Prognostic Indicator of Dermal Backflow Detected by SPECT-Lymphoscintigraphy in Breast Cancer Patients

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Lymph node in breast cancer is of clinical significance in determining the disease stage, appropriate therapy and predicting the outcome of patients. Lymphoscintigraphy is essential for preoperative Sentinel Lymph Node (SLN) identification in breast cancer; it provides the surgeon with a roadmap of lymphatic drainage and the location of SLN. SLN are normally easily detected by lymphoscintigraphy most of the time.

We report a case of right breast cancer for sentinel node mapping at mastectomy. Planar lymphoscintigraphy images showed tracer dispersion around the injection site with non-visualization of SLN while SPECT/CT delineated the SLN and identified the initial breast tracer dispersion to be localized dermal activity, indicating dermal lymphatic backflow.

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Breast cancer is the most frequent cancer diagnosed in women worldwide[1]. Accurate identification of sentinel lymph nodes (SLNs) is a key factor in prognosis of early-stage disease and treatment. A study found that SLN biopsy was superior to axillary nodal dissection regarding morbidity and recurrence rate[2].

Lymphoscintigraphy provides a roadmap for surgeons to trace the direct lymphatic pathway from the tumor site to the SLN; therefore, allowing easy identification and biopsy of SLN[3].

Planar lymphoscintigraphy is routinely performed for mapping the regional lymph nodes; however, sometimes SLNs are not visualized, such as in obese patients, located too close to the injection site and if completely involved by tumor. The exact SLN location is difficult to define especially in deeply located nodes. Unexpected lymphatic pathways hinder interpretation of planar images. SPECT/CT can overcome most of these limitations because of its superior contrast, resolution and the display of exact anatomic landmarks [4].

The aim of this case report is to highlight the added value of SPECT/CT compared to planar imaging in the detection of non-visualized sentinel lymph node in planar images.

THE CASE

A forty-seven-year-old female with no history of prior surgery of breast or axilla was diagnosed with invasive ductal carcinoma seen in the lower quadrant of the right breast. The mass measured 33x24 mm. Axillary manual exploration and ultrasound were negative for axillary lymph nodes.

F-18 fluorodeoxyglucose (FDG) PET-CT revealed low-grade FDG avid two right breast nodules seen at its lower outer quadrant measured 2.4x1.8cm and retroareolar region measured 1.7x1.2cm with SUVmax~2.7, associated with diffusely enhanced breast parenchymal activity and diffuse skin thickening. No FDG avid axillary or distant metastases detected. Therefore, the clinical decision was to undergo right mastectomy and SLN biopsy.

On the day of surgery, a lymphoscintigraphy was performed with intradermal injection of single dose of 25.9 MBq of Technetium-99m-nano colloid (volume of 0.1 ml) at upper outer quadrant of right breast. Planar images were acquired at 15 minutes post injection, including anterior and lateral chest views, with and without flood cobalt-57 source.

The planar images revealed diffuse uneven breast tracer dispersion with non-visualization of lymphatic drainage to ipsilateral axillary sentinel nodes, see figure 1. SPECT-CT revealed tracer uptake in small right axillary lymph node, which confirmed the planar images of localized dermal breast activity likely corresponding to dermal backflow, see figures 2 and 3.

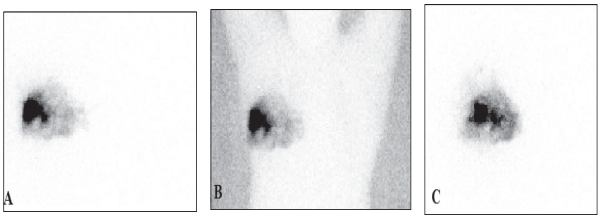

Figure 1: Planar Lymphoscintigraphy Images Anterior, Anterior with Cobalt-57 Flood and Right Lateral Images (A, B, C) Showing Tracer Dispersion in Right Breast Around Injection Site with No Sentinel Lymph Node Detected

