Peak Enhancement of up to 1.0cm Breast Masses May Help Differentiate Cancers from Benign Entities

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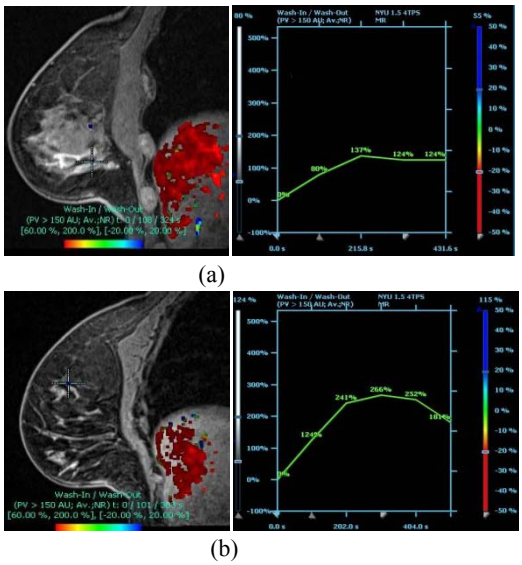
Introduction: Dynamic contrast enhanced (DCE) breast magnetic resonance imaging (MRI) is highly sensitive for the detection of early stage breast cancer; however, its variable specificity leads to a high proportion of benign biopsies [1]. To date, studies have demonstrated the ability of DCE-MRI to simultaneously depict lesion morphology as well as physiology by means of kinetic tracer analysis [2]. Studies have also demonstrated that mass size greater than 1.0 cm is an independent predictor of malignancy [3]. However, up to 1.0 cm masses and foci are often seen in normal background parenchymal enhancement and show morphologic characteristics which overlap with malignancy. Therefore appropriate management of such findings is controversial. Kinetic parameters including peak enhancement, time to peak enhancement and signal enhancement ratio (SER) have been recently investigated and may able to differentiate benign and malignant lesions [4,5]. The purpose of our study was to investigate, for the first time, whether kinetic markers including time to peak enhancement, peak enhancement, and SER can be used to separate malignancies from benign findings in up to 1.0cm masses and foci.

Materials and Methods: Subsequent to institutional review board approval, a retrospective review of 105 MRI guided breast biopsies performed at our institution between January 1 and December 31, 2009, yielded and subsequent MRI-guided breast biopsy of suspicious lesions was performed. Thirty up to 1.0cm masses or foci in 30 women with full sets of pre-biopsy images interpretable on DynaCAD underwent MRI guided biopsy. These women were included in our study. Bilateral dynamic contrast enhanced breast MRI was performed on a Siemens 3T magnet (Tim Trio) with a dedicated 7 channel breast coil (Invivo). MRI-guided biopsies were performed using the Suros ATEC device. For these patients, DCE-MRI using a 3D VIBE sequence (resolution 1.4 x 0.9 x 1.5 mm) with fat suppression was acquired for at least five consecutive frames; administration of Gd-DTPA contrast agent was administered after the first frame. Diagnosis of the lesions as benign (n=25) and malignant (n=5) was based on the biopsy pathology report from electronic medical records. Lesions were identified based on the associated image numbers given in radiology reports. Three signal intensity time points were acquired: S0, S1, S2. Signal enhancement ratio (SER), defined as (S1-S0)/(S2-S0), measures the change in contrast signal intensity over three time points, (S0), early postcontrast (S1), and late postcontrast (S2). Time to peak enhancement, peak enhancement, and SER values were calculated on color-coded maps generated using DynaCAD software. Significance was determined with student's t-test.



(a)

(b)

Figure 1 DCE MRI with DynaCAD kinetic parameters demonstrating time to peak and percent peak enhancement. (a) Benign 6mm mass (b) Malignant 6mm mass

Results and Discussion: Thirty-one target lesions comprised 23 benign masses, two benign foci and 5 malignant masses. Indication for examination in benign lesions was extent of disease in 14, screening in 9 and evaluate for implant rupture in 2. Indication for examination in malignant lesions was extent of disease in 2 and screening in 3. The mean size of benign masses was 0.75cm (0.5-1.0cm), of benign foci was 0.38cm (0.35-0.4cm) and of malignant masses was 0.8cm (0.55 -1.0cm). In malignant masses vs. benign masses and foci, time to peak enhancement was 299 seconds mean, range 197-436 s vs. 275 s (186-429 s); peak enhancement was 262% (207-329%) vs. 226% (100-386%) and SER was 0.66 (0.48-0.79) vs. 0.55 (0.35-0.91). Perhaps because of our small sample size, none of these variables met significance. Our findings are contrary to published literature (3,4), which includes larger masses and demonstrates that SER and time to peak enhancement may predict malignancy. These findings may be related to increased angiogenesis in larger lesions. However, peak enhancement trended toward significance (p=0.22) and may prove useful in a larger investigation. In our study, no malignancies demonstrated peak enhancement below 207%, while 24% of benign biopsies did. Further investigation may yield a cut-off below which biopsies need not be performed, thereby increasing specificity without affecting sensitivity. Peak enhancement may be useful in differentiating benign from malignant masses which measure 1.0cm or less. Our non-significant data suggests that establishing a minimum peak enhancement can reduce false positive DCE breast MRI studies and in decrease unnecessary biopsies by 24%. A larger study is warranted to establish significance.

References: 1. Kuhl et al, J Clin Oncol 2010;28(9):1450-7. 2. Saslow et al, CA Cancer J Clin 2007;57(2):75-89. 3. Demartini et al, Eur Radiol 2011;21(8):1609-17. 4. Arasu et al, Acad Radiology 2011; 18(6) :716-721. 5. Jansen et al, J Magn Reson Imaging 2011;33(6):1382-9.