Case Report

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PET-MRI Findings of Two Patients with Breast Carcinoma before Treatment

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ABSTRACT

Integrated positron-emission tomography-magnetic resonance imaging (PET-MRI) is a new hybrid simultaneous imaging modality with higher soft tissue contrast and lower radiation doses compared with PET-CT. Two patients who were referred to our hospital with left breast masses that were pathologically diagnosed as invasive ductal carcinoma. The women were then scanned using the first PET-MRI system in Turkey, which was established in our department. In this case report, we aimed to determine the advantages of PET-MRI in staging, follow-up, neoadjuvant chemotherapy response, and to compare the usefulness of this modality with PET-CT and dynamic contrast-enhanced breast MRI.

Keywords: Positron-emission tomography, magnetic resonance imaging, breast neoplasm

Introduction

Integrated positron-emission tomography-magnetic resonance imaging (PET-MRI) systems were first developed in 2005, and have become a simultaneous imaging modality that can provide morphologic, functional, and molecular data (1). This new imaging modality is more advantageous compared with PET-CT examination owing to its high sensitivity and specificity, perfect soft-tissue contrast, high spatial and temporal resolution, diffusion-weighted imaging, as well as allowing practices such as MRI spectroscopy. Furthermore, the large reduction of radiation dose is one of its significant benefits. PET-MRI enables viewing details of soft-tissue, enhancement parameters, and measuring 18F-FDG involvement and metabolic activity with one investigation (2, 3). In presenting these cases, we aimed to display the imaging findings of two patients with breast cancer whose preoperative evaluation was performed using a PET-MRI device that had recently become available for use in our clinic.

Case Presentations

Case 1

A woman aged 52 years with symptoms of a mass in her left breast was tested through diagnostic mammography and mammary ultrasonography. The mammography showed irregularly-bordered nodular radiopacities, including internal microcalcifications of an approximate 4x3 cm mass in the upper inner quadrant and an approximate 1.5x1 cm mass near the axilla in the upper outer quadrant of the left breast, which were ACR BIRADS 5 (American College of Radiology Breast Imaging and Reporting Data System). In the ultrasonography, an irregularly-bound, heterogeneous, hypoechoic solid mass lesion sized 42x34x28 mm that included cystic, necrotic areas located at 11 o'clock, and multiple heterogeneous, hypoechoic solid nodular lesions, the largest of which was 37x20x17 mm peripherally-located near the axilla at 3 o'clock in the left breast could be seen, which were primarily evaluated for lymphadenopathy (ACR BIRADS 5). The results obtained from the tru-cut biopsy revealed triple-negative grade III invasive ductal carcinoma with Ki-67 70%. After consent was obtained from the patient with locally-advanced breast cancer (cT2N2Mx), the patient was considered to have neoadjuvant chemotherapy (CT) and underwent PET-MRI in order to evaluate the patient's response to therapy and investigate the pres-

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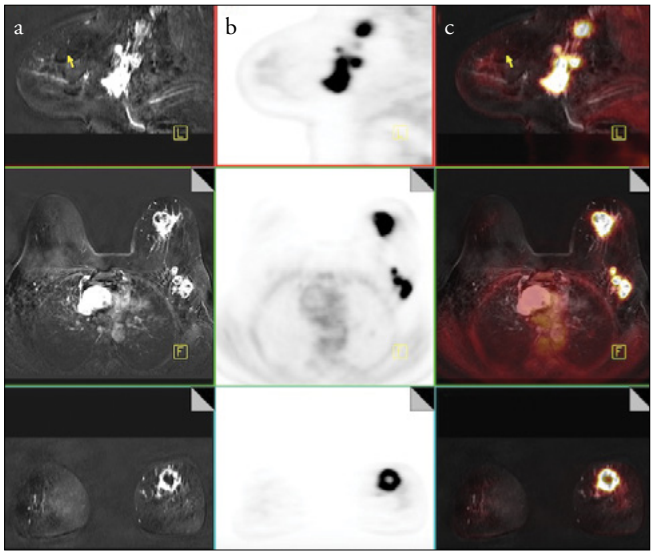

Figure 1. a-c. Mass lesions with 18F-FDG involvement connected to heterogeneous-enhanced high metabolic activity in the upper-inner and upper-outer quadrant axillary tail of the left breast in the fat-suppressed post-contrast (a), PET (b), and PET/MRI fusion images (c)