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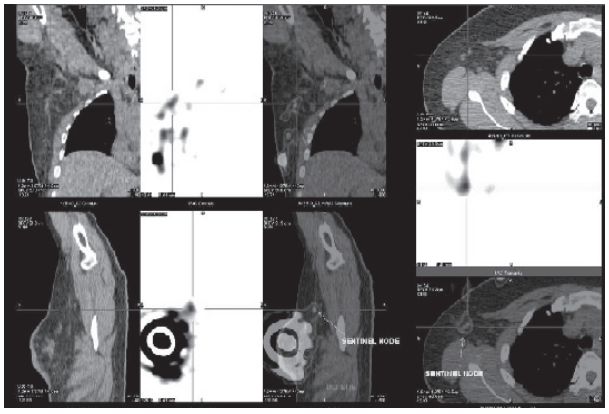

Figure 2: Coronal, Axial and Sagittal CT, SPECT, SPECT-CT Images Showing:
Small Right Axillary Sentinel Lymph Node (Level I) Not Seen in Planar Images

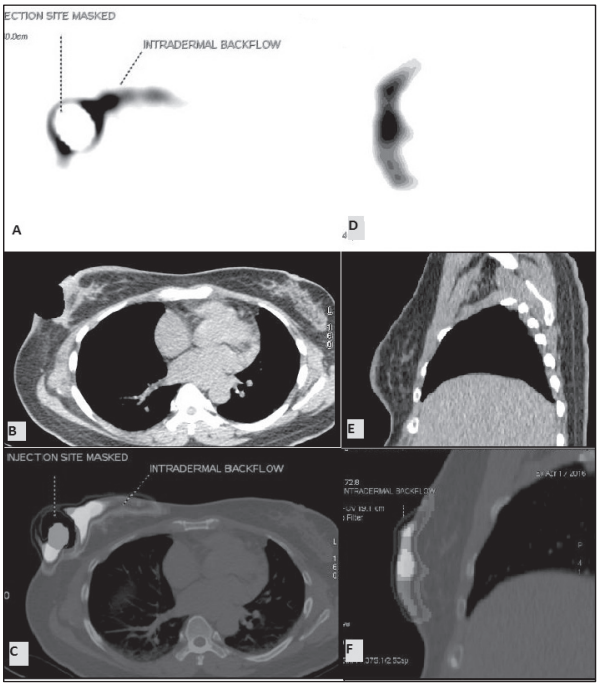

Figure 3: SPECT, CT, SPECT-CT Axial A, B, C & Sagittal D, E, F Images after Masking the Injection Site, Showing: Intradermal Tracer Localization (Intradermal Lymphatic Backflow)

Frozen section revealed metastatic adenocarcinoma. Consequently, the patient underwent right modified radical mastectomy and axillary lymph nodes clearance with final histopathology showing multifocal invasive ductal carcinoma 65 mm in maximum dimension G2, ER positive, PR positive, HER2 negative, presence of lymphovascular invasion, involvement of all 13 excised axillary lymph nodes with extra-nodal soft tissue extension (TNM staging: pT3 N3 Mx R0).

Eight months follow-up PET-CT after completion of adjuvant chemotherapy revealed multiple osteolytic bone metastases associated with an elevated tumor marker, see figure 4.

