# Does a predictive multiparametric [18F]FDG-PET/MRI model including imaging biomarkers of the tumor and contralateral healthy breast tissue aid breast cancer diagnosis?

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## Background

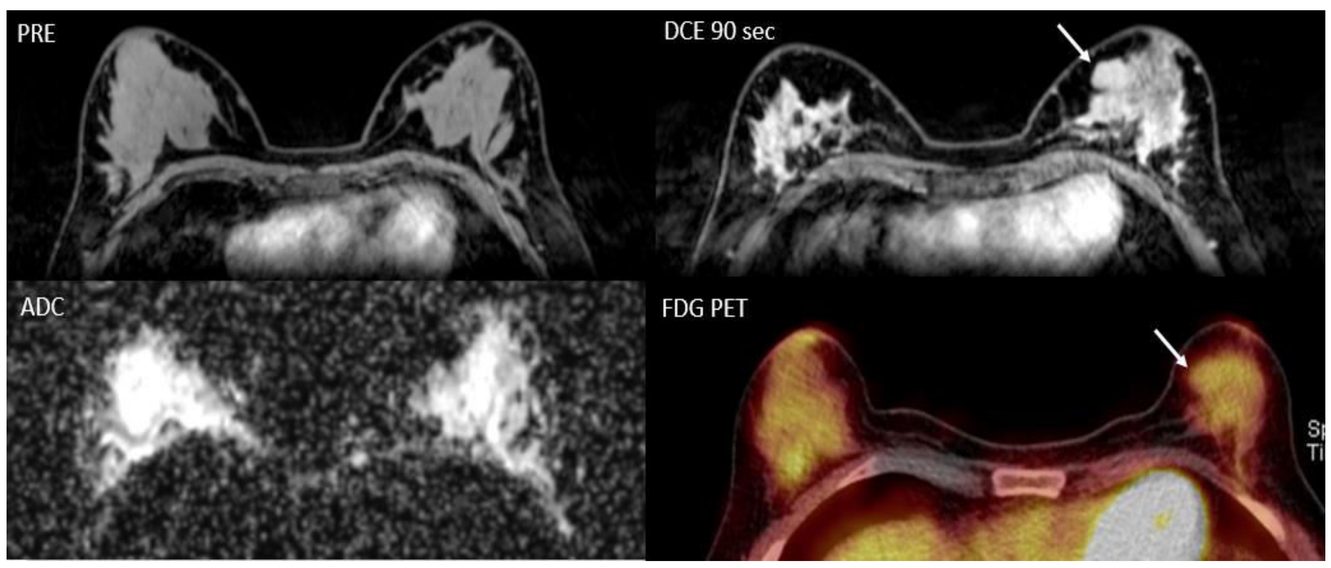
Dynamic contrast-enhanced MRI (DCE-MRI) is the most sensitive method for breast cancer diagnosis. Multiparametric MRI combining diffusion-weighted imaging (DWI) and DCE-MRI has been successfully implemented in the clinical routine, leading to gains in diagnostic accuracy. The potential predictive and prognostic value of imaging features derived from healthy breast tissue, such as background parenchymal enhancement (BPE) and amount of fibroglandular tissue (FGT), have only recently been recognized. BPE and FGT have been found to be correlated with increased cancer risk. Similarly, healthy breast parenchyma has shown varying degrees of tracer uptake in 18-Fluorodeoxyglucose ([18F]FDG) positron emission tomography (PET), referred to as breast parenchymal uptake (BPU). Significant direct correlations between BPU and BPE as well as between BPU and FGT has been found. With the advent of PET/MRI scanners and given the improvements in diagnosis and prognosis using multiparametric MRI, it is of interest to explore the potential of [18F]FDG PET/MRI for multiparametric MRI.

