Peak Enhancement and Time to Peak Enhancement May Differentiate Mammographically and Sonographically Occult Breast Malignancies from Normal Enhancing Breast Parenchyma

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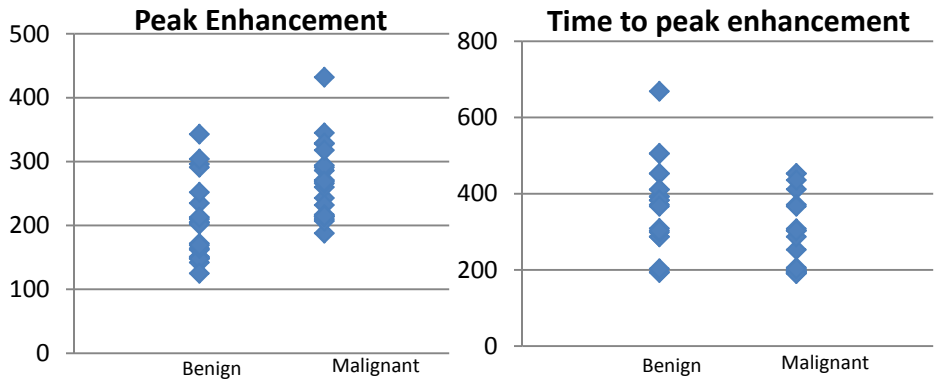
Introduction: Dynamic contrast enhanced (DCE) breast MRI is highly sensitive and is known to detect early stage breast cancers which are occult on physical examination, mammography and sonography (1). However, specificity of DCE breast MRI is variable (2) and differentiating these often subtle and small cancers from normal enhancing breast parenchyma can be challenging. To date, studies have investigated whether kinetic data such as peak enhancement, time to peak enhancement, signal enhancement ratio (SER) and percent wash-out can be used to decrease unnecessary biopsies (3-5). However, these studies have included masses which were amenable to ultrasound guided biopsy. These larger malignant masses may demonstrate more robust rapid initial rise and wash out kinetics than typically sub-centimeter masses which are mammographically and sonographically occult. Including such malignancies could accentuate kinetic differences between malignant and benign enhancing tissue. We therefore sought to exclude findings associated with typically more advanced cancers and, for the first time to our knowledge, we quantified differences in enhancement kinetics between sonographically and mammographically occult malignancies and normal breast parenchyma on DCE breast MRI.

Methods: Following institutional board review approval, a retrospective review of 31 subjects who underwent 35 malignancy positive MRI guided biopsies between January 2007 and October 2009 was conducted. Of these 35 malignancies, 14 were excluded because of incompatibility with our current DynaCADsystem. The remaining 21 malignancies were detected on MRI performed for extent of disease (14), screening (5), or not recorded (2). Bilateral dynamic contrast enhanced breast MRI was performed on a Siemens 3T magnet (Tom Trio) using a dedicated 7 channel breast coil (Invivo). MR biopsies were performed using the Suros ATEC device. Enhancement kinetic analysis was performed using DynaCAD software. Segmentation analyses were made in the malignant lesions and in 21 benign control regions of interest (ROIs) in enhancing breast parenchyma which met threshold for color mapping. Time to peak, peak enhancement, signal enhancement ratio (SER, S1-S0/S2-S0); percent washout, plateau and persistent kinetics; and percent rapid, moderate, and slow enhancement were recorded. Differences in measurements between background parenchyma and malignancies were compared using a 2-tail t-test. All areas of benign enhancement have at least 2 years of benign imaging follow-up and all patients are cross-referenced with the New York State Tumor Registry.



Figures 1 Percent peak enhancement and time to peak enhancement for benign and malignant lesions.

Results and Discussion: Twenty one malignant lesions comprised 11 masses and 10 areas of non-mass like enhancement (NMLE). Mass size ranged from 0.5 to 1.0 cm, mean 0.75 cm and NMLE size ranged from 1.2 to 8.0 cm, mean 3.33 cm. Control areas of enhancing normal breast tissue measured >/= 0.5cm. There were no malignant foci or > 1.0cm masses in our population. In malignant lesions compared to benign controls, there was a shorter time to peak (mean 281 vs 370 sec, p=0.0007) and a greater peak (mean 268% vs 204%, p=0.004) enhancement, greater but not significant SER (mean 0.66 vs 0.61 p=0.15). No malignancies demonstrated time to peak greater than 453 sec while 24% of benign controls did. No malignancies demonstrated peak enhancement less than 188% while 48% of controls did. Percent rapid, moderate and slow initial rise and percent wash-out, plateau and persistent later phase did not vary in a way that can be used to differentiate malignant lesions from normal background. Our findings were similar to Arasu *et al* (3) in that peak enhancement and Jansen *et al* (4) in that time to peak enhancement were predictive of malignancy but were different from both in that SER, in our study, was not significantly different between benign and malignant tissue. Statistically significant differences in time to peak enhancement and in peak enhancement were seen between background parenchymal enhancement and mammographically and sonographically occult malignancies. With further study, these data may be useful in recategorizing BI-RADS 3 and 4 lesions, thereby reducing unnecessary biopsies and unnecessary follow-up examinations.

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. Arasu et al, Acad Radiology 2011; 18(6):716-721. 4. Jansen et al, J Magn Reson Imaging 2011; 33(6):1382-9. 5. Jansen et al, Eur Radiol 2011; 21(7):1374-82.