

# Incremental Value of ADC as an Indicator of Treatment Response in Patients Undergoing Neoadjuvant Chemotherapy for Locally Advanced Breast Cancer

J. E. Gibbs<sup>1</sup>, S. C. Partridge<sup>2</sup>, N. M. Hylton<sup>2</sup>

<sup>1</sup>University of California San Francisco, San Francisco, United States, <sup>2</sup>University of California San Francisco, San Francisco, CA, United States

## Synopsis

Twenty-eight women undergoing neoadjuvant chemotherapy for locally advanced breast cancer were imaged using diffusion weighted MRI to assess treatment response. The apparent diffusion coefficient (ADC) of tumor was measured before chemotherapy and after one cycle, and the value of ADC for predicting treatment response was compared to volumetric and vascular parameters measured by contrast-enhanced MRI. Early change in ADC significantly contributed to the prediction of residual disease size at pathology, but was not significantly predictive of other treatment response measures (nodal status, volume change).

## Introduction

Neoadjuvant, or preoperative, chemotherapy is increasingly being used in the treatment of locally advanced breast tumors. The ability to detect response to treatment early would allow non-responsive patients to be identified and their treatment plans modified. Changes in contrast enhanced MR measures of tumor vascularity and volume have been associated with treatment response as measured by size of residual disease at pathology, nodal status, and tumor volume [1]. Diffusion weighted imaging (DWI) has also shown promise as a tool for monitoring response [2-4]. DWI provides different information about physiological tumor changes with treatment, and changes in diffusion may be apparent earlier than volumetric response. In this study we investigated the contribution of ADC to predictive models of treatment response.

## Methods

**Patients:** Twenty-eight women with locally advanced breast cancer were imaged before treatment, after one cycle of AC chemotherapy, and after completing four cycles of AC chemotherapy.

**MR Imaging:** Patients were imaged on a 1.5T GE LX scanner using a bilateral phased-array breast coil. A contrast-enhanced T1-weighted 2DFGRE sequence was acquired to provide detailed anatomical information for post-processing, and diffusion data was acquired using a DW-SSFSE pulse sequence in order to minimize image distortion from magnetic susceptibilities. All images were acquired axially with FOV=35x35cm, thickness=5mm, 128x128 matrix, b=0 and 600 s/mm<sup>2</sup>, scan time=2.5 minutes. DW images were acquired in the x, y, and z directions independently. Four acquisitions were obtained consecutively and the resulting DWIs were averaged for improved image signal to noise. Example images are shown in Figure 1.

**Post-Processing:** ADC maps were generated and region of interest (ROI) measurements were calculated for each patient at each treatment time point. Tumor was identified as contrast enhancement on the T1-weighted images, and volume and vascular measurements were obtained from contrast-enhanced images at each treatment time point. ADC and contrast enhanced MR measurements were compared for their ability to predict treatment response.

## Results

In multivariate linear regression analysis, early change in ADC significantly contributed to the model predicting size of residual disease at pathology ( $p=0.0013$ ), and was more predictive than early change in MR volume and vascular measurements. The goodness of fit parameter adjusted  $R^2$  ( $R^2_{adj}$ ) was improved when ADC was added to the model predicting path size ( $R^2_{adj}$  without ADC=0.46,  $p=.01$ ;  $R^2_{adj}$  with ADC=0.70,  $p=.003$ ). ADC did not significantly add value to the prediction of lymph node status or volume change on MRI. Pair-wise comparison revealed that on its own, ADC was not significantly correlated to the outcome measures.

## Discussion

In this study, ADC was predictive of residual disease size measured by pathology. The DWI sequence adds only 2.5 minutes to scan time and is relatively easy to incorporate into the exam. The findings of this study indicate that the information obtained using DWI adds value to the prediction of treatment response and may be a beneficial addition to clinical exams. Future work will follow patients to see if ADC is associated with survival, and will measure the value of ADC in a larger population with a more heterogeneous response profile.

## References

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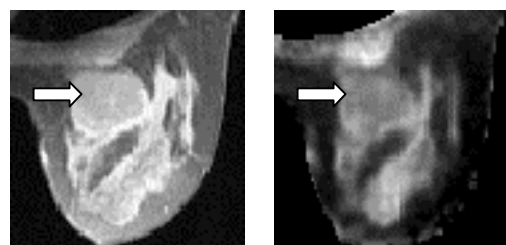


Figure 1: Rim-enhancing lesion (arrow) on post-contrast image (left) and diffusion map (right).