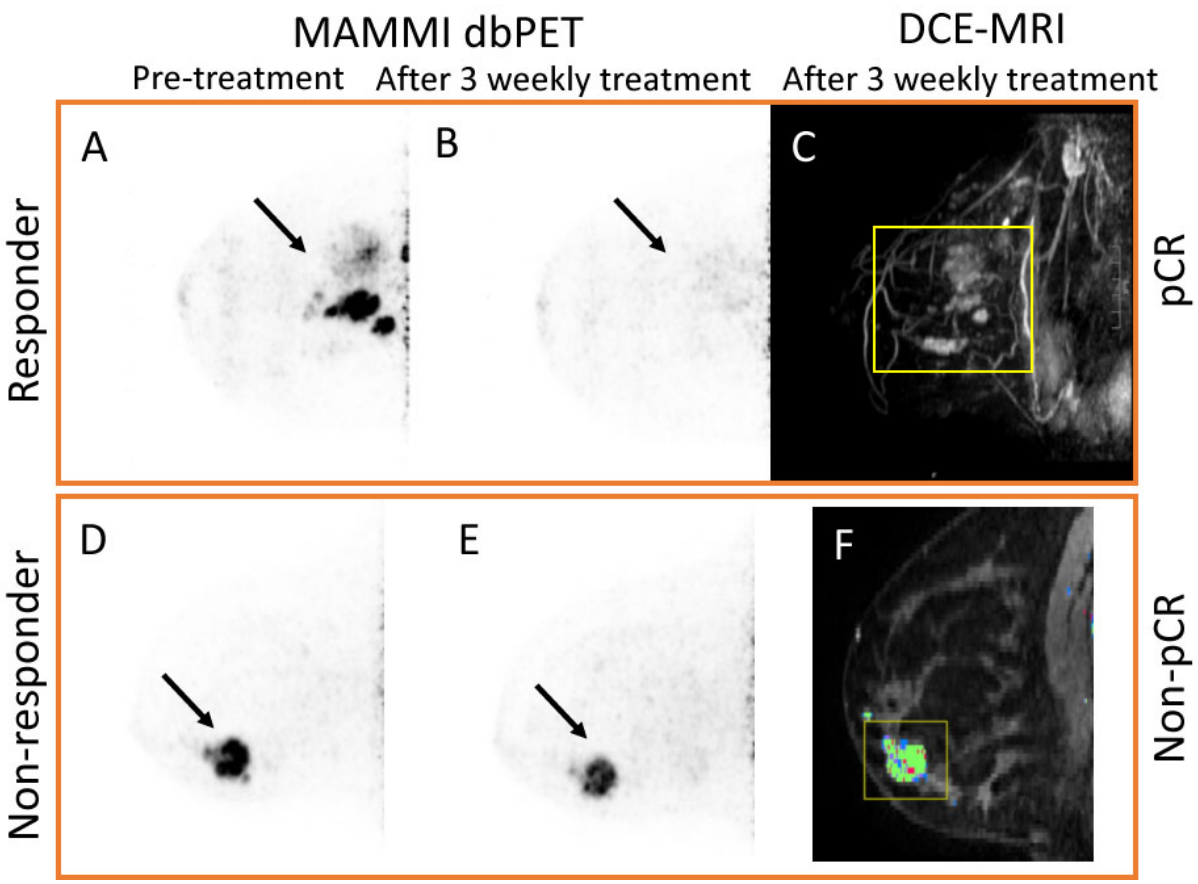
BACKGROUND: In the neoadjuvant chemotherapy (NAC) setting, imaging plays a critical role in non-invasively assessing the response of the intact primary tumor to targeted systemic therapies. Treatment-induced change in the primary tumor can serve as a surrogate marker for the effect of chemotherapy. Thus, imaging evaluation of the primary tumor during treatment can provide important prognostic and predictive information. While DCE-MRI depicts changes in tumor morphology and vascularity in response to NAC, PET provides molecular information about tumor biology that can predict treatment response early in the course of therapy. Whole-body PET (wbPET) with FDG has proven to be a powerful imaging technique for interrogation of breast lesions. However, its use for assessing primary breast tumors is hampered by poor spatial resolution and associated partial volume error in small lesions. Dedicated breast PET (dbPET) is an emerging PET technology specially designed for breast imaging. It has a high sensitivity to detect sub-centimeter lesions and high spatial resolution to depict molecular variations within the primary tumor. The incorporation of dbPET into breast cancer management, therefore, may provide critical molecular insights to guide treatment selection and to better assess early molecular changes in response to treatment.

METHODS: In an IRB-approved protocol, patients with biopsy-confirmed stage II/III locally advanced breast cancers were imaged with breast MRI (1.5 T Signa LX, GE Healthcare, WI) and dbPET (MAMMI, General Equipment and Medical Imaging SA (OncoVision), Valencia, Spain) before and after three weekly cycles of treatment. Standard dynamic contrast-enhanced MRI was obtained using a dedicated breast coil. Patients also underwent dbPET imaging with 5 mCi of FDG at 45 min post-injection.

RESULTS: Seven primary tumors from five breast cancer patients were analyzed. Patient age ranges from 29 to 63. Breast cancer subtype includes 2 HR+/HER2-; 1 HR-/HER2+; 1 HR+/HER2+ and 3 triple negatives (TN). Two patients had a complete resolution of FDG uptake by dbPET in the primary tumor after three weeks of neoadjuvant treatment, while MRI showed residual enhancement at the same visit (**Figure 1 A to C**). Tumors with over 70% SUVmax reduction after treatment were found to achieve pathologic complete response (pCR), but those with less than 40% SUVmax reduction at the same time point showed substantial residual disease that was confirmed by MRI and at surgery (**Figure 1 D to F**).

CONCLUSION: These examples illustrate that FDG-dbPET may capture the early response of primary breast cancer to NAC, revealing functional changes that precede anatomical changes at MRI. In breast cancer management, FDG-dbPET may be a promising predictor of pCR, differentiating patients from both ends of the response spectrum early in the course of treatment. While preliminary, the use of FDG-dbPET along with breast MRI may present an opportunity to guide earlier treatment redirection for excellent responders and to provide functional information to confirm chemo-resistance for non-responding patients. Further studies involving a larger cohort are needed to validate our initial findings.


MAMMI dbPET
DCE-MRI
Pre-treatment
After 3 weekly treatment
After 3 weekly treatment
A
B
C
Responder
pCR
D
E
F
Non-responder
Non-pCR