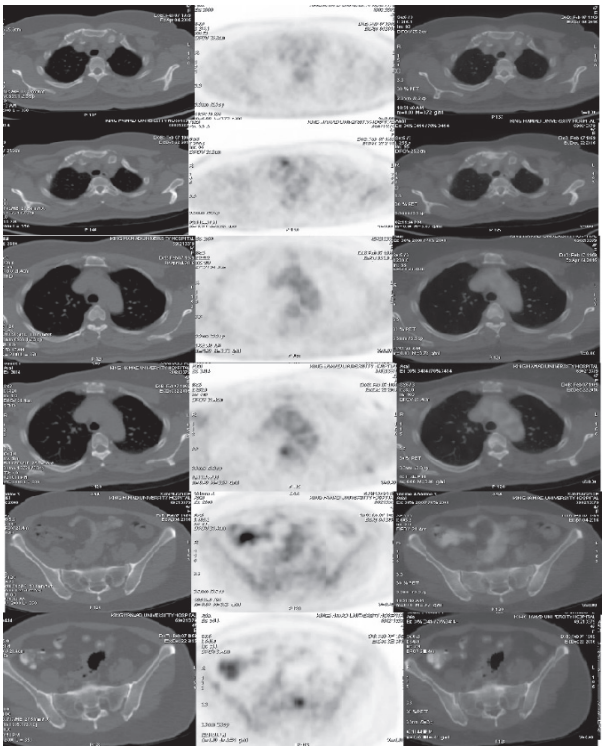

Figure 4: Axial CT, PET and Fused PET-CT Images (from Left to Right) before and after Surgery and Chemotherapy (Upper and Lower Rows, Respectively) Revealing Bone Metastases at the Right Side of Manubrium Sterni, Mid-dorsal Vertebra and Left Side of Sacrum

DISCUSSION

Non-visualization of SLN in lymphoscintigraphy could be attributed to large number of axillary lymph nodes and lymphatic system involvement by metastatic disease. Our case clarifies the added value of SPECT/CT in cases of non-visualized SLN during planar lymphoscintigraphy imaging. SPECT/CT is greatly helpful in detection of dermal lymphatic backflow as marker of lymphatic obstruction.

Axillary lymph nodes are the principal lymphatic drainage from the breast[5]. SLN biopsy is a minimally invasive technique to assess the potential nodal involvement. It is based on the assumption that nodal basin is free of malignancy if the SLN is not involved. Marked reduction in post-surgical lymphedema is associated with sentinel lymph node biopsy compared with axillary nodal dissection[6].

Lymphoscintigraphy is standard practice for the preoperative SLN identification in early-stage breast cancer. It provides the surgeon with a roadmap of lymphatic drainage and the location of SLN[7].

Non-visualization of SLN in lymphoscintigraphy could be due to tumor larger than two cm and involvement of the draining lymph nodes by the tumor[9,10]. Lymphatic system cancer involvement might impede the passage of radionuclides and might lead to unsuccessful SLN detection; this was the case in our patient in which the pathology revealed large tumor size

measuring 65 mm with the involvement of all excised axillary lymph nodes and even extra-nodal extension.

Robyn et al reported that patients with non-visualized SLNs on lymphoscintigraphy had a significantly lower rate of SLN identification at surgery compared with visualized SLNs. In a study of 37 patients with non visualized SLNs, 30 were identified at surgery as having SLN[11].

Planar lymphoscintigraphy can detect SLN in more than 95% of patients with breast cancer. However, in some cases, the detection and precise location of SLN might be difficult. SPECT/CT that combines functional and anatomical data can overcome some of these limitations because of its better contrast resolution that improves SLN visualization along with accurate anatomical localization. These advantages facilitate surgical exploration and eventually lead to better outcome[12,13].

Husarik and Steinert have compared planar and SPECT images to SPECT–CT in SLN mapping of breast cancer[14]. They found that SPECT–CT was a better method and was able to detect SLN which was not detected on planar images and superior to SPECT alone or planar images, especially with exact anatomical localization of the SLN.

SPECT/CT may obviate preoperative skin marking and replace delayed planar imaging. In addition, an intra-operative detection rate could be 100% for SLN[15-17].

The reported rates of 10-30% of sentinel nodes detected only on SPECT/CT and not visualized on planar imaging[9-10].

In our patient, SPECT-CT visualized SLN undetectable on planar images and determined its exact anatomic location; therefore, the added costs and extra time for SPECT/CT are justified.

Dermal backflow has been described in cases of limb lymphatic obstruction. In case of lymphatic obstruction, lymph is refluxed from lymph nodes or lymphatic vessels through dermal lymphatic collaterals towards the superficial dermal collateralization network[12].

In our patient, dermal lymphatic backflow post tracer injection was found in the involved breast, which is associated with lymphatic invasion and lymphatic obstruction with tumor cells. Up to our knowledge, this is the first time to report dermal backflow in breast lymphatic mapping as an indicator to breast lymphatic invasion and axillary node involvement by tumor cells.

CONCLUSION

SPECT/CT is helpful in accurately localizing sentinel lymph nodes especially those non-visualized on planar images or poorly detected by intraoperative gamma probe.

SPECT-CT detect dermal lymphatic backflow which indicates lymphatic obstruction and extensive axillary nodal metastases.

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