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Case Report

Drug injection-related fat necrosis of the breast with FDG PET-CT uptake

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ABSTRACT

A 52-year-old woman was found to have a lung mass and bilateral breast lesions on computed tomography (CT). Subsequent positron emission tomography/CT demonstrated marked uptake in the lung mass and mild uptake within the breast lesions. A diagnostic mammogram and targeted ultrasound were performed to exclude primary breast malignancy or metastases from presumed pulmonary malignancy. A pertinent history of recent intravenous drug use with heroin injection into bilateral breasts, together with imaging features, facilitated diagnosis of fat necrosis. Fat necrosis is a common diagnosis in breast imaging and may be an incidental finding on positron emission tomography/CT in the oncologic setting. The presence of fat along with suggestive clinical history can lead to the diagnosis and appropriate assignment of either benign, breast imaging-reporting and data system (BI-RADS) 2, or probably benign, BI-RADS 3, category with short interval follow-up. Appropriate work-up of incidental fluorodeoxyglucose-avid breast masses with diagnostic mammogram ± ultrasound is warranted to avoid incorrect interpretation as neoplastic processes.

Case report

A 52-year-old woman with multiple comorbidities, including hepatitis C, chronic obstructive pulmonary disease, 100-pack-year smoking history, remote deep vein thrombosis, and migraines, presented to the emergency department for shortness of breath. Chest radiograph showed a left pulmonary nodule, which prompted a chest computed tomography (CT) scan that demonstrated a left lower lobe cavitating mass (images not shown). Fluorodeoxyglucose (FDG) positron emission tomography (PET)-CT scan demonstrated an FDG-avid left lower lobe mass and hilar and axillary adenopathy

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with minimal FDG uptake. The adenopathy was thought reactive due to hepatitis C. In addition, on the PET-CT, there were multiple irregular soft tissue nodules in bilateral breasts, which demonstrated mild FDG uptake.

Given the PET-CT scan findings, the patient required work-up for bilateral breast nodules to evaluate for breast primary process with subsequent axillary nodal and/or lung metastasis. Subsequently, she was sent for a bilateral diagnostic mammogram including bilateral whole breast images (Fig. 1) and spot magnification views (Fig. 2). The mammographic images demonstrate scattered fibroglandular densities (25%-50% fibroglandular), and multiple bilateral breast masses, which were oval in shape. The 3 largest of these masses were in the left breast at 1:30-o'clock position, 5 cm from the nipple, in the left breast at 8:30-o'clock position, 4 cm from the nipple, and in the right breast at 10-o'clock position, 9 cm from the nipple. The 2 masses in the left breast demonstrated central low attenuation consistent with fat density.

The patient then underwent targeted diagnostic ultrasound of these 3 masses (Fig. 3). The 2 left breast masses demonstrated heterogeneous echogenicity consistent with the presence of fat, indistinct margins, and posterior acoustic shadowing. Targeted ultrasound of the right breast demonstrated an oval-shaped, hypoechoic solid mass with circumscribed margins. During the ultrasound examination, the patient was queried for any history of trauma to the breast to potentially support the diagnosis of multifocal fat necrosis. The patient then endorsed a history of heroin injections into her bilateral breasts within the past several months.