## Purpose

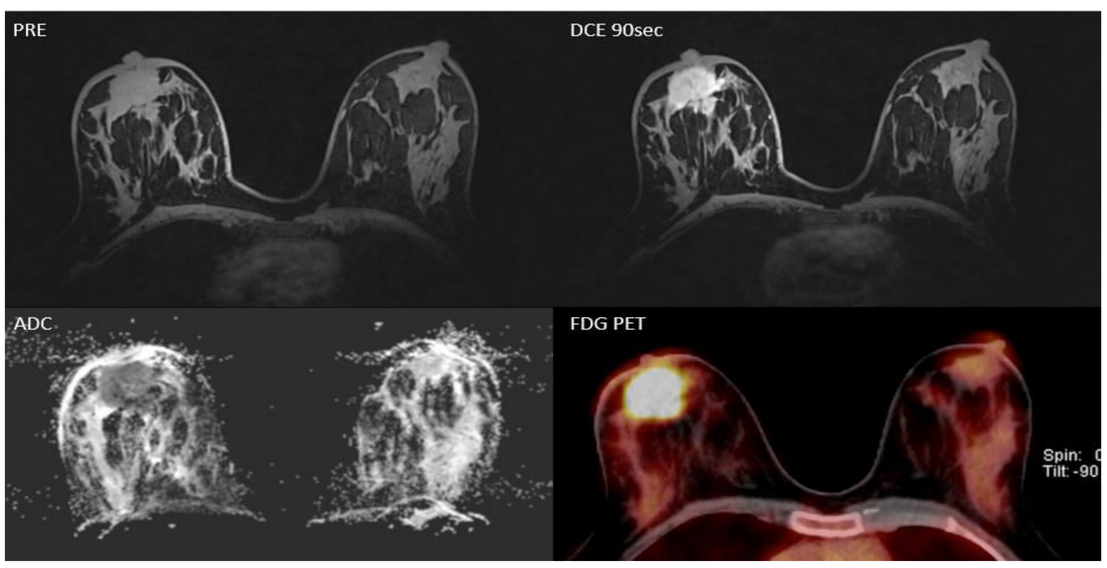
To develop a multiparametric [18F]FDG PET/MRI model for breast cancer diagnosis incorporating biomarkers of breast tumors and contralateral healthy breast tissue.

## Materials and Methods

In this IRB-approved prospective study and retrospective data analysis, 141 women underwent fused multiparametric PET/MRI at 3T with DCE-MRI, DWI, and PET with the radiotracer [18F]FDG for the assessment of an imaging abnormality (BI-RADS 0,4/5). Data were evaluated by two radiologists in consensus. Patient age, BI-RADS descriptors with DCE-MRI, ADC with DWI, SUVmax with [18F]FDG PET/CT for the tumor, and SUVmax, ADCmean, BPE and FGT of the contralateral healthy breast were recorded. Histopathology was used as the standard of reference. Uni-, bi- and multivariate logistic regression analyses were performed to assess the relationships between tumor malignancy and imaging features. Predictive discrimination of benign and malignant breast lesions was examined using area under the receiver operating characteristics (ROC) curve (AUC).




Fibroadenoma: ADCmean 1386, SUVmax 1.9
Healthy breast: marked BPE, FGT D, ADCmean 1542, BPU 2.2; premenopausal




Intraductal carcinoma G3: ADCmean 521, SUVmax 15
Healthy breast: minimal BPE, FGT C, ADCmean 1693, BPU 1.9; premenopausal

## Results

There were 100 malignant and 41 benign lesions. On DCE-MRI, morphological and kinetic features predictive of breast cancer presenting as masses were: irregular/spiculated margin, irregular shape, heterogeneous internal enhancement and plateau/wash-out curves (P<0.0001). Patients with a malignant lesion showed decreased BPE of the contralateral healthy breast (P=0.001), while a borderline significant difference was observed for FGT (P=0.0564). On DWI, malignant lesions showed significant lower average ADCmean ($0.96x10^{-3}$ $mm^2/s$) compared with benign tumors ($1.52x10^{-3}$ $mm^2/s$) (P<0.0001). On [18F]FDG PET, cancers showed a higher FDG avidity (mean SUVmax 5.2) than benign tumors (mean SUVmax 2.6) (P<0.0001). Multivariate logistic regression analysis determined that tumor ADCmean on DWI, tumor enhancement kinetics and BPE of the contralateral healthy breast in DCE-MRI were significantly associated with breast cancer diagnosis. Based on the combination of these three imaging biomarkers, the model discriminated between benign and malignant tumors with an area under the curve (AUC) value of 0.98.

## Conclusion

- **A multiparametric [18F]FDG PET/MRI model including qualitative and quantitative imaging biomarkers of the tumor and healthy breast tissue (tumor enhancement kinetics, ADCmean tumor, BPE) shows promise to improve differentiation of benign from malignant breast lesions**
- **Implementation of imaging biomarkers of healthy breast tissue for breast cancer diagnosis should be considered**

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; 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.

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