A 54-year-old man was referred to Ehime Prefectural Central Hospital because of dysphagia. After several examinations, he was diagnosed with unresectable stage IV esophageal cancer. The patient received chemotherapy (5-fluorouracil+cisplatin) and mediastinal radiotherapy (RTx) with a total dose of 60 Gy for the tumor and lymph nodes, with 40 Gy and 20 Gy using anterior-posterior and parallel-oblique fields, respectively (Figure 1A). Before RTx, \(^{18}\)F-fluorodeoxyglucose (FDG) positron emission tomography (PET)/computed tomography (CT) showed increased FDG uptake in the esophageal cancer (Figure 1B). FDG uptake was also observed in the left ventricle (Figure 1C), suggesting radiation-induced cardiomyopathy. This case highlights the importance of monitoring FDG uptake in oncology patients undergoing radiation therapy.
>12h after overnight fasting showed FDG uptake from the thoracic to the lower esophagus (Figure 1B). Eight months after RTx, however, FDG-PET/CT >12h after overnight fasting showed FDG uptake in the basement of the left ventricle (LV; Figure 1C, D; Movie S1), while the uptake from the thoracic to the lower esophagus could not be observed. Thus, he was referred to the cardiology department. Transthoracic echocardiography showed slightly reduced LV wall motion in basal segments and moderate pericardial effusion (Movie S2). Two-dimensional speckle-tracking echocardiography indicated preserved global longitudinal strains (~17.9%) with a regional decrease predominantly in the basal segments (Figure 2A). No late gadolinium enhancement was detected on cardiac magnetic resonance imaging (MRI; Figure 2B). Coronary angiography showed no significant stenosis. Accordingly, we diagnosed this condition as radiation-induced cardiomyopathy, and the patient was treated with β-blockers and angiotensin-converting enzyme inhibitors (ACEI). His course was uneventful thereafter, and regional LV dysfunction was restored.

RTx is one of the cornerstones of treatment for cancer. RTx improves survival, but normal tissue toxicity is a matter of concern. In particular, cardiac toxicity is one of the most concerning side-effects of RTx. The correlation between the incidence of cardiovascular disease and radiation dose is well established. Diagnosis of radiation-induced cardiomyopathy is challenging and usually is a diagnosis of exclusion. Therefore, diagnosis of radiation-induced cardiomyopathy needs multimodality assessment using echocardiography, cardiac MRI, and myocardial perfusion imaging. Late gadolinium enhancement has been detected on cardiac magnetic resonance imaging (MRI; Figure 2B). Coronary angiography showed no significant stenosis. Accordingly, we diagnosed this condition as radiation-induced cardiomyopathy, and the patient was treated with β-blockers and angiotensin-converting enzyme inhibitors (ACEI). His course was uneventful thereafter, and regional LV dysfunction was restored.

FDG Uptake in Radiation-Induced Cardiomyopathy

Treatment for RTx-induced cardiomyopathy is the same as that for heart failure, and involves ACEI, angiotensin receptor blockers, aldosterone antagonists and β-blockers. FDG-PET/CT has been widely used to evaluate cancer and inflammatory cardiovascular diseases. These conditions reflect enhanced glucose utilization in tumor cells or inflammatory cells. In contrast, in normal myocytes, free fatty acid (FFA) is the main substrate of energy production in the fasting state, whereas the predominant substrate during ischemia is glucose because β-oxidation of FFA is susceptible to ischemia. Yan et al investigated RTx-induced microvascular damage and mitochondrial injury in an experimental study. These alternations may cause ischemia and diminished energy production, resulting in regional metabolic shift from FFA to glucose and contractile dysfunction. It is well known, however, that non-specific FDG uptake is occasionally observed even under fasting conditions, leading to misinterpretation. There are several methods to suppress glucose uptake (i.e., heparin loading, low-carbohydrate/high-fat diet, prolonged fasting) to facilitate diagnosis of cardiac sarcoidosis on FDG-PET. Routine oncology PET (including in the present case), however, does not involve these methods. Although the fasting condition at PET acquisition was almost the same before and after RTx, the modification of physiological FDG uptake could not be completely excluded. Nevertheless, if incidental FDG uptake is detected in the myocardium after RTx, cardiac screening on multimodality imaging is mandatory to facilitate early identification of cardiac complications.

Funding

None.

References


**Supplementary Files**

**Supplementary File 1**

**Movie S1.** Fusion of 3-D cardiac computed tomography and 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) showing accumulation of FDG that crossed the left ventricle obliquely.

**Supplementary File 2**

**Movie S2.** Transthoracic echocardiography from the apex showing slightly reduced left ventricular wall motion in the basal segment and moderate pericardial effusion. 2CV, 2-chamber view; 3-CV, 3-chamber view; 4CV, 4-chamber view.

Please find supplementary file(s); http://dx.doi.org/10.1253/circj.CJ-17-0466