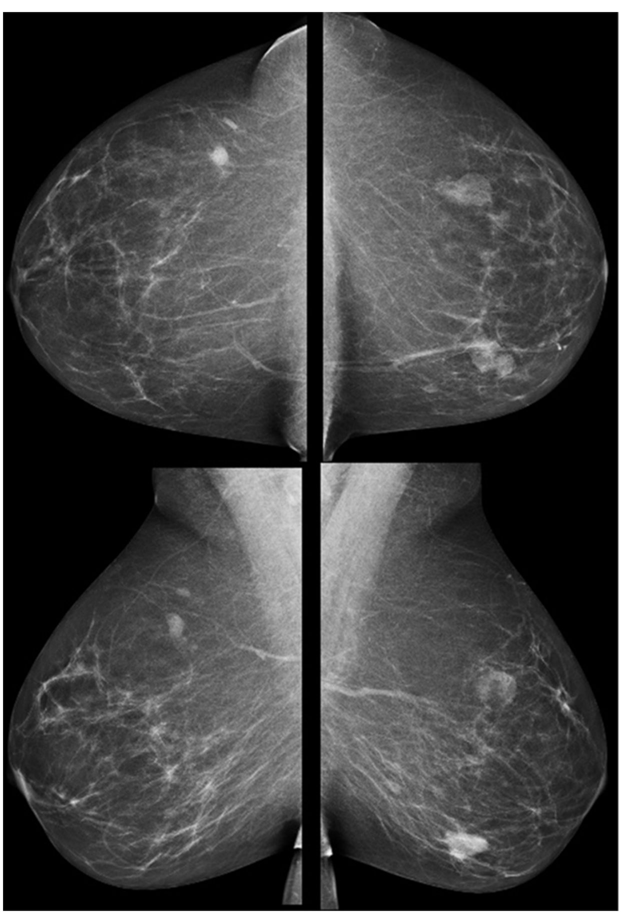

Fig. 1 – Whole breast images from diagnostic mammogram demonstrate scattered fibroglandular densities. There are multiple masses in bilateral breasts. Prior imaging is not available for comparison.

The 3 sonographic and/or mammographic lesions were anatomically correlated with the soft tissue nodules demonstrating mild FDG uptake on recent PET-CT (Fig. 4). The cavitating left lower lobe mass and mediastinal and axillary lymphadenopathy are again demonstrated on the PET-CT images (Fig. 5).

Given this history, all the masses were felt consistent with benign fat necrosis secondary to needle injection. A breast imaging-reporting and data system (BI-RADS) category 3 was assigned to bilateral breasts, with recommendation for short interval follow-up in 6 weeks to document continued evolution and/or stability of fat necrosis.

Follow-up imaging in 3 months including diagnostic mammogram and targeted ultrasound of the same 3 sites, demonstrated continued evolution of the multiple foci of fat necrosis with stability in size and number of lesions. Repeat CT scan at this time (not shown) demonstrated increase in size of the cavitating left lower lobe mass and stability of mediastinal adenopathy. Mediastinoscopy and left lower lobectomy were performed, and pathologic evaluation revealed poorly differentiated non–small cell carcinoma with glandular, squamous, and sarcomatoid differentiation within the lung and inflammatory and/or reactive adenopathy within the mediastinum.

Discussion

Fat necrosis of the breast is a benign lesion often encountered on mammographic, sonographic, and magnetic resonance imaging (MRI) of the breast [1,2]. The lesion is a sterile inflammatory process, most commonly occurring as a response to localized trauma, such as after blunt (impact to a steering wheel) and breast intervention, such as biopsy, lumpectomy, breast flap reconstruction, or radiation [1,2]. The lesion typically presents as a single or multiple small, painless lumps [3,4].

The histologic composition of the lesion depends on the age and will contain varying amounts of degenerating adipocytes and red blood cells, inflammatory cells, and fibrosis. Early in fat necrosis, degenerating adipocytes and fresh hemorrhage predominate. In the intermediate phase, inflammatory histiocytes and multinucleated giant cells infiltrate, whereas the adipocytes and red blood cells undergo necrosis. In the chronic phase, fibrosis predominates, possibly enclosing saponified fat, with hemosiderin deposition serving as a nidus for calcifications (yielding the classic mammographic oil cyst appearance) [1]. On mammogram, rim, heterogeneous, or dystrophic calcifications can be seen and usually develop in that order [2]. On MRI, homogeneous or rim enhancement may be seen [2,4]. Biopsy is warranted when the imaging features are

