

Quantitative improvement in breast lesion detectability on delayed images using high resolution positron emission mammography.

LP Adler¹, D Narayanan², L Gammage¹, D Beylin², R Keen², V Zavarzin²
¹Adler Institute for Advanced Imaging, Jenkintown, PA, ²Research and Development, Naviscan PET Systems, Inc., Rockville, MD
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Introduction

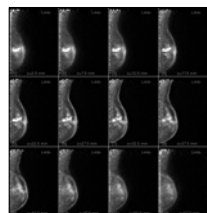


PEM Flex PET Scanner

Positron Emission Mammography (PEM) is imaging of the gently compressed breast with high resolution PET detectors. 3-D tomographic images are obtained by imaging breasts using the PEM Flex™, (Naviscan PET Systems, San Diego, CA), a commercially available PET scanner optimized for breast and small body parts imaging. The PEM Flex device is a high resolution (2mm in plane) dedicated partial ring PET scanner with two detector heads containing 2mm x 2mm x 10mm LSO/LYSO crystals. [1]

In previous studies, PEM has shown promise in both depicting primary breast cancer [2] and correctly evaluating the extent of disease for both invasive and in-situ carcinomas [3]. In a previous multi-center study with 77 patients Berg and colleagues reported 90% sensitivity and 86% specificity for detecting malignancies. Patients were injected with a median dose of 12mCi and imaged for 10 minutes after a median delay of 95 minutes.

It is known from whole-body PET studies that delay of imaging up to 3 hours post FDG injection improves the lesion contrast, although at the same time increasing statistical noise. Kumar et al [4] showed an increase in the uptake of 18F-FDG over time for malignant breast tissues imaged with whole-body PET imaging.



Tomographic PEM image showing FDG uptake in patient with lobular ca.

Purpose

To perform a retrospective review of PEM patients at our facility to determine quantitatively if delayed imaging with 18F-FDG using high resolution PEM would improve detectability of breast lesions.

Methods

- Acquired bilateral PEM images of 11 patients (average age: 51 years) with known or suspected breast cancer.
- Patients injected with median 13.9mCi (range 11.4-25.5mCi) of 18F-FDG.
- Patients imaged at an median delay of 71 minutes (range 53-117 minutes) for initial imaging and 180 minutes (142-234 minutes) for delayed imaging.
- Images acquired for 10 minutes per view with gentle compression (average 5.8cm).



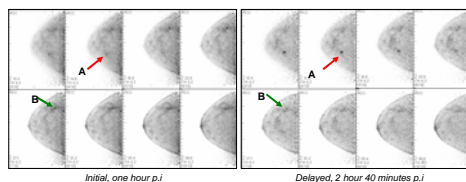
Patients imaged with gentle compression

Analysis

- Region of interest drawn on known or suspected area of malignancy. Background ROI drawn on area of normal glandular tissue.
- Contrast to noise ratio for each lesion and background to noise ratio for every patient calculated.
- Visual inspection of the images to detect additional lesions.
- 18 lesions in 11 patients were analyzed with 13 malignant lesions and 3 benign lesions evaluated. No pathology was present after PEM imaging for 2 lesions.

Quantitative difference in delayed imaging

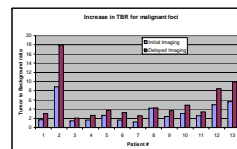
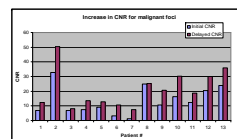
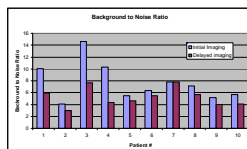
54 year old woman injected with 16mCi FDG & imaged for 10 minutes using dedicated breast imaging PET scanner (PEM Flex Solo, Naviscan PET Systems, Inc).



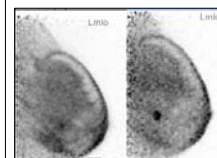
	Initial CNR	Delayed CNR	% Change	Pathology
Lesion A	6.9	12.2	↑ 43.44%	Grade 1 3mm Invasive Ductal Carcinoma with cribriform DCIS
Lesion B	11.2	10.83	↓ -3.4%	Benign fibrocystic condition involving atrophic breast tissue

Findings

- Median increase in Contrast to Noise Ratio (CNR) in all 13/13 cancer cases is 35% (range: 16-85%)
- 3/3 benign cases had a decrease in CNR
- 26% reduction in Background to Noise Ratio due to decrease in statistical noise
- 6/13 cancers detected in delayed images only

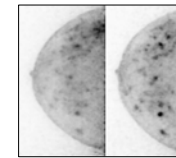


Additional lesions visualized on delayed images



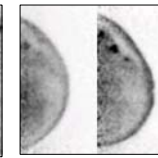
Initial Image Delayed Image

45 year old woman with ductal carcinoma post radiation therapy injected with 12 mCi FDG. Patient was imaged at hour and 3 hours post injection. Tumor is depicted clearly in the delayed images



Initial Image Delayed Image

44 y/o injected with 13mCi FDG. Patient was imaged at one hour and 3 hours post injection. Multicentric tumor clearly depicted in delayed images



Initial Image Delayed Image

32 y/o injected with 14mCi FDG. Patient was imaged at one hour and 3 hours post injection. Multifocal invasive tumor clearly depicted in delayed images

FDG PEM allows detection of sub-centimeter breast lesions.
 Lesion visualization improves in delayed images.

Discussion & Conclusion

DISCUSSION:

Visual inspection of the images showed improved lesion detectability in the delayed breast images which correlated with increased CNR. In 5 (50%) of the lesions the measured CNR increased from below 7 to above, thus providing quantitative confirmation of improvement in lesion visualization. In prior studies with PEM, the sensitivity in detecting breast cancer has shown to be ~90% with a patient soak time of between 60-90 minutes. In this series, we show improved lesion detectability and decrease in background noise, suggesting an improvement in PEM sensitivity in detecting breast cancer.

CONCLUSION:

Dual time point imaging is feasible with PEM and in this preliminary study, delayed imaging actually increased CNR in all malignancies and detected malignancies not prospectively detectable on early imaging. Further studies with a larger subset of patients and pathological correlation are required to assess the influence of the delayed imaging on the clinical performance of PEM.

References

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2. Berg WA, Weinberg IN, Narayanan D, Lohrman MB, Ross E, Amodei L, et al. High Resolution FDG Positron Emission Tomography with Compression ("Positron Emission Mammography") is Highly Accurate in Depicting Primary Breast Cancer. Breast J 2006;12(4):309-23
3. Tafra L, Cheng Z, Uddo J, Lohrman MB, Stein W, Berg WA, et al. Pilot clinical trial of 18F-fluorodeoxyglucose positron-emission mammography in the surgical management of breast cancer. Am J Surg 2005;190(4):628-32
4. R. Kumar, V. A. Loving, A. Chauhan, H. Zhuang, S. Mitchell, and A. Alavi. Potential of Dual-Time-Point Imaging to Improve Breast Cancer Diagnosis with 18F-FDG PET. J. Nucl. Med., November 1, 2005; 46(11): 1819 - 1824.