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Clinical Image
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Clinical Benefit of High Resolution Breast PET

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Clinical Image

Anatomic breast imaging techniques are very useful in the detection of breast cancer, but can have limited sensitivity and positive predictive value [1]. These limitations have provided the incentive for adjunctive metabolic technologies such as high-resolution breast PET. Metabolic or functional imaging focuses on activity at the cellular level and can provide more precise information and often better differentiation between benign *vs.* malignant findings.

Since its inception little more than a decade ago high-resolution, breast specific, PET imaging has proven to be an invaluable clinical asset, particularly in complex case problem solving. The instrumentation design of the Naviscan Solo-II™ high resolution PET scanner consists of a pair of linear detector arrays with LYSO crystal scintillators coupled with position sensitive photomultipliers. High-resolution breast PET utilizes tomographic reconstruction and uniform high spatial resolution with increasing tumor depth. Multiple reiterative reconstruction and post-reconstruction filtering contribute to lesion conspicuity.

In addition to the high intrinsic spatial resolution (1.6mm), sensitivity (92.5%), and specificity (91.2%) [2], the ability to conduct real-time, guaranteed sampling of suspicious lesions through core imaging verification provides an unprecedented advantage for breast biopsy [3,4].

As experienced dedicated breast imagers, we are always looking for advancements that can help promote a more personalized approach to breast cancer diagnosis and treatment versus a one-size-fits-all strategy. We have employed high-resolution breast PET for over 7 years, convinced of its efficacy we use it as an ancillary option for many problematic cases. One such case is discussed here.

At just 35 years of age, this patient was initially diagnosed with poorly differentiated invasive ductal carcinoma of the right breast. After treatment with lumpectomy, chemotherapy, and radiation therapy the patient was returned to routine surveillance screening. Nine years later, she suffered a recurrence in the right breast. Another lumpectomy and re-excision for positive margins were performed. Once again, post-surgery the patient resumed routine imaging surveillance. Fast forward another seven years. The patient presented with clinically enlarged lymph nodes on the contralateral (left) side. Diagnostic imaging work up to include mammography, ultrasound, PET/CT, and MRI were all performed. All modalities revealed abnormal lymph nodes, only MRI showed enhancement at the previous right breast site. The patient underwent left node biopsy and ultimately ALND on the left which proved she had recurrent, locally metastatic adenocarcinoma, Estrogen, Progesterone and HER 2 negative. MR-guided biopsy of the prior right lumpectomy site was done and the results were negative yielding only fat necrosis and fibrosis. The primary lesion associated with the left lymphadenopathy could not be found. After consultation with oncology, we decided to try high-resolution breast PET. Finally, the answer was revealed. Active tumor in the right breast, with a PUV max of 3.25 and a lesion to background ratio (LTB) of 6.2 and metastasis to contralateral axillary lymph nodes. The imaging diagnosis was confirmed through PEM-guided biopsy of the right breast with the ability to confirm location accuracy through imaging the activity in core samples. The post- biopsy mammogram showed the biopsy marker for the PEM guided biopsy in the expected location but the clip from the MR- guided biopsy was distant from the lesion site.

Same-day PEM-guided biopsy is feasible for most patients. It results in decreased radiation dose to both the patient and medical staff and expedites the patient's preoperative staging workup for breast cancer. The feasibility and advantages of performing high-resolution PET imaging and PEM-guided biopsy on the same day are well documented [5]. The ability to perform real-time image guided biopsy with the ability to confirm specimen sample activity is an unprecedented clinical benefit. This case demonstrates correct sampling proven by activity in specimen imaging. The post PET biopsy mammogram image also shows that the clip placed on the MR guided biopsy was far distant from the actual cancer site.