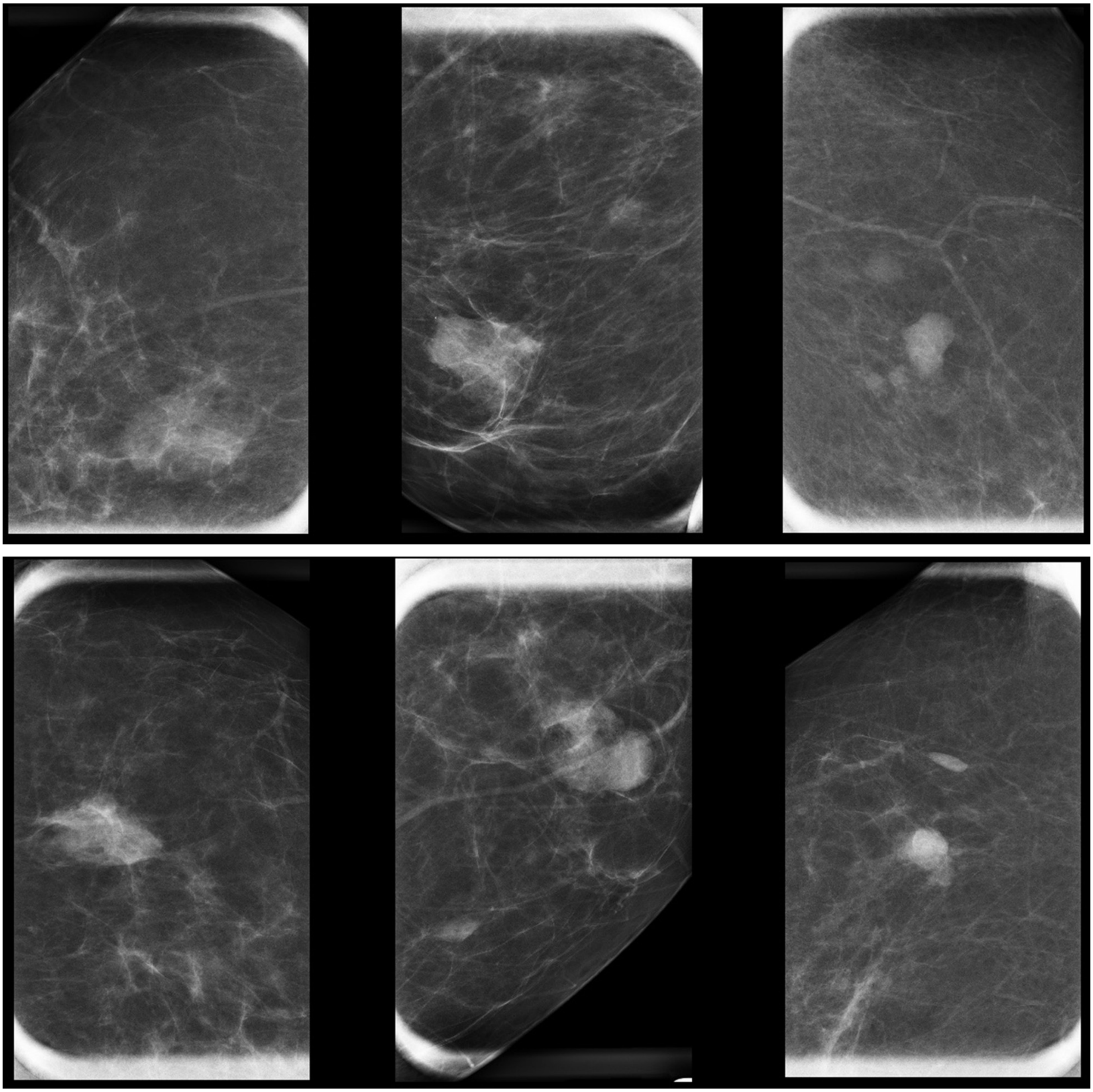

Fig. 2 – Spot magnification views from the 3 largest bilateral breast masses (top: craniocaudal views and bottom: mediolateral views). The 3 masses are located in the left breast at 1:30-o'clock (left), left breast at 8:30-o'clock (middle), and right breast at 10-o'clock (right) positions. They are all oval in shape. The 2 left breast masses contained central lucency compatible with fat density. The right breast mass could not be confirmed mammographically to be fat containing.

suspicious, such as if spiculated margins or if pleomorphic calcifications are present.

FDG PET-CT is a molecular imaging test used in a wide variety of oncologic and nononcologic applications. The primary mechanism for increased FDG uptake is increased glycolytic activity, as FDG is taken up by the glucose transporter and trapped within the cell. Auxiliary mechanisms for increased uptake include increased vascularity and compartmental third spacing. Malignant cells generally have increased metabolic activity, vascularity, and express an increased number of glucose transporters, forming the basis for their visibility on a PET-CT image [5–7].

