Correlation of ADC Values with Histopathology of Lung Masses: Preliminary Results

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Target Audience: Thoracic radiologists.

Purpose: Measurement of the apparent diffusion coefficient (ADC) of lung malignancies has been described as a promising biomarker for assessment of treatment response (1-2). The value of ADC measurement at the time of initial diagnosis of a lung nodule or mass remains uncertain. The purpose of this study is to correlate ADC values with histopathology of lung masses.

Methods: MRI was performed on seven patients with suspicious lung masses who subsequently underwent surgery. Each patient was scanned on a 1.5T MR system (Siemens Avanto, Erlangen, Germany) using a respiratory-triggered EPI-based DWI sequence with inversion recovery (TR 3000/TE 65, TI 180, 2-4 NEX, 5.5mm slice thickness, and in-plane resolution of around 1.3 x 1.3 mm) and b values of 0, 50, 100, and 800 s/mm^2. Regions of interest (ROIs) were drawn around the suspicious mass as well as the paraspinal muscles on the ADC map (Figure 1) for each b value as well as a single composite ADC map. The ADC of the mass was normalized to the ADC of the paraspinal muscle. Pathology reports were reviewed, and a two-tailed t-test was used to evaluate for significance (<0.05) in the difference of the normalized ADC values between benign and malignant pathology.

Results: The mean age of the patients was 53 years ranging from 33-83 years; 4/7 (57%) were male. Two of the patients who underwent surgical resection had benign pathology. Figure 1 illustrates an example of an ROI on the b=0, b=800, and the composite ADC parametric map. The size of the pulmonary lesions ranged from 58-1358 mm^2. Table 1 lists the ADC value at b=800 and the composite ADC value along with the histopathology for each lesion. The normalized ADC was significantly lower for malignant lesions compared to benign lesions on both the ADC map at b=800 (p=0.013) and the composite ADC map (p=0.004).

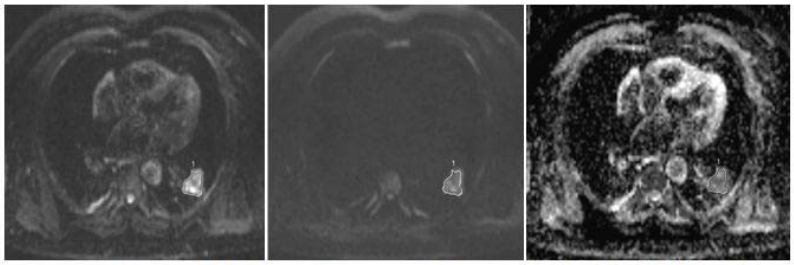

Figure 1. ROI around a left lower lobe mass on the b=0 (left), b=800 (middle), and the composite ADC map. This corresponded to patient 7 in Table 1.

Patient	Pathology	ADC_{800} mm^2/s (normalized)	ADC mm^2/s (normalized)
1	Focal organizing pneumonia with lymphoplasmacytic inflammation	1.19	1.11
2	Invasive poorly differentiated Gr 4/4 ACA	0.98	0.74
3	Gr 3/4 ACA	0.79	0.79
4	Well-differentiated invasive ACA	0.98	0.84
5	Invasive Gr 3/4 SCC	0.76	0.70
6	Fibrosing mediastinitis	1.56	1.47
7	Invasive Gr 3/4 moderately differentiated SCC	0.67	0.64

Table 1. Histopathology and ADC normalized to muscle. ACA: adenocarcinoma; SCC: squamous cell carcinoma

Discussion: This small sample size suggests that ADC values may be lower for malignant pulmonary lesions compared to benign lesions, and illustrates that routine DWI measurements are feasible in patients with newly diagnosed lung cancer.

Conclusion: Preliminary results demonstrate ADC values normalized to muscle as a possible way to improve specificity in discriminating between malignant and benign pulmonary nodules or masses. This is a continuing study with an aim to recruit 30 patients in total.

References:

1. Chang Q, et al. Diffusion-weighted magnetic resonance imaging of lung cancer at 3.0 T: a preliminary study on monitoring diffusion changes during chemoradiation therapy. Clinical Imaging 2012;36(2):98-103.
2. Ohno Y, et al. Diffusion-weighted MRI versus 18F-FDG PET/CT: performance as predictors of tumor treatment response and patient survival in patients with non-small cell lung cancer receiving chemoradiotherapy. AJR Am J Roentgenol 2012;198(1):75-82.