The Evaluation of Inflammatory Breast Cancer with F-18-Fluorodeoxyglucose Positron Emission Tomography and Review of The Literature

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# Abstract:

Inflammatory breast cancer is a rare and aggressive form of breast cancer characterized by dermal lymphatic invasion and tumor embolization resulting in erythema and edema of the breast. In many cases, by the time of diagnosis, there is already distant metastasis. Mammography, US, CT and MRI are usually preformed for initial staging; however, PET/CT can also be used for initial staging as it offers additional diagnostic information.

### Introduction:

Inflammatory breast cancer (IBC) is the most aggressive form of locally advanced breast cancer. Fortunately, it is rare and comprising 1-6% of breast cancer cases (1). Pathologically, this type of cancer demonstrates highly angiogenic properties which accounts for its early metastasis. The imaging and physical exam findings of IBC mimic inflammatory processes, and it is important to distinguish between these etiologies in a timely manner for proper management. Approximately 30% of women have stage IV de novo disease at diagnosis, and PET/CT has high sensitivity in identifying the extent of disease (2).

In this case report, we present the imaging findings of inflammatory breast cancer on PET/CT with MRI correlation. We discuss the role of PET/CT in the workup and management of IBC including diagnosis, staging, and predicting the overall survival in patients undergoing chemotherapy.

#### Case report:

A 67 year old female presented after an area of erythema in her right axillary region had progressed to involve her right breast. Examination revealed diffuse erythema and edema of the right breast. A mammogram performed one year prior showed no evidence of malignancy. Skin punch biopsy was performed and yielded invasive carcinoma compatible with IBC.

The patient subsequently underwent a contrast enhanced breast MRI. The T2 weighted image of the breasts shows asymmetric skin thickening of the right breast with breast distortion and retraction (Figure 1a). Increased T2 signal within the thickened skin indicates edema (arrow). A right breast parenchymal mass with peritumoral edema is also noted. Post contrast subtracted maximum intensity projection image demonstrates enhancement

of the large irregular mass in the central right breast with spiculated margins (arrow in Figure 1b). Additionally, the overlying skin shows abnormal contrast enhancement due to involvement with malignancy (arrowhead). Subtracted post contrast image through the axilla shows right axillary lymphadenopathy (arrow in Figure 1c).

PET/CT scan for initial staging was then performed. Sixty minutes after intravenous administration of 19.06 mCi (7.03 Bq) of F-18flurodeoxyglucose (FDG), sequential unenhanced CT and then PET images were acquired. This demonstrated an infiltrating mass within the right breast extending into the axilla with increased radiotracer activity; quantification showed maximum of SUV 8.1 (Figure 2). Diffuse hypermetabolic skin thickening of the right breast corresponds to the abnormal findings on MRI (arrow). Moreover, multiple regional and distant F18-FDG avid lymph nodes were discovered including the right axilla and an enlarged portocaval node (Figure 3). These findings are consistent with inflammatory carcinoma of the breast with regional and distant metastases. Percutaneous core biopsy confirmed the presence of metastasis to the portocaval node.

#### Discussion:

IBC is the most aggressive form of breast cancer with poorer survival compared to non-IBC tumors (3). Imaging plays an important role in cases of IBC to detect intraparenchymal breast lesions, nodal involvement and distant metastasis (3). Mammography and ultrasound are the recommended imaging modalities in the initial workup of IBC. However, MRI is also used in many cases to provide additional sensitivity for detection of breast parenchymal lesions.

While these imaging modalities provide excellent sensitivity for locoregional disease, additional imaging is required to establish the stage and extent of disease, which are critical for treatment planning. CT and bone scan are still used for initial staging (3). However, the use of PET/CT is increasingly being used in this setting.

The usual findings in patients with IBC are multiple hypermetabolic breast foci associated with hypermetabolic thickened skin (1). PET/CT has high sensitivity for detection of breast lesions, axillary nodal involvement and distant metastasis. Yang et al reported sensitivity of PET/CT of 96% for

detection of breast parenchymal lesions, 95% for axillary metastasis and 100% for distant metastasis (4). Champion et al showed that PET/CT performed better than contrast-enhanced CT in evaluation of regional lymph nodes (sensitivity 93% vs 86% and positive predictive value of 93% vs 89%) (2). In our case, PET/CT was equal to breast MRI for detection of locoregional disease as both modalities detected the breast parenchymal lesion, skin and axillary nodal involvement. PET/CT may give false negative results in cases of small lesions, particularly in the liver and lung parenchyma. Also, false positive results may occur in cases of inflammation or infections (5). Ipsilateral axillary lymph node uptake has been reported due to extravasation or partial subcutaneous injection of the antecubital region, thus giving false positive results in some cases.

Multiple studies have shown that PET/CT detects metastases which were not previously suspected. For example Carkaci *et al*, reported that among 41 patients with IBC, 7 of the 20 cases of distant metastases were not suspected before PET/CT (6). In our case, the staging PET/CT leads to the discovery of distant nodal involvement in the portocaval region. PET/CT specifically is useful in detection of internal mammary lymph node involvement which is predictive of recurrence (3).

In addition, PET/CT is useful to monitor the response to treatment and to detect early recurrence. Patients undergoing chemotherapy for IBC who show interval decrease in tumor metabolic activity have better overall survival; every 10% decrease in standard uptake value translates into a 15% lower probability of death and complete resolution of tumor F18-FDG uptake to 80% lower probability of death (6).

In summary, MRI is the most precise examination for detecting a cancer in an inflamed breast when it's compared to mammography, ultrasonography, and PET-CT (6). PET-CT is useful for local/regional lymph node staging before neoadjuvant chemotherapy, for guidance regarding the fields to be irradiated after mastectomy, and for detecting remote metastases (5).

# Conclusion:

We present a case of IBC in which PET/CT was equal to MRI in evaluation of locoregional disease yet provided additional detection of distant metastasis. PET/CT scan plays an important role in the diagnosis, staging, and monitoring of disease in IBC patients. Given the high likelihood of distant metastasis in cases IBC, accurate initial staging with PET/CT scan is crucial as it impacts treatment planning and ultimately patient outcome.

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Figure 1. T2 weighted image of the breast (a) shows diffuse skin thickening of the medial right breast with increase signal compatible with edema (arrow). Post contrast image (b) shows contrast enhancement of the skin (arrowhead) and irregular breast parenchymal mass (arrow). Subtracted post contrast image (c) shows abnormal enlarged right axillary lymph node (arrow).



Figure 2. Infiltrating mass within the right breast extending into the axilla with increased radiotracer activity



Figure 3. FDG avid portocaval node