FDG PET-CT is not currently indicated in the staging of clinically stage I or II breast cancer, as it has a high false negative rate for small and/or low-grade primary lesions and locoregional metastatic lymph nodes. However, it is helpful in

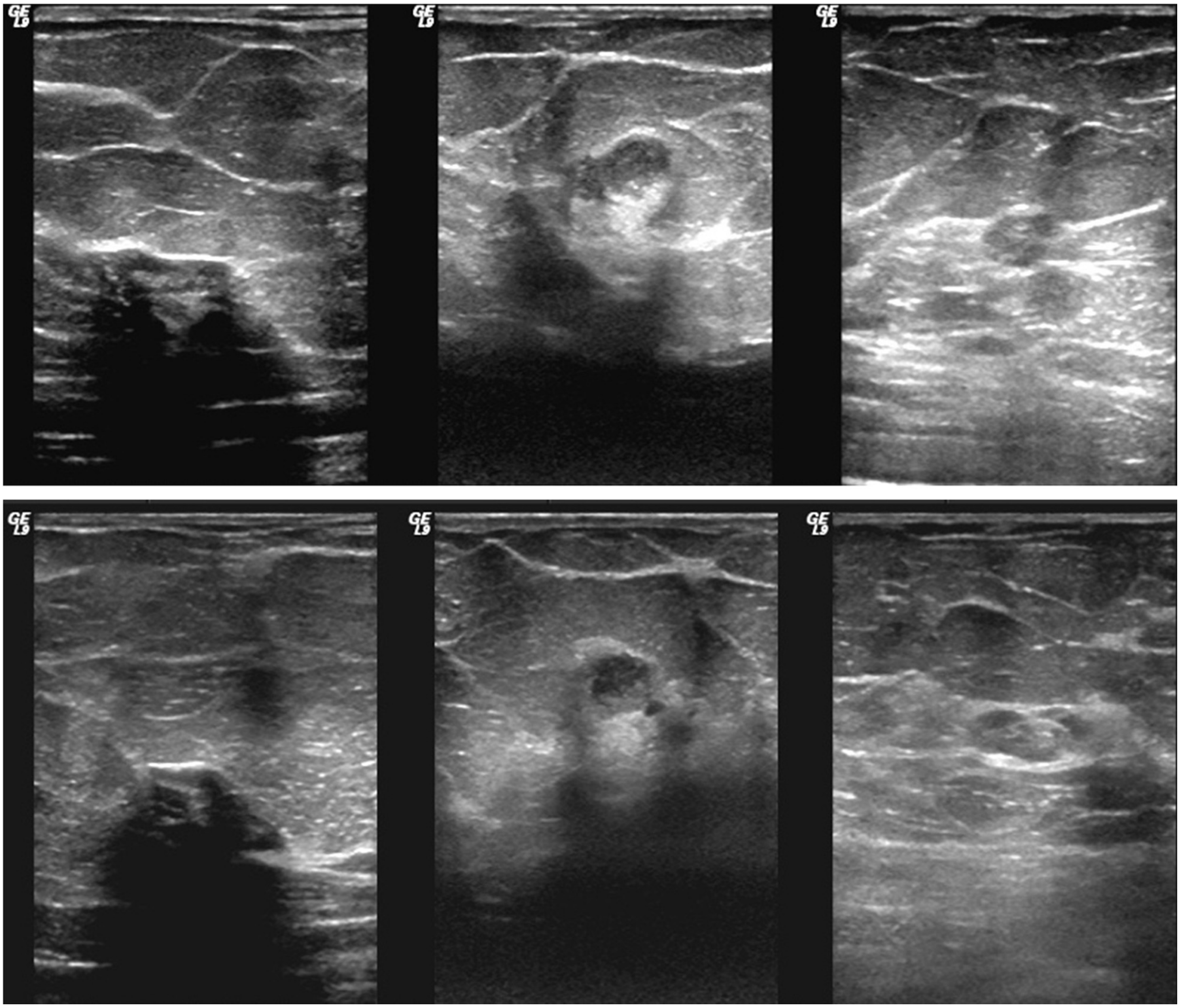

Fig. 3 – Ultrasound images (top: transverse views and bottom: longitudinal views) of 3 breast masses left breast at 1:30-o'clock (left), left breast at 8:30-o'clock (middle), and right breast at 10-o'clock (right) positions. The 2 left breast masses were heterogeneous in echo texture containing some areas of fat, with irregular margins and posterior acoustic shadowing. The right breast mass was solid hypoechoic, oval, with circumscribed margins.

evaluation for distant metastases in locally advanced breast cancer, in troubleshooting situations where standard staging studies are equivocal, or in evaluation for locoregional recurrence [8].

