chest wall tangential irradiation (five 2.0 Gy daily fractions per week, 50 Gy given by two 5.0 cm x 18.0 cm fields and 10 Gy by two 5.0 cm x 7.2 cm boost fields), followed by a five-year tamoxifen treatment.

Correspondence to: Andreas Fotopoulos
Department of Nuclear Medicine, University Hospital of Ioanniva, Ioannina, Greece; e-mail: professor.fotopoulos@yahoo.com

Bone scans was performed using the same gamma camera, 1, 3, 8 and 12 years post-treatment. Scintigraphy was performed with a dual head gamma camera, low energy high-resolution collimator and 140 keV ± 10% photopeak window, after admission of 740 MBq (20 mCi) 99mTC-MDP. Follow-up bone scans were unremarkable except the loss of anatomical detail and reduced uptake with a diffuse pattern in the left anterior ribs, i.e. bones in the irradiation field. These findings were first noted during the first post-treatment scintigraphic evaluation and were persistent thereafter (12 years post-treatment) (Fig. 1).

Plain thoracic x-ray imaging (not shown) ruled out metastatic bone disease. Quantitative computed tomography carried out eleven years post-treatment revealed higher bone mineral density in the irradiated sections of the left ribs than that in the contra lateral right ones (Fig. 2) with mean CT numbers in the studied slices 346 ± 31 and 268 ± 33, respectively).

Discussion

Bone scintigraphy can detect bone metastases but in addition may detect bone alterations due to hormonal therapy, chemotherapy and radiotherapy, such as the flare effect on metastases or osteonecrosis [2]. MR studies have shown that the incidence for

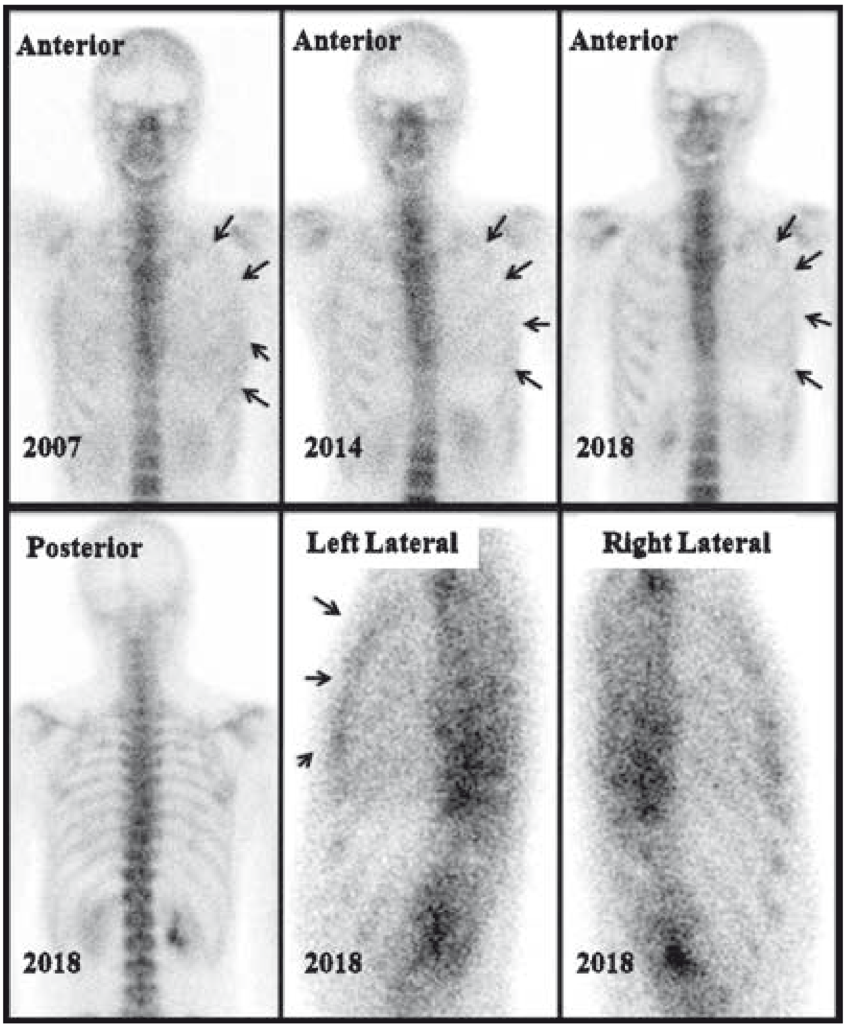

Figure 1. In the first exam, slightly lower uptake in the ribs of the left thoracic cage, compared with the ribs of the contralateral side, was noted. The same, finding were noted in each scan that was performed even after twelve years from treatment