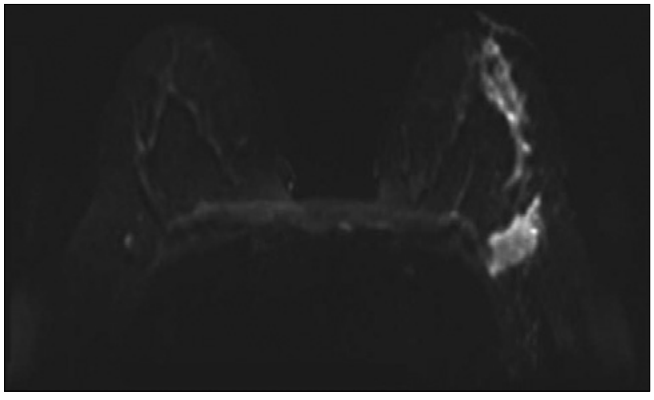

Figure 2. Diffusion restriction in the diffusion-weighted images

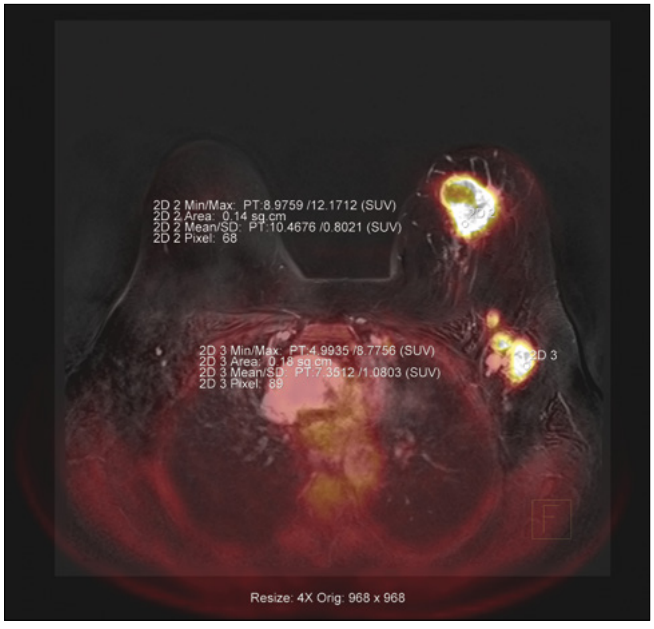

Figure 3. Measurement of SUV values of mass lesions in the axial fusion PET-MRI images

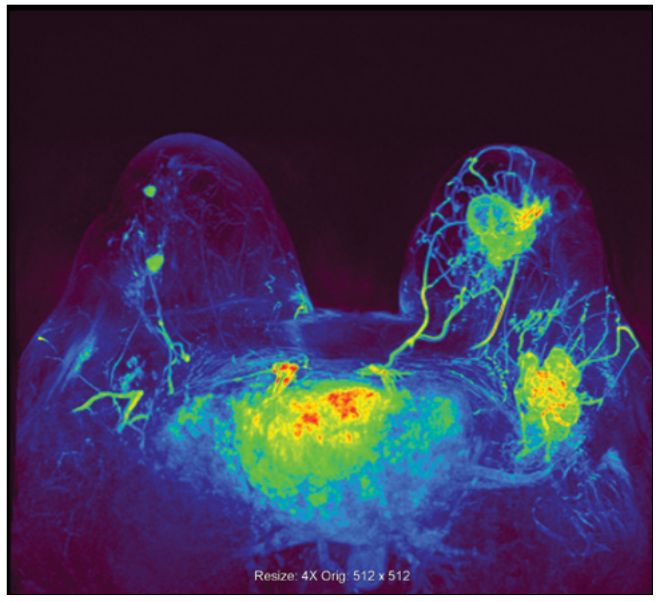

Figure 4. Color mapping and vascularization in the Sub-MIP image

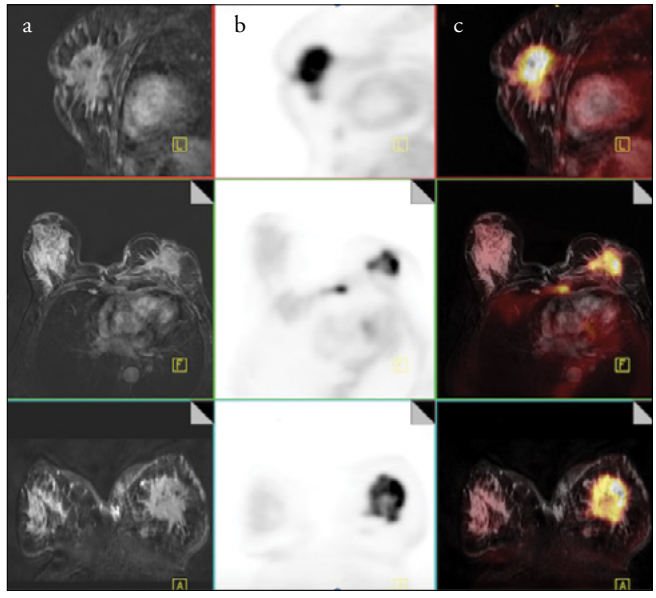

Figure 5. a-c. Irregularly bordered mass lesion with 18F-FDG involvement connected to heterogeneous-enhanced high metabolic activity and sternum metastasis in the retroareolar area of the left breast in the fat-suppressed postcontrast (a), PET (b), and PET/MRI fusion images (c)