Incidental foci of FDG uptake within the breast on a PET-CT scan are not uncommon. Focal FDG uptake has been described within many non-neoplastic conditions, including fat necrosis, fibroadenomas, silicone granulomata, fibrocystic changes, postsurgical change, focal inflammation related to ruptured breast prosthesis, abscess, and even simple breast cysts [9–14]. Within fat necrosis, mild or even marked uptake may occur because of the previously mentioned mechanisms, likely most predominantly due to glycolysis within inflammatory white blood cells.

Although the appearance of fat necrosis is well documented on mammography and ultrasound [2], uptake within fat necrosis is less well recognized [15–18]. Some authors have described uptake within fat necrosis as a "false positive" [15,16]; however, we prefer to avoid this description noting that preferential FDG uptake within fat necrosis accurately reflects local increased metabolic activity and/or hyperemia and that FDG PET-CT is not exclusively a test of malignancy.

Knowledge that fat necrosis and other benign breast lesions may demonstrate increased FDG uptake is important to avoid interpreting this finding as malignancy. In general, correlation of areas of increased FDG uptake with the appearance on conventional breast imaging modalities will

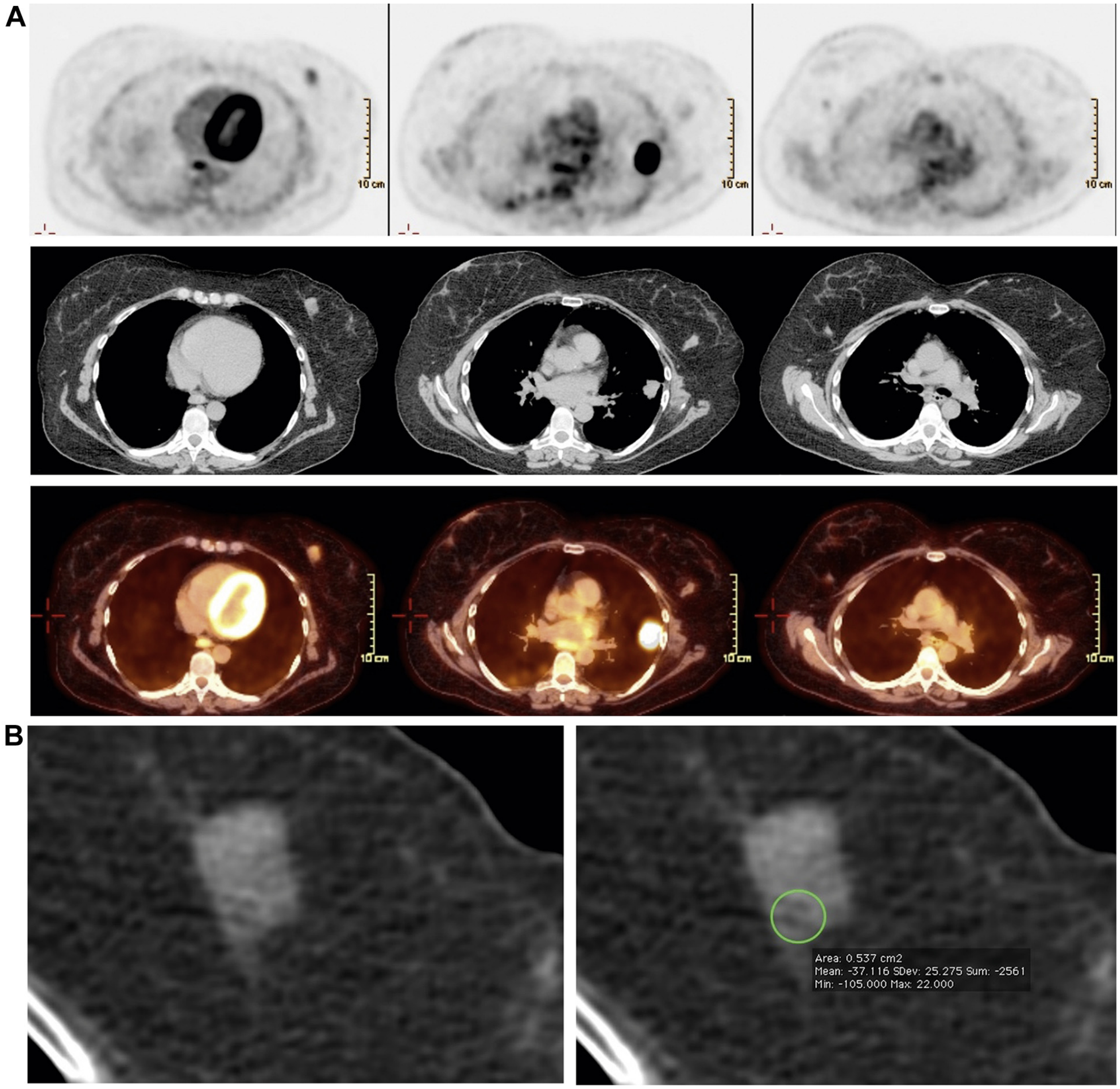

Fig. 4 – (A) Positron emission tomography (PET)-computed tomography (CT) images (top: fluorodeoxyglucose PET, middle: noncontrast CT, and bottom: fused CT/PET-CT) demonstrate 3 foci of uptake corresponding with breast masses left breast at 1:30-o'clock (left), left breast at 8:30-o'clock (middle), and right breast at 10-o'clock (right) positions. (B) Magnified CT image of the lesion in the left breast at 1:30-o'clock demonstrating that it contains fat (HU, −37).

