LONGITUDINAL VARIATION OF FIBROGLANDULAR TISSUE AND BACKGROUND PARENCHYMAL ENHANCEMENT ON BREAST MRI IN HIGH-RISK WOMEN: A QUANTITATIVE ASSESSMENT

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TARGET AUDIENCE: Radiologists, oncologists, and quantitative scientists interested in imaging biomarkers for breast cancer risk assessment.

PURPOSE: Screening breast MRI is recommended for women at high risk (lifetime risk ≥20%-25%) of developing breast cancer. Recent studies have shown that the fibroglandular tissue volume (FGT) and background parenchymal enhancement (BPE) seen in breast MRI may be predictive of breast cancer risk and are potential intervention-response biomarkers for risk-reducing salpingo-oophorectomy. The purpose of this pilot study is to perform quantitative assessment on the longitudinal variation of FGT volume and BPE volume in sequential breast MRI scans for a cohort of high-risk women who did not undergo any specific risk-reduction intervention.

METHODS: We retrospectively identified 71 high-risk women in our high-risk screening program. For each participant we collected two longitudinal cancer-free MRI scans acquired at two time points (TPs) (TP1: early scan; TP2: later scan; the mean (±SD) of the temporal gap between TP1 and TP2 was 519±282 days, min=166 days and max=1613 days; the mean (±SD) of age is 45.0±8.5 years at TP1 and 46.6±8.8 years at TP2). A fully automated computerized methodology pipeline was adapted to compute the FGT in the dynamic contrast enhanced (DCE) pre-contrast images and the BPE in the fourth DCE subtraction images (subtraction = post-contrast – pre-contrast) (Fig. 1). In total, 142 MRI scans were processed. For each scan, three quantitative measures are produced by the computerized methods: (1) volume of FGT (|FGT|); (2) volume of the enhancement detected over the whole breast (|BPEb|); and, (3) volume of the enhancement detected over the FGT area only (|BPEf|). For each measure, the mean (±SD) across scans at TP1 and TP2 was compared using a paired t-test for significance. The difference between paired values measured respectively at TP2 and TP1 (i.e., XTP2 - XTP1) was compared to show the temporal variation for each of the 71 women.

RESULTS: Five women in the study cohort were diagnosed with breast cancer with an average of 432±188 days follow-up after TP2. The variation of each measure was analyzed for three subgroups: full cohort (N=71), cancer (N=5), and non-cancer (N=66). No significant change (all p>0.05) was observed in both |FGT| and |BPEf| for all three subgroups. However, there appears to be significant increase in the measure of |BPEb| in the full cohort (p=0.02) as well as the non-cancer group (p=0.03), albeit, not in the group of 5 cancer patients (p=0.3). Furthermore, based on the paired differences in the three measures (Fig. 2), it appears that from TP1 to TP2, |BPEb| increases for the three invasive cancer cases (i.e., ILC and IDC) while it decreases for the two cases of less-aggressive cancer (i.e., DCIS). At the same time, we also observe a large increase in |BPEb| at TP2 for several non-cancer participants (no breast cancer diagnosed at the time of the study).

DISCUSSION: The assessment of enhancement occurring only in the FGT area (i.e., |FGT|) is more relevant in clinic as in principle primarily FGT is expected to enhance. While there is no significant change in both |FGT| and |FGT| within the time studied (i.e., TP2 - TP1), which is as expected, the observed significant variation in |BPEb| indicates that |BPEb| may capture certain properties that reflect biological differences (e.g., vasculature) in the non-FGT (fatty) area over time. In addition, although invasive cancer and DCIS may be separated by the paired differences in |BPEb|, this finding should be interpreted quite cautiously because of the limited number of cancer cases and the observed increase in |BPEb| in several non-cancer women as well.

CONCLUSION: The preliminary results demonstrate the temporal variability of FGT and BPE, which may be useful as a reference measure when investigating these parameters as risk predictors and possibly as indicators of intervention-response in high-risk women.

REFERENCES: