



# Short Latency Radiation Induced Osteosarcoma Detected on <sup>18</sup>F-FDG PET/CT Scan in Solitary Plasmacytoma

Soliter Plazmasitomada <sup>18</sup>F-FDG PET/BT Görüntülemeye Saptanan Radyasyona Bağlı Kısa Latent Dönemde Gelişen Osteosarkom

✉ Sana Munir Gill<sup>1</sup>, ✉ Aamna Hassan<sup>1</sup>, ✉ Namra Asghar<sup>1</sup>, ✉ Usman Ahmad<sup>2</sup>, ✉ Umm e Kalsoom Awan<sup>2</sup>, ✉ Imran Khalid Niazi<sup>3</sup>

<sup>1</sup>Shaukat Khanum Memorial Cancer Hospital and Research Centre, Department of Nuclear Medicine, Lahore, Pakistan

<sup>2</sup>Shaukat Khanum Memorial Cancer Hospital and Research Centre, Department of Medical Oncology, Lahore, Pakistan

<sup>3</sup>Shaukat Khanum Memorial Cancer Hospital and Research Centre, Department of Radiology, Lahore, Pakistan

## Abstract

<sup>18</sup>Fluorine-fluorodeoxyglucose (<sup>18</sup>F-FDG) positron emission tomography/computed tomography (PET/CT) plays a pivotal role in the staging, restaging, and surveillance of various bone tumors, including plasmacytomas and osteosarcomas. Solitary plasmacytomas most frequently occur in the bones and are primarily treated with either surgery or radiotherapy. Radiation-induced osteosarcomas (RIOS) usually develop after a median interval of 11 years between radiation and sarcoma presentation. However, these can rarely present with a short latent period of 4 years or even lesser. In such cases, whole-body imaging plays a vital role in the early detection and management of RIOS. Herein, we present the case of a 29-year-old female patient with solitary plasmacytoma undergoing a follow-up whole-body <sup>18</sup>F-FDG PET/CT, which revealed metastatic RIOS after a short latent period.

**Keywords:** Solitary plasmacytoma, <sup>18</sup>F-FDG PET/CT, radiation-induced osteosarcoma

## Öz

<sup>18</sup>Flor-florodeoksiglukoz (<sup>18</sup>F-FDG) pozitron emisyon tomografisi/bilgisayarlı tomografi (PET/BT), plazmasitomlar ve osteosarkomlar dahil olmak üzere çeşitli kemik tümörlerinin evreleme, yeniden evreleme ve takibinde çok önemli bir rol oynar. Soliter plazmasitomlar en sık olarak kemiklerde görülür ve esas olarak cerrahi veya radyoterapi ile tedavi edilir. Radyasyona bağlı osteosarkomlar (RIOS) genellikle radyasyon ve sarkom prezentasyonu arasındaki ortalama 11 yıllık bir aradan sonra gelişir. Ancak, nadiren 4 yıl veya daha kısa bir latent periyotla da ortaya çıkabilir. Bu gibi durumlarda, tüm vücut görüntüleme, RIOS'nin erken tespiti ve yönetiminde hayati bir rol oynar. Burada, tüm vücut <sup>18</sup>F-FDG PET/BT takibi yapılan ve kısa bir latent dönemden sonra metastatik RIOS saptanan soliter plazmasitomu olan 29 yaşında bir kadın hastayı sunuyoruz.

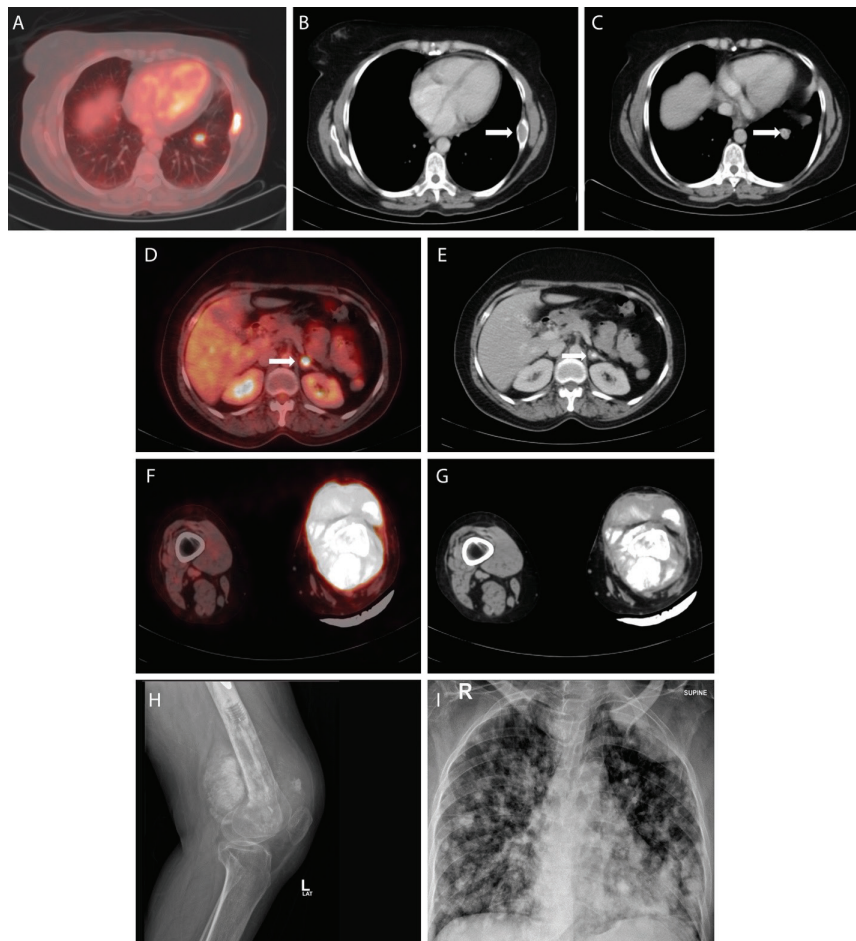
**Anahtar kelimeler:** Soliter plazmasitoma, <sup>18</sup>F-FDG PET/BT, radyasyona bağlı osteosarkom

**Address for Correspondence:** Aamna Hassan MD, Shaukat Khanum Memorial Cancer Hospital and Research Centre, Department of Nuclear Medicine, Lahore, Pakistan

**Phone:** +92 42 35905000 **E-mail:** aamnah@skm.org.pk ORCID ID: orcid.org/0000-0003-0026-0729

**Received:** 08.06.2020 **Accepted:** 24.11.2020

©Copyright 2022 by Turkish Society of Nuclear Medicine  
Molecular Imaging and Radionuclide Therapy published by Galenos Yayınevi.



**Figure 1.**  $^{18}\text{F}$ -fluorodeoxyglucose ( $^{18}\text{F}$ -FDG) positron emission tomography/computed tomography (PET/CT) has higher sensitivity (89.2%) in localizing second malignancies compared with conventional imaging modalities (23%) (1). This was highlighted in a 29-year-old female patient who presented with two primaries that occurred in the same bone at two different time intervals. She re-presented 4 years after initial treatment with intramedullary cementation/nailing and radiotherapy of the left proximal femur for plasmacytoma. Skeletal survey at re-presentation revealed a new solitary lytic lesion in the skull for which  $^{18}\text{F}$ -FDG PET/CT, a non-invasive functional imaging modality, was acquired to optimally identify small lesions that may not be well characterized on magnetic resonance imaging and CT (2). PET/CT showed hypermetabolic lesions in the sternum, left 7<sup>th</sup> rib (A, B), left parietal bone, and fractured left intramedullary nail. Histopathology of the left proximal femur showed no recurrence. Serum protein electrophoresis showed a faint band in the gamma region, potentially a small paraprotein. Follow-up PET/CT at 2 months showed progression with partially calcified and non-calcified pulmonary nodules (A, C), calcified left adrenal nodule (D, E), and multiple soft tissue lesions along the left distal femur with intra-articular extension (F, G). Radiographs showed a destructive left distal femur lesion (H). Serum Kappa and Lambda levels and ratios were normal.

Plasmacytoma rarely metastasizes, which may lead to the development of multiple myeloma. No obvious histopathological or serological evidence of plasmacytoma/multiple myeloma biopsy of the distal femoral lesion was planned, which showed pleomorphic and atypical spindle cells with osteoid formation. It was positive on immunohistochemistry for special AT-rich sequence-binding protein 2 valuable diagnostic biomarker, which can differentiate between osteosarcoma and its mimickers. Overall findings confirmed the diagnosis of radiation-induced osteosarcoma (RIOS). The patient was later admitted to the emergency department with worsening dyspnea. Chest radiograph showed cannon-ball lesions in both lungs (I). She was then referred to the palliation team for further management.

Nanni et al. (3) were some of the first to suggest the supremacy of  $^{18}\text{F}$ -FDG PET/CT over conventional imaging in new lesion detection. Hybrid PET/CT does not only anatomically localize the tumor but also adds further information regarding tumor aggressiveness in its metabolic activity. Osteosarcomas are notorious for being chemoradiotherapy-resistant. Therefore, early detection is imperative for optimal treatment with excision at the initial stages (4). These occur after long latency periods of up to 11 years; however, the possibility of RIOS after short latency periods should always be considered in patients with a radiation therapy history while reviewing  $^{18}\text{F}$ -FDG PET/CT. An increased chance of metastatic disease can occur in the case of delayed diagnosis, which is the greatest adverse prognostic factor, especially in the older age group (5).

This case illustrated that reporting clinicians need to be mindful of RIOS development with a short latent period as up to 0.5-5.5% of all sarcomas are caused by radiation, which is commonly seen in osteosarcomas followed by fibrosarcomas (6). Therefore, in the current era of hybrid imaging with new hypermetabolic areas within the radiation field and evidence of distant metastases that do not fit the primary pathology, nuclear physicians should consider the possibility of RIOS.

## Ethics

**Informed Consent:** IRB approval obtained.

**Peer-review:** Externally and internally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: A.H., U.A., U.K.A., I.K.N.,  
Concept: S.M.G., A.H., Design: S.M.G., A.H., Data Collection  
or Processing: S.M.G., A.H., N.A., Analysis or Interpretation:  
S.M.G., A.H., N.A., I.K.N., U.A., U.K.A., Literature Search:  
S.M.G., A.H., Writing: S.M.G., A.H.

**Conflict of Interest:** No conflict of interest was declared  
by the authors.

**Financial Disclosure:** The authors declared that this study  
received no financial support.

## References

1. Ali SA, Hamed MAE. The diagnostic efficacy of whole body 18F-FDG PET CT in detection of unexpected second primary malignancy in cancer patients. *EJRN* 2017;48:671-676.
2. Zhang X, Guan Z. PET/CT in the diagnosis and prognosis of osteosarcoma. *Front Biosci (Landmark Ed)* 2018;23:2157-2165.
3. Nanni C, Rubello D, Zamagni E, Castellucci P, Ambrosini V, Montini G, Cavo M, Lodi F, Pettinato C, Grassetto G, Franchi R, Gross MD, Fanti S. 18F-FDG PET/CT in myeloma with presumed solitary plasmocytoma of bone. *In Vivo* 2008;22:513-517.
4. Rustemeyer P, Micke O, Blasius S, Peters PE. Radiation-induced malignant mesenchymoma of the chest wall following treatment for breast cancer. *Br J Radiol* 1997;70:424-426.
5. Tsuda Y, Ogura K, Shinoda Y, Kobayashi H, Tanaka S, Kawai A. The outcomes and prognostic factors in patients with osteosarcoma according to age: a Japanese nationwide study with focusing on the age differences. *BMC Cancer* 2018;18:614.
6. Mavrogenis AF, Pala E, Guerra G, Ruggieri P. Post-radiation sarcomas. Clinical outcome of 52 Patients. *J Surg Oncol* 2012;105:570-576.