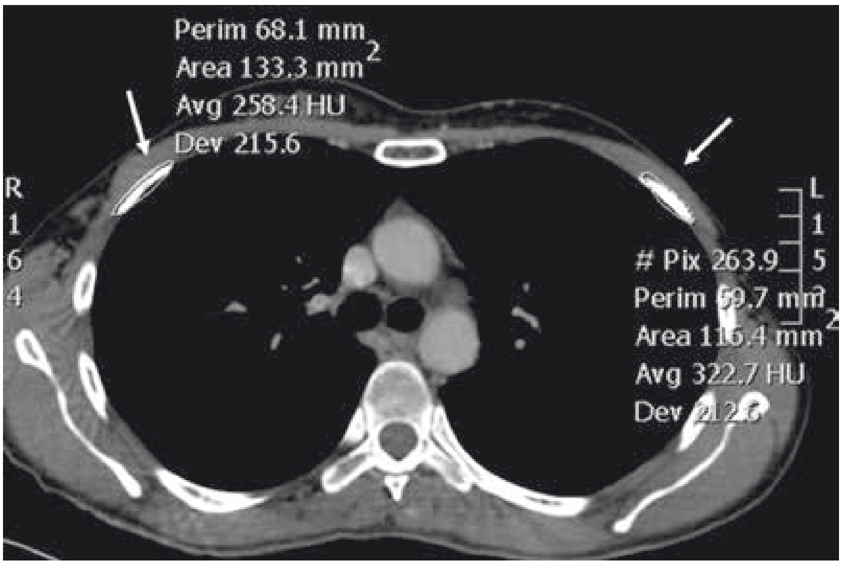

Figure 2. Regions of interest were performed in thoracic CT, for evaluating bone density, where a significant difference was found in left versus right thorax, indicating reduced bone mineral density in left thoracic ribs, result of the previous radiotherapy for left breast cancer therapy. The same method was used for evaluating lung parenchyma for lung injury; however, no significant difference was found (not shown), thus excluding radiation-induced fibrosis in the heavily irradiated lung parenchyma [9, 10]

both radiation-induced changes in the heavily irradiated bone sections peak about 1-year post-treatment followed by almost full recovery within few years [8].

In our case, the scintigraphic findings persisted even 12 years post-treatment. The reduced ^{99m}Tc diphosphonate uptake with a diffuse pattern and the increased bone mineral density in the irradiated rib sections are considered to be localized irradiation side-effects that persisted long time after post-treatment.

Reference

1. Cox PH. Abnormalities in skeletal uptake of 99Tcm polyphosphate complexes in areas of bone associated with tissues which have been subjected to radiation therapy. Br J Radiol. 1974; 47(564): 851–856, doi: 10.1259/0007-1285-47-564-851, indexed in Pubmed: 4434055.
2. Stokkel MP, Valdés Olmos RA, Hoefnagel CA, et al. Tumor and therapy associated abnormal changes on bone scintigraphy. Old and new phenomena. Clin Nucl Med. 1993; 18(10): 821–828, indexed in Pubmed: 7694820.
3. Stewart FA, Akleyev AV, Hauer-Jensen M, et al. Authors on behalf of ICRP. ICRP publication 118: ICRP statement on tissue reactions and early and late effects of radiation in normal tissues and organs--threshold doses for tissue reactions in a radiation protection context. Ann ICRP. 2012; 41(1–2): 1–322, doi: 10.1016/j.icrp.2012.02.001, indexed in Pubmed: 22925378.
4. Overgaard M. Spontaneous radiation-induced rib fractures in breast cancer patients treated with postmastectomy irradiation. A clinical radiobiological analysis of the influence of fraction size and dose-response relationships on late bone damage. Acta Oncol. 1988; 27(2): 117–122, indexed in Pubmed: 3390342.
5. Kiamanesh Z, Nasiri Z, Jahanpanah P, et al. 99mTC-MDP bone scanning in a subungual glomus tumour. Nucl Med Rev Cent East Eur. 2018; 21(2): 111–112, doi: 10.5603/NMR.2018.0029, indexed in Pubmed: 30070352.
6. Sioka C, Konstanti E, Papadopoulos A, et al. Heterotopic ossification in patients previously hospitalized in an intensive care unit. Nucl Med Rev Cent East Eur. 2018; 21(2): 100–103, doi: 10.5603/NMR.2018.0027, indexed in Pubmed: 30070350.
7. Giżewska A, Witkowska-Patena E, Stembrowicz-Nowakowska Z, et al. Long bone metastases as predictors of survival in patients with metastatic renal cancer. Nucl Med Rev Cent East Eur. 2015; 18(2): 89–91, doi: 10.5603/NMR.2015.0021, indexed in Pubmed: 26315869.
8. Meixel AJ, Hauswald H, Delorme S, et al. From radiation osteitis to osteoradionecrosis: incidence and MR morphology of radiation-induced sacral pathologies following pelvic radiotherapy. Eur Radiol. 2018; 28(8): 3550–3559, doi: 10.1007/s00330-018-5325-2, indexed in Pubmed: 29476220.
9. Kalef-Ezra JA, Karantanas AH, Koligliatis T, et al. Electron density of tissues and breast cancer radiotherapy: a quantitative CT study. Int J Radiat Oncol Biol Phys. 1998; 41(5): 1209–1214, indexed in Pubmed: 9719134.
10. Kalef-Ezra J, Karantanas A, Tsekeris P. CT measurement of lung density. Acta Radiol. 1999; 40(3): 333–337, indexed in Pubmed: 10335975.