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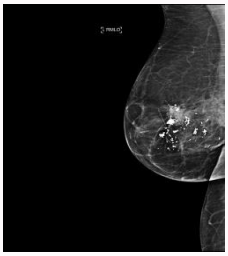
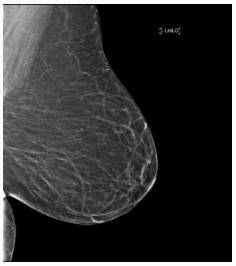


MM: Right MLO



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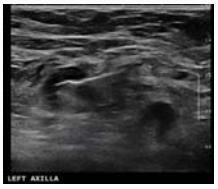
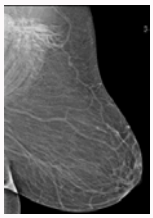
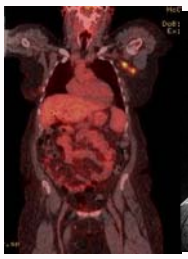


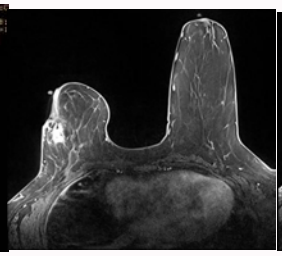
US BX: Metastatic CA



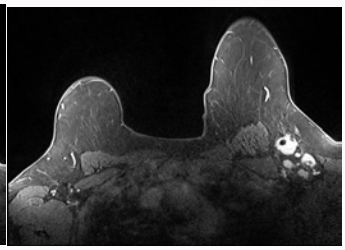
MM Post Biopsy



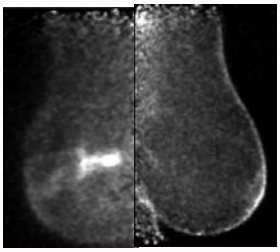
PET/CT: + LN



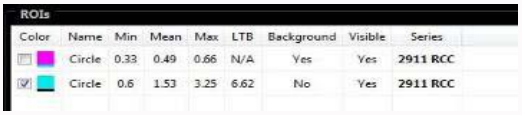
MRI: Right CA site



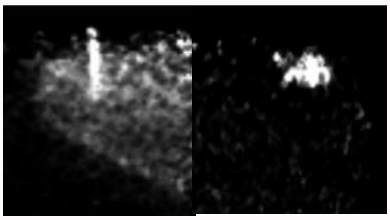
MRI: Left Axillary LN



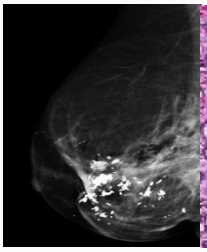
Breast PET: uptake at CA site



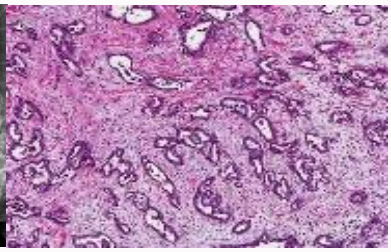
Statistics: LTB 6.62 at CA site



Real time Breast PET Bx w/specimen



Right MM: post BX



Pathology: Invasive Ductal CA

Figure:

The radiology community at large has expressed confidence in the value of using high-resolution PET imaging of the breast to improve detection and diagnosis [6]. At our center we have seen first-hand the accuracy of this modality and the benefit it provides to patients. Patient care is improved by accurately identifying the extent of disease so appropriate management can be assessed. Breast surgeons can appreciate the precise information provided for pre-surgical planning.

Interest in nuclear breast imaging has increased significantly with the advancement of dedicated devices with improved technological capabilities that allow extremely high sensitivity and specificity at very low dose. Breast density notification laws have also contributed to the debate and highlighted the need for functional vs. anatomic breast imaging methods.

Encouraging work is underway with many radiotracers not currently approved for use in the United States. 18F-fluoroestradiol may have a role in predicting early response to treatment in the breast [7]. With initial flare in responders, 3'-deoxy-3'-^{18}F-fluorothymidine (^{18}F-FLT) is also being assessed in treatment response [8]. New pathways in radiotracer development only broaden the horizon for high-resolution breast PET.

Individualized assessment is a key component of our practice.

By having multiple modalities at our disposal we can maximize early detection which decreases interval cancer rate. Patients need a more tailored approach to diagnosis and treatment. We feel that functional imaging with high-resolution breast PET can play a major role in that paradigm.

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