

Differential Diagnosis of Chest Lesions: Values of Diffusion-Weighted MR Imaging

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Background and Purpose: Lung cancer is the leading cause of cancer death among men and women worldwide. The precise pre-operation diagnosis of chest neoplasms and inflammatory nodules using CT, MRI and PET-CT is difficult. The most sensitive diagnostic method is the surgical biopsy. On T2-weighted MR images could not be used to distinguish malignant from benign pulmonary nodules [1]. On diffusion-weighted MR imaging (DWI), the apparent diffusion coefficient (ADC) value refers to the specific diffusion capacity of a biologic tissue. ADC value depends largely on the presence of barriers to diffusion within the water microenvironment. Consequently, ADC values of lung carcinomas could be considered difficult to use as a differentiating parameter among the histologic subtypes of lung carcinoma [2]. The lesion-to-spinal cord ratio (LSR) is more effective than ADC for differentiation between lung cancer and benign lesions but the ROI for measuring signal intensity is small and the standard deviation (SD) of the signal intensity tends to be relatively large [3]. The goal of this study is to present a novel method for differential diagnosis among primary chest cancers, metastatic tumors and benign tumors using ADC SD value of diffusion-weighted MR imaging.

Methods: We conducted a retrospective study of patients with thoracic mass lesions in the past three years who had an MRI examination of the chest at our institution. MRI studies were performed on a 1.5T MR scanner. 27 patients were enrolled for this study (20 male, 7 female; age range 15 to 85, mean age: 68). In total 30 mass lesions were analyzed by ADC values and ADC SD values acquired from diffusion-weighted images. The patients were divided into five groups: primary lung cancers (N=10), esophageal cancers (N=5), metastatic tumors (N=8), benign tumors (N=3) and inflammatory lesions (N=4). The quantitative measurement of the MR parameters of the mass lesion was performed by a senior radiological technician. The slice with the largest diameter of the chest lesions was selected for measurement of DWI parameters. The ADC value was acquired based on the average of the whole tumor area. The t-test and multivariate linear regression were used for statistical analysis.

Results: The ADC SD value (mean \pm SD) was $4.77 \pm 1.48 \times 10^{-4} \text{ mm}^2/\text{sec}$ in primary lung cancers, and $3.59 \pm 0.35 \times 10^{-4} \text{ mm}^2/\text{sec}$ in metastatic tumors. A statistical significant difference in ADC SD value existed between primary lung cancers and metastatic tumors ($P<0.05$) (Figure 1). The case illustrations of MRI findings and ADC values of primary lung cancer and metastatic tumor are demonstrated on Figure 2 and Figure 3.

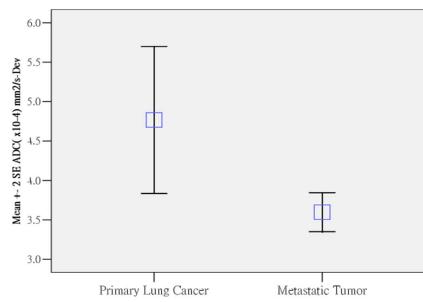


Fig. 1: The box plot of ADC SD value of primary lung cancer and metastatic tumor.

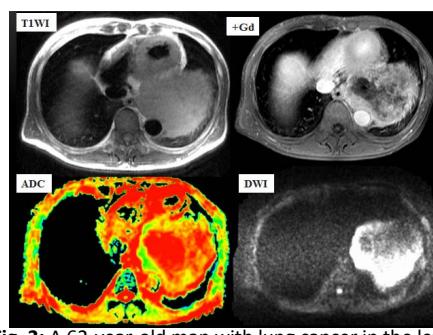


Fig. 2: A 62-year-old man with lung cancer in the left lower lung. ADC SD value = $5.03 \times 10^{-4} \text{ mm}^2/\text{sec}$

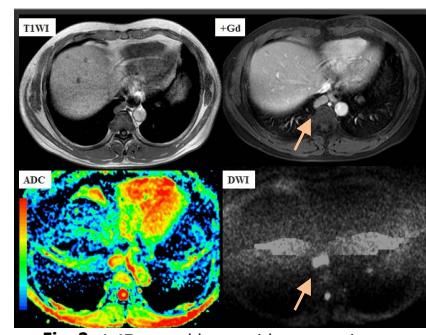


Fig. 3: A 47-year-old man with metastatic meningioma in the right lower lung. ADC SD value = $3.62 \times 10^{-4} \text{ mm}^2/\text{sec}$

The mean ADC SD value was $4.47 \pm 1.46 \times 10^{-4} \text{ mm}^2/\text{sec}$ in all chest malignant tumors including primary lung cancers and esophageal cancers. The ADC SD value was $2.97 \pm 0.36 \times 10^{-4} \text{ mm}^2/\text{sec}$ in benign tumors. There was a statistical significant difference in ADC SD value ($P<0.01$) between malignant chest tumors and benign chest tumors (Figure 4). The MRI findings and ADC SD values of malignant tumors and benign tumors are exhibited on Figure 5 and Figure 6. According to our study, there is no significant difference in the ADC value among primary lung cancers, metastatic tumors and benign tumors.

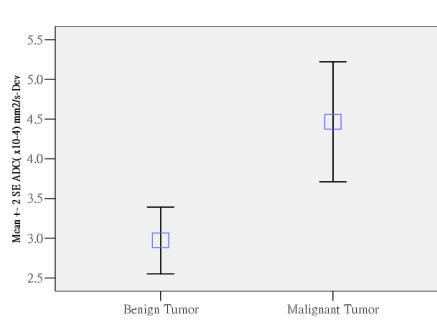


Fig. 4: The box plot of ADC SD value of benign and malignant chest tumors.

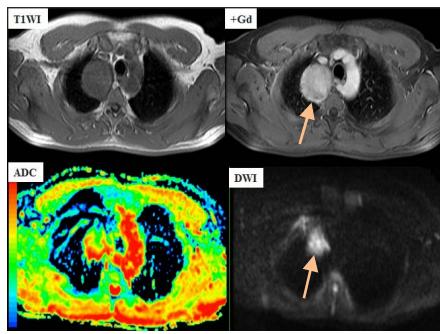


Fig. 5: A 34-year-old man with schwannoma in the mediastinum. ADC SD value = $2.72 \times 10^{-4} \text{ mm}^2/\text{sec}$

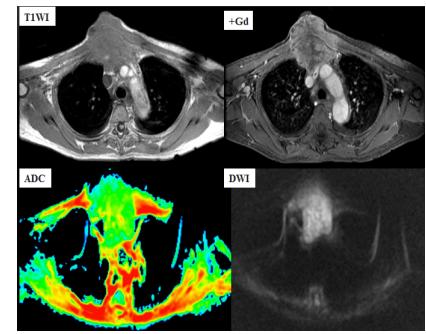


Fig. 6: A 70-year-old woman with breast cancer involving sternum. ADC SD value = $3.37 \times 10^{-4} \text{ mm}^2/\text{sec}$

Discussion: The results from our study found the ADC value of primary lung cancers was significantly higher than metastatic tumors and benign tumors. The next steps of work include additional analyses of data with 3D volume measure and continuous study to confirm findings in larger patient population.

References: [1] Am J Roentgenol 2008; 191:464-470. [2] Radiology, 2007; 243:570-577. [3] Radiology, 2009; 252: 247-254

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