Multiparametric breast [18F]FDG-PET/MRI: are there differences in imaging biomarkers of contralateral healthy tissue in patients with and without breast cancer?

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Background

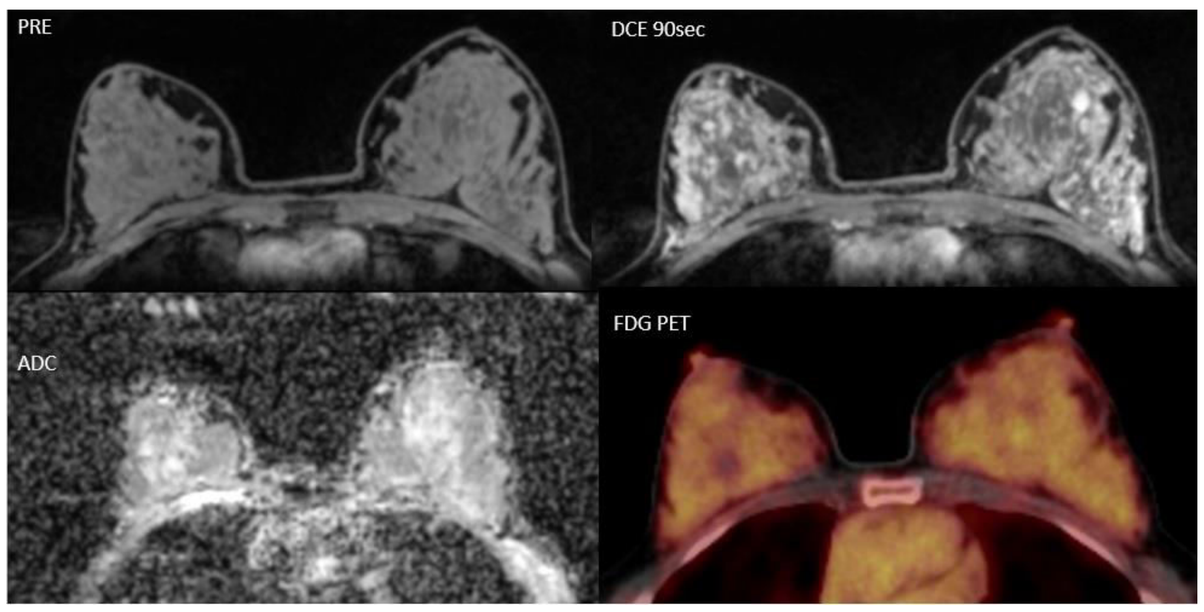
MRI allows the assessment of breast morphology, as well as physiologic activity of breast tissue. Amount of fibroglandular tissue (FGT), and background parenchymal enhancement (BPE) on MRI are considered sensitive predictive and prognostic imaging biomarkers in breast cancer. [18F]FDG-PET provides insight into tissue glycolysis and hence, physiologic activity of normal breast parenchyma, which is defined as breast parenchymal uptake (BPU). With the increasing clinical use of hybrid PET/MRI systems, these potential imaging biomarkers of breast cancer can be assessed simultaneously. A recent study found a significant direct correlation between BPU and BPE, and between BPU and FGT. The investigation of BPU as another potential quantifiable imaging biomarker for breast cancer prediction, prognosis, and risk assessment is therefore of considerable interest.