allow correct characterization of the benign breast lesion. Furthermore, it is often the case that comparison of the degree of uptake within the breast lesion, with that of the primary malignancy, as in this case, will allow the radiologist to confirm that these areas of uptake are because of 2 physiologically distinct processes. For example, the highest maximum standard uptake value of the breast lesions pertained to the left lower inner quadrant lesion, measuring 2.8, whereas the maxSUV of the left lung lesion was 19.1.

In summary, management of a breast lesion, which demonstrates mild-to-marked FDG uptake but otherwise has features of fat necrosis, should not dissuade a radiologist from this benign diagnosis. Assignment of no follow-up (BI-RADS 2), short interval follow-up (BI-RADS 3), or recommendation of biopsy (BI-RADS 4) should be determined primarily by the lesion's features on mammography, ultrasound, and/or MRI images [3]. Clinical history is key in suggesting this diagnosis. In our patient, although 1 of the 3 lesions did not demonstrate fat, it was otherwise similar in appearance to these 3 lesions on breast imaging, CT, and PET. In light of her provided history of bilateral breast injections, this could be comfortably categorized together with

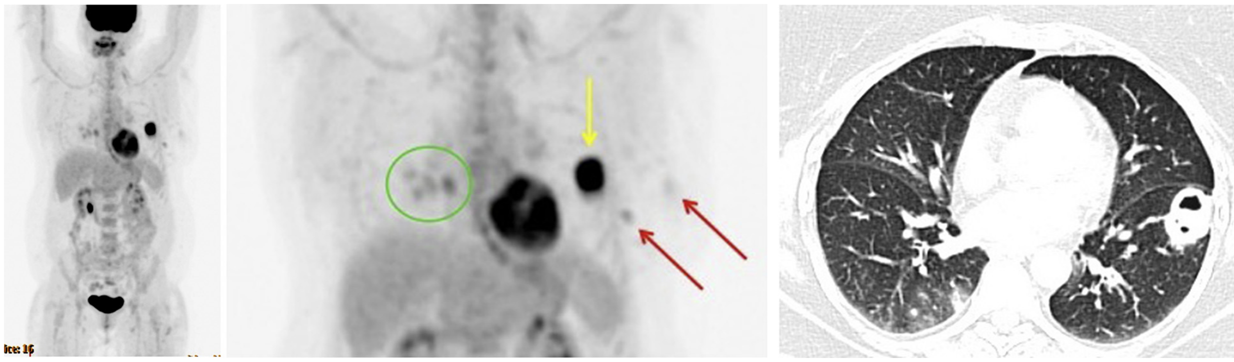

Fig. 5 – Whole body positron emission tomography-computed tomography (CT) maximum intensity projection image (left and middle) demonstrates subtle uptake in mediastinal (green circle) and axillary lymph nodes bilaterally, intense uptake in left lower lobe cavitating mass (yellow arrow) as demonstrated on axial CT image (right). The foci of mild uptake in the breasts faintly seen in the left breast (red arrows).

