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Case Report

# Radiation Induced Secondary Lung Cancer Detected with F-18 FDG-PET/CT 20 Years after Radiotherapy of Breast Cancer

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## Abstract

Irradiation of surrounding tissues during breast Radiotherapy (RT) may cause secondary cancers to develop within these tissues. Here we report a case of non-small cell lung cancer developed within irradiated field of right lung after RT of right breast cancer 20 years later which was detected with Fluorine-18-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography (F-18 FDG PET/CT).

## Introduction

With recent advances in diagnosis and treatment, breast cancer has become a survivable disease with a large population of long-term survivors [1]. But unfortunately irradiation of surrounding tissues during breast Radiotherapy (RT) may cause second primary cancers within radiation field areas [2]. Lung, colon, esophagus, thyroid gland cancers, malignant melanomas of the skin, myeloid leukemia and second primary breast cancers, have been shown to be associated with RT of the breast [3].

Here, we report a case of secondary primary lung cancer in radiation field area of a breast cancer patient detected with F-18 FDG PET/CT.

## Case Report

A 55-years-old non-smoker woman was first admitted to our hospital 20 years ago with a palpable mass in her right breast. Biopsy detected malignancy and she had undergone right breast mastectomy and sentinel lymph node biopsy. The sentinel lymph node was metastatic and right axillary lymph node dissection was also performed. Histopathological examination showed estrogen receptor positive and progesterone receptor negative invasive ductal carcinoma with a diameter of 3.4 cm. 9 of 17 lymph nodes were metastatic after axillary dissection. No abnormality was detected in systemic scanning. After 6 cycles of Cyclophosphamide-Methotrexate-Fluorouracil (CMF) treatment, RT of 25 × 200:5000 cGy cobalt-60 was administered. 5 years of tamoxifen treatment had been continued with aromatase inhibitor treatment 2 years afterwards. Subsequently, the patient did well for 13 years more.

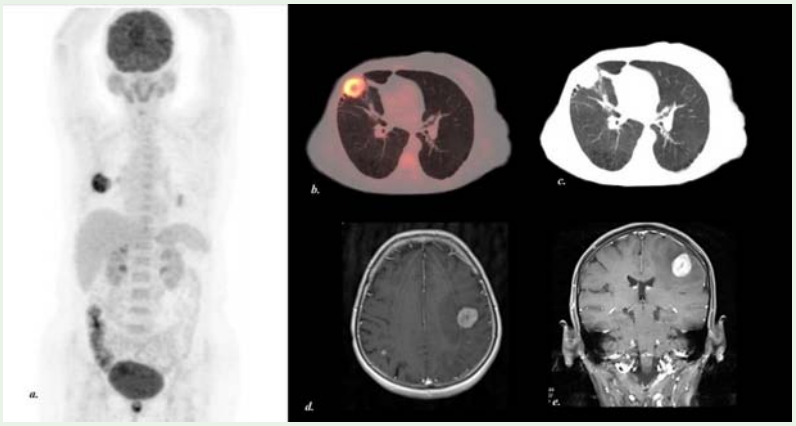

**Figure 1: (a)** Multi-Image-Projection (MIP) PET image. **(b) & (c)** Fusion axial PET/CT image and CT image with a mass lesion of highly increased FDG uptake in middle lobe of right lung in radiation field area. **(d) & (e)** Axial and coronal contrast enhanced MRI images with multiple cranial metastases.

In her last visit to our hospital she represented right sided chest pain. The plain chest X-ray demonstrated suspicious opacity in right lung. For further evaluation F-18 FDG PET/CT was performed and detected hypermetabolic mass lesion of 46 mm diameter with a Standard Uptake Value (SUV max) of up to 9.9 in middle lobe of right lung in radiation field area. Biopsy was performed and non-small cell lung cancer was reported. Cranial contrast enhanced magnetic resonance imaging was also performed afterwards and multiple metastatic lesions were observed (Figure 1). Palliative chemoradiotherapy was started.

## Discussion

RT is very important in treatment of various cancers but unfortunately has many side effects, such as oncogenesis. Radiation induced tumor diagnosis needs 3 benchmarks: detection of tumor in a formerly irradiated area, long time interval after first radiotherapy and different histopathological subtype with the initial tumor [4], like in our case.

Patients who received adjuvant RT after mastectomy for breast carcinoma have a moderately increased risk for ipsilateral lung carcinoma starting 10 years up to at least 20 years after exposure, but on the other hand post lumpectomy RT does not appear to demonstrate a similar risk [5].

It is suggested that leukaemias are expected to develop within 5 years after initial RT; while secondary radiation induced solid tumors are observed after 10 or more years [6]. Also, it is shown that post-mastectomy RT was associated with significantly increased incidence of lung cancers after 10 years whereas post-lumpectomy radiotherapy had no increased risk for secondary lung carcinoma [4].

After postmastectomy RT, the increased risk of ipsilateral lung carcinoma was high for all three major histologic subtypes of lung carcinoma (adenocarcinoma, squamous cell carcinoma, and small cell carcinoma) starting 10 years after exposure persisting at least 20 years [4]. The risk increases over time, and is highest 15 or more years after breast cancer diagnosis [7].

In a cohort study, it is shown that in breast cancer patients, new cancer rate is higher with incidence of 5.71 per 1000 Person-Years. In this mentioned study, of the total 216 breast cancer positive patients who had undergone radiotherapy, 8 (3.7%) developed secondary cancers of the digestive tract (4), uterus (2), respiratory tract (1), and other areas of the genitourinary tract (1) in the 4-year follow-up [8]. Another study demonstrated that 8% of breast cancer patients who had given RT developed secondary non-breast malignancies in 8 years follow-up [9]. Also it is found that younger breast cancer patients (<50 years old) had a higher risk of secondary cancer than did elderly patients, like in our case [8,10-11].

From the beginning of twentieth century, the combined electron and Intensity-Modulated Radiotherapy (IMRT) technique was started to be used in breast cancer patients. This modality showed improvement over the conventional treatment technique with reduced dose to the ipsilateral lung, the heart and controversial breast [12,13]. In recent years, for dose reduction to healthy surrounding tissues many studies have been planned moreover. It is also shown that, IMRT potentially leads to a more favorite dose distribution compared to 3-dimensional or conventional tangential radiotherapy for breast cancer after conservative surgery or mastectomy and it was suggested also that Inverse-Planned IMRT (IP-IMRT) showed smaller exposed volumes of ipsilateral lung, heart, contralateral lung, and breast [14]. Comparisons of organ-specific organ equivalent with conventional IMRT, preferring scattering mode in proton therapy is claimed to be either significantly lower or, at least, does not exceed the risk of estimated secondary cancer [15]. From this point of view, when choosing an RT technique, dosimetric advantage, clinical effect, and economic burden should be taken into consideration [14]

In conclusion, the benefits of radiotherapy are greater than the risks of development of secondary malignancies. Therefore further investigation for minimizing the radiation dose delivered towards the surrounding tissues or the volume of such tissues exposed and also regular long time follow-up of patients is needed in order to detect secondary malignancies at earlier stages.

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