

Microperfusion-induced Elevation of ADC is Suppressed after Contrast in Breast Carcinoma

S. Yuen¹, M. Goto¹, K. Yamada¹, A. Takahata¹, K. Nishida¹, and T. Nishimura¹

¹Radiology, Graduate School of Medical Science, Kyoto Prefectural University of Medicine, Kyoto, Japan

Background and Purpose: DWI is usually performed before contrast administration, but it is reportedly also possible after contrast. After contrast administration, a slight reduction in ADC has been observed [1,2]. These previous investigators have postulated that suppression of the microperfusion effect causes this ADC reduction. Considering that breast carcinomas are usually highly vascularized on histopathology, the effect of contrast on ADC would also be expected to be present in these lesions. The microperfusion effect, if truly present, would lead to an increase in ADC. To assess the pure cellularity of the tumor by measuring ADC, elimination of the microperfusion effect could lead to more precise assessment. Thus, we hypothesized that post-contrast ADC would be a better indicator of tumor aggressiveness. The purpose of our study was to investigate the effect of MR contrast material on ADC in breast carcinomas and to assess the potential role of post-contrast ADC in evaluating breast carcinomas.

Materials and Methods: Nineteen histopathologically confirmed breast carcinomas (mean size = 22 mm) were analyzed. Single-shot echo-planar imaging (EPI) was used for DWI (TR/TE = 1206/71 msec) with a motion-probing gradient in 6 orientations, b-value = 1000 sec/mm², spectral presaturation with inversion recovery (SPIR) for fat suppression, and image averaging = 4 times. A parallel imaging technique (i.e., sensitivity encoding [SENSE]) was used with a reduction factor of 2. ADCs of the tumors both before and after contrast administration were measured. The contrast-to-noise ratios (CNRs) of the tumors were measured on fat-suppressed 3D T1-weighted images (TR/TE = 9.3–9.8/4.6–4.8 msec, flip angle of 20 degrees and SENSE factor = 1.3) at the pre-contrast, early, and late post-contrast phases. These results were correlated with the measured ADC values.

Results: A significant decrease in the measured ADC was noted after contrast administration (-23%, p=0.01)(Figure 1). Lesions with relatively high ADC before contrast ($> 1.3 \times 10^{-3} \text{ mm}^2/\text{sec}$; n=12) demonstrated a larger degree of ADC reduction (mean 34%) than lesions with low ADC ($\leq 1.3 \times 10^{-3} \text{ mm}^2/\text{sec}$; n=9) (mean 4.5%)(Figure 2). When early post-contrast images were used as a surrogate marker of tumor aggressiveness, we found a significant inverse correlation with the post-contrast ADC ($\gamma = -0.57$, p=0.02) (Figure 3).

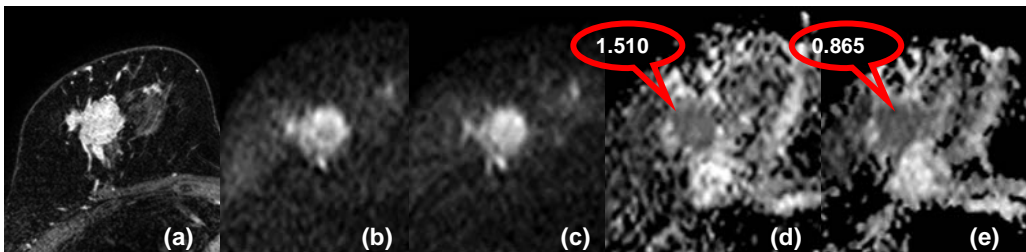


Figure 1

- (a) Early contrast-enhanced T1WI
- (b) Pre-contrast DWI
- (c) Post-contrast DWI
- (d) Pre-contrast ADC map
- (e) Post-contrast ADC map

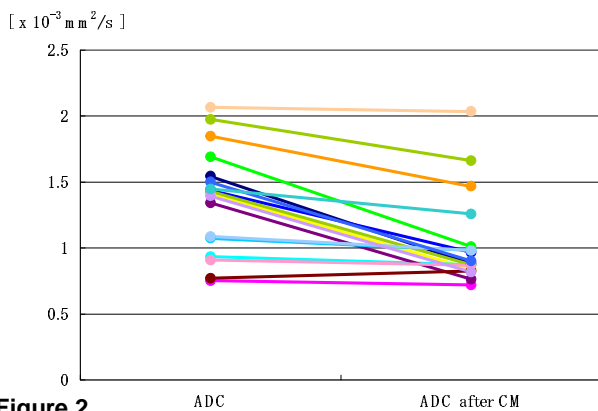


Figure 2

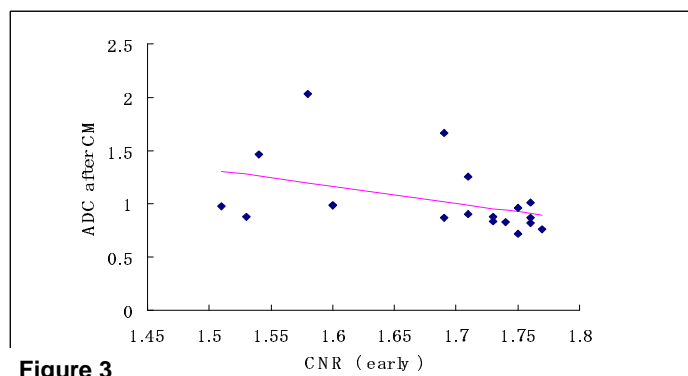


Figure 3

Conclusion: Post-contrast ADC exhibited a lower value than pre-contrast ADC, which is thought to reflect the suppression of the microperfusion-induced effect on DWI. Post-contrast ADC may be a better indicator to reflect the aggressiveness of tumors.

References: 1. Yamada K, et al. Effect of intravenous gadolinium-DTPA on diffusion-weighted images: evaluation of normal brain and infarcts. Stroke 2002;33:1799-1802. 2. Firat AK, et al. The effect of intravenous gadolinium-DTPA on diffusion-weighted imaging. Neuroradiology 2006;48:465-470.