Purpose

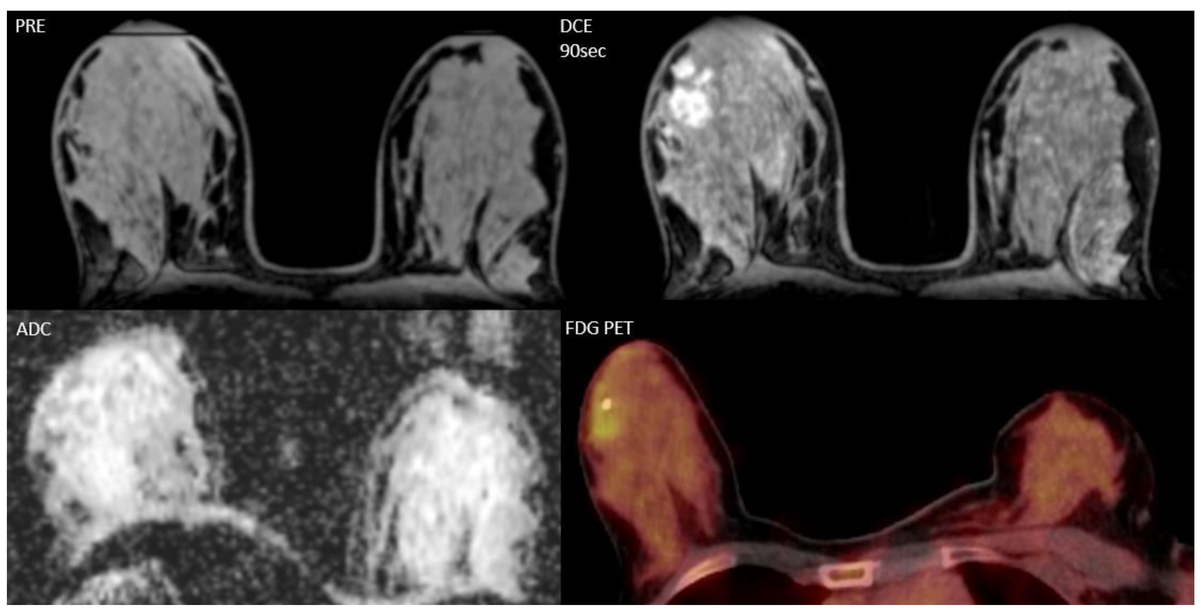
To assess whether there are differences in multiparametric (mp) [18F]FDG-PET/MRI imaging biomarkers of contralateral healthy breast tissue in patients with benign and malignant breast tumors.

Materials and Methods

In this IRB-approved prospective study and retrospective data analysis, 141 women underwent fused mp PET/MRI at 3T with contrast-enhanced MRI (CE-MRI), diffusion-weighted imaging (DWI), and PET with the radiotracer [18F]FDG for the assessment of an imaging abnormality (BI-RADS 0,4/5). In all patients, the following imaging biomarkers were recorded for the contralateral (tumor-free) breast: BPU with [18F]FDG-PET; mean apparent diffusion coefficients (ADCmean) with DWI; BPE; and FGT in CE-MRI. SUVmax was calculated to quantify BPU. FGT and BPE were qualitatively assessed by 2 independent readers and classified ACR A-D, and as mild, moderate, or marked. Histopathology was used as the standard of reference. Appropriate statistical tests were used to assess differences in imaging biomarkers between benign and malignant lesions.



Fibroadenoma: moderate BPE, FGT D, BPU 3.2, ADC 1496, postmenopausal



Mucinous carcinoma G2: mild BPE, FGT D, BPU 2.58, ADC 2166, premenopausal

Results

There were 100 malignant (mean 60 years) and 41 benign lesions (mean 50 years). BPE was minimal in 61 (53 malignant) patients. BPE differed significantly (P<0.001) between patients with benign and malignant lesions with patients with cancer demonstrating decreased BPE in the contralateral breast. A borderline statistically significant difference was observed for FGT (P=0.055), with decreased FGT in patients with breast cancer. BPU for patients with mild BPE was 1.5 (SD, 0.56), for mild BPE 1.9 (SD, 0.55), for moderate BPE 2.2 (SD, 0.54), and for marked BPE 1.9 (SD, 0.80). BPU differed significantly between patients with benign (mean, 1.9; SD, 0.65) and malignant lesions (mean, 1.8;SD, 0.59) (P<0.001), whereas ADCmean did not differ between groups (P=0.19).

Conclusion

- **Differences in mp PET/MRI imaging biomarkers obtained from contralateral healthy breast tissue exist between patients with benign, and patients with malignant breast tumors**
- **BPE, BPU, and FGT of the contralateral healthy breast are decreased in patients with breast cancer.**
- **Contralateral BPE and BPU may potentially serve as imaging biomarkers for the presence of cancer**

References:
King et al. Background parenchymal enhancement at breast MR imaging and breast cancer risk. Radiology, 2011; Dontchos et al. Are qualitative assessments of background parenchymal enhancement, amount of fibroglandular tissue on MR images, and mammographic density associated with breast cancer risk? Radiology, 2015; Preibsch et al. Background parenchymal enhancement in breast MRI before and after neoadjuvant chemotherapy: correlation with tumour response. Eur Radiol. 2016; Leithner et al. Quantitative Assessment of Breast Parenchymal Uptake on 18F-FDG PET/CT: Correlation with Age, Background Parenchymal Enhancement, and Amount of Fibroglandular Tissue on MRI. JNM, 2016.