Diagnostic Performance of DCE-MR Imaging of the Breasts as a Function of Contrast Dose

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Introduction

Although breast imaging is one of the most significant applications of dynamic contrast enhanced MR imaging (DCE-MR), a rigorous study to determine the optimal contrast dose has never been performed. In this study, high-resolution MR breast images were acquired using both high dose and low dose contrast in separate patient populations. Using tumor architecture and the signal-enhancement-ratio (SER) to characterize the lesions, a comparison of diagnostic performance was made as a function of contrast dose. While contrast dose is a function of the specific imaging parameters, the comparison made in this study is valid for many applications.

Methods

IRB approval was obtained prior to the start of this study. Two-hundred-fifteen (215) subjects with palpable or mammographically-visible suspicious findings were recruited either by physician referral or internal and external advertisement. Images were acquired at 1.5T using a General Electric Signa 1.5T (59 cases) or a Siemens Sonata (156 cases). One-hundred-sixteen (116) subjects were imaged using a gadolinium contrast dose of 20 ml ('high dose') and 99 subjects received a dose by weight of 0.1 mmol/kg ('low dose'). Subjects were placed in the prone position, with the breasts gently compressed within a dedicated breast coil. The contrast-enhanced images were acquired using a projection interleaved fast 3D spoiled gradient-recalled radial sequence [1] using 512 data samples/projection with 384 projections, and 32 phase encoding steps in the slice direction (TR/TE, 10/4; flip angle=20° for the low dose and 60° for the high dose). The fat signal was suppressed using a spectral inversion pulse played-out twice per slice group. A high-resolution baseline volume was acquired followed by dynamic imaging. Contrast was administered at 1.5 ml/s followed by a saline flush. Data were acquired over the following 6-minute period with ~15 s effective temporal resolution.

The images were read by an experienced radiologist who was blinded to the biopsy results. The reader also placed an ROI on the most enhancing region of the lesion. From the time resolved ROIs, the signal intensity data were obtained and fit to a five parameter modified logistic equation given by [2] from which the SER [3] was calculated.

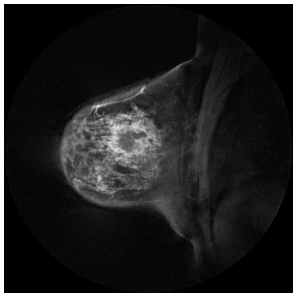

Figure 1. Post-contrast breast image with a malignant lesion.

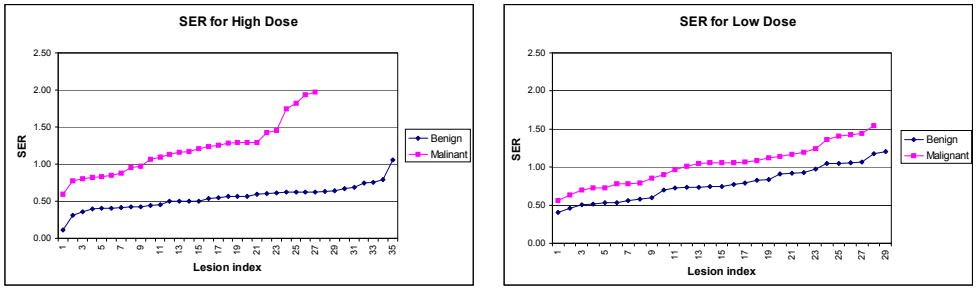

Figure 2. Signal-enhancement-values (SER) from breast lesions for high contrast dose (left) and low dose (right).

Results

Of the 215 cases, 164 lesions were identified and correlated with pathology (103 benign, 61 malignant). Of these lesions, 119 enhanced with contrast (63 benign, 56 malignant). A representative case is shown in **Figure 1**. The diagnostic performance including all lesion for the high dose population was Sensitivity = 80%, Specificity = 83%. Likewise for the low dose population, Sensitivity = 71% and Specificity = 84%. Considering just the enhancing lesions, the high dose set had a Sensitivity = 89% and Specifity = 71% while the low dose set had a Sensitivity=76% and Specificity=75%. Additionally, there was a greater differential in SER between the benign and malignant lesions for the high dose than that shown for the low dose lesions (**Figure 2**). The average SER for the high dose cases was 0.55 for the benign lesions and 1.20 for the malignant lesions. The low dose population had an average SER value of 0.78 for the benign lesions and 1.03 for the malignant lesions.

Conclusion

Using measures of tumor architecture as well as contrast kinetics, the diagnostic performance of DCE-MR breast imaging was greater for subjects receiving a high contrast dose (20 ml) than those subjects receiving a low dose (0.1 mmol/kg).

1. Doughetry L, *et al*. Magn. Reson. Med., 57:220-225, 2007.
2. Moate PJ, *et al.* Magn Reson Imaging 22:467–473, 2004.
3. Li KL, *et al.* Magn Reson Med , 58:572-581, 2007