Role of quantitative pharmacokinetic parameter (transfer constant: K^{trans}) in the characterization of breast lesions on MRI

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Abstract

Background: The semi-quantitative analysis of the time–intensity curves in dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) has a limited specificity due to overlapping enhancement patterns after gadolinium administration. With the advances in technology and faster sequences, imaging of the entire breast can be done in a few seconds, which allows measuring the transit of contrast (transfer constant: K^{trans}) through the vascular bed at capillary level that reflects quantitative measure of porosity/permeability of tumor vessels. **Aim:** Our study aims to evaluate the pharmacokinetic parameter K^{trans} for enhancing breast lesions and correlate it with histopathology, and assess accuracy, sensitivity, and specificity of this parameter in discriminating benign and malignant breast lesions. **Materials and Methods:** One hundred and fifty-one women with 216 histologically proved enhancing breast lesions underwent high temporal resolution DCE-MRI for the early dynamic analysis for calculation of pharmacokinetic parameters (K^{trans}) using standard two compartment model. The calculated values of K^{trans} were correlated with histopathology to calculate the sensitivity, specificity, and accuracy. **Results:** Receiver operating characteristic (ROC) curve analysis revealed a mean K^{trans} value of 0.56, which reliably distinguished benign and malignant breast lesions with a sensitivity of 91.1% and specificity of 90.3% with an overall accuracy of 89.3%. The area under curve (AUC) was 0.907. **Conclusion:** K^{trans} is a reliable quantitative parameter for characterizing benign and malignant lesions in routine DCE-MRI of breasts.

Key words: Breast lesions, dynamic contrast-enhanced magnetic resonance imaging, K^{trans}

Introduction

Dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) is being increasingly used for evaluating the breasts because of its high sensitivity to detect breast cancer. DCE-MRI of the breast enables the depiction of the physiological and morphological characteristics of the enhancing breast lesions wherein by observing the uptake and washout of MRI contrast agents in a breast lesion, combined with the pattern of enhancement, the malignant and benign disease can be discriminated.[1] Nevertheless, the specificity of MRI remains equivocal[2] as both benign and malignant breast lesions enhance with overlapping enhancement patterns which is the major determinant in the characterization of breast lesions in routine DCE-MRI. Major area of clinical research aims at increasing the specificity of MRI for differentiating benign and malignant breast lesions.

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Quantitative analysis of DCE-MRI is possible with the advances in technology and faster sequences, wherein high temporal resolution images of the entire breast can be taken in few seconds that allows measuring the transit of contrast (transfer constant: K^{trans}) through the vascular bed at capillary level, a parameter that reflects quantitative measure of qualitative changes, i.e., increased porosity/permeability of tumor vessels, a surrogate of neoangiogenesis. Benign and malignant breast lesions differ in the characteristics of their microvessels, and hence the behaviors of Gd (Gadolinium) uptake in the lesion which