ence of distant metastasis. In this imaging, there was one mass in the upper inner quadrant (4.5x3.5x4 cm) and a second mass located near the axillary tail approximately (5x4x4 cm) that showed a tendency to unite in places in the left breast (Figure 1-4). Although the masses signified early washout and heterogeneous contrast in the MRI scans after the contrast agent injection, they showed diffusion restriction in the diffusion-weighted images (Figure 2). In contrast, the PET images revealed lesions with distinctive 18F-FDG involvement and approximately 9-12 SUV_{max} values measured in fusion images (Figure 3). Furthermore, the maximum intensity projection (MIP) images with color mapping showed vascularization in the masses (Figure 4). As a result of the PET-MRI, neoadjuvant CT was scheduled for the patient with no apparent systemic diffusion.

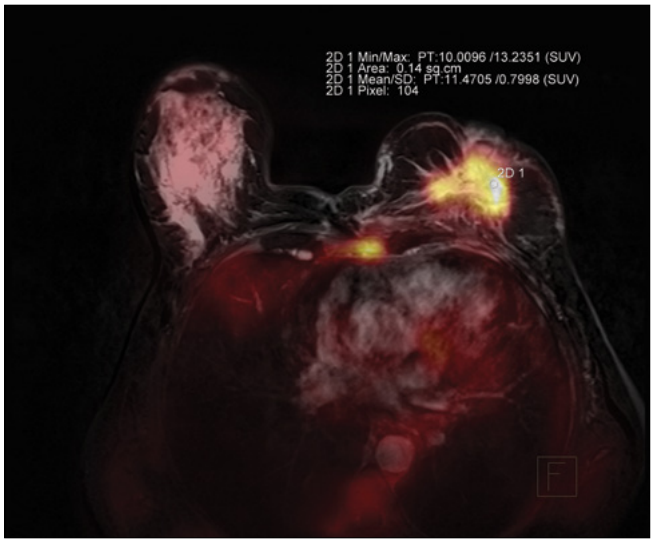

Figure 6. Measurement of the SUVmax value of spiculated mass lesion with contour monitored in the left breast in the axial fusion PET-MRI image

Case 2

The woman aged 48 years consulted our hospital with symptoms of nipple shrinkage in the left breast, erythema, and increase in the thickness of skin in addition to a breast mass. Mammography examination on the external center displayed an irregularly-bordered radiopacity approximately 8x10 cm in the retroareolar area of the left breast; a sonography showed a spiculated, heterogeneous, hypoechoic mass with contour and distinct posterior acoustic shadowing approximately 8x9 cm in the retroareolar area of the left breast (ACR BIRADS 5). The results of the tru-cut biopsy indicated positive estrogen, progesterone, and HER-2 receptors, 30% Ki-67, and grade III invasive ductal carcinoma. The patient was clinically believed to have locally-advanced breast cancer (cT2N2Mx) and was scheduled for neoadjuvant chemotherapy (CT) and also underwent PET-MRI examination after obtaining her consent. In this imaging, an irregularly-bordered mass with distinct heterogeneous enhancement after contrast agent injection sized approximately 7x8 cm was observed in the retroareolar area of the left breast. The tumor showed high metabolic activity, and had a SUV_{max} value over 10 in measurements taken from the fusion images (Figure 5, 6). Additionally, sternum and hepatic metastases were found in the patient.

Discussion and Conclusion

Clinical staging should be performed when determining disease prognosis and treatment for patients who are diagnosed as having breast cancer (4, 5). Physical examination, mammography, ultrasonography, and when necessary, MRI help detect local and regional extension (6-8). Patients who are presumed to have locally-advanced or metastatic breast cancer are usually requested to undergo whole-body 18F-FDG PET-CT. However, the PET-CT optimal breast protector is insufficient for evaluating tumor extension for surgical procedures. Therefore, preoperative dynamic contrast-enhanced MRI is performed to determine small multifocal/centric and synchronous contralateral disease (7).

Fully integrated PET-MRI systems only became available in recent years and it has not been shown superior at diagnosing compared with other modalities, as was the case in these case reports. However, they simultaneously perform investigations with high affinity and specificity and possess all data that could be gathered from the two examinations (PET-CT and MRI), while at the same time considerably reducing the amount of radiation exposure. In light of these facts, we present the efficiency and benefits of PET-MRI, practiced in our clinic in Turkey for the first time, for diagnosing breast cancer, staging, and monitoring neoadjuvant therapy.

Informed Consent: Informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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