them as likely fat necrosis with short interval follow-up (BI-RADS 3) to confirm the diagnosis.

REFERENCES

[1] Taboada JL, Stephens TW, Krishnamurthy S, Brandt KR, Whitman GJ. The many faces of fat necrosis in the breast. AJR Am J Roentgenol 2009;192(3):815–25.
[2] Bilgen IG, Ustun EE, Memis A. Fat necrosis of the breast: clinical, mammographic and sonographic features. Eur J Radiol 2001;39(2):92–9.
[3] Upadhyaya VS, Uppoor R, Shetty L. Mammographic and sonographic features of fat necrosis of the breast. Indian J Radiol Imaging 2013;23(4):366–72.
[4] Cyrlak D, Carpenter PM. Breast imaging case of the day. Fat necrosis of the breast. Radiographics 1999;19(Spec No):S80–3.
[5] Lim HS, Yoon W, Chung TW, Kim JK, Park JG, Kang HK, et al. FDG PET/CT for the detection and evaluation of breast diseases: usefulness and limitations. Radiographics 2007;27:S197–213.
[6] Love C, Tomas MB, Tronco GG, Palestro CJ. FDG PET of infection and inflammation. Radiographics 2005;25:1357–68.
[7] Kapoor V, McCook BM, Torok FS. An introduction to PET-CT imaging. Radiographics 2004;24:523–43.
[8] National Comprehensive Cancer Network (NCCN). NCCN clinical practice guidelines in oncology. Breast Cancer. J Natl Compr Canc Netw 2015;13:448–75.
[9] Adejolu M, Huo L, Rohren E, Santiago L, Yang WT. False-positive lesions mimicking breast cancer on FDG PET and PET/CT. AJR Am J Roentgenol 2012;198:W304–14.
[10] Dobbs NB, Latifi HR. Diffuse FDG uptake due to fat necrosis following transverse rectus abdominus myocutaneous (TRAM) flap reconstruction. Clin Nucl Med 2013;38(8):652–4.
[11] Bakheet SM, Powe J, Kandil A, Ezzat A, Rostom A, Amartey J. F-18 FDG uptake in breast infection and inflammation. Clin Nucl Med 2000;25:100–3.
[12] Kumar R, Rani N, Patel C, Basu S, Alavi A. False-negative and false-positive results in FDG-PET and PET/CT in breast cancer. PET Clin 2009;4:289–98.
[13] Bhargava P, Glass E, Ghesani M. Inflammatory F-18 FDG uptake secondary to ruptured breast prosthesis. Clin Nucl Med 2006;31:227–8.
[14] Chen CJ, Lee BF, Yao WJ, Wu PS, Chen WC, Peng SL, et al. A false positive F-FDG PET/CT scan caused by breast silicone injection. Korean J Radiol 2009;10:194–6.
[15] Akkas BE, Ucmak Vural G. Fat necrosis may mimic local recurrence of breast cancer in FDG PET/CT. Rev Esp Med Nucl Imagen Mol 2013;32(2):105–6.
[16] Adejolu M, Huo L, Rohren E, Santiago L, Yang WT. False-positive lesions mimicking breast cancer on FDG PET and PET/CT. Am J Roentgenol 2012;198(3):W304–14.
[17] Mojtahedi A, Chacko G, Fu Y, Laine R, Wells K. Fat necrosis might mimic metastasis on 18F-FDG PET/CT. J Nucl Med Meeting Abstracts 2011;52:1063.
[18] Belakhlef A, Jani C, Church C, Fraser R, Lakhanpal S. Fat necrosis mimicking B-cell lymphoma: a PET/CT and FDG study. Clin Nucl Med 2008;33(4):271–2.