

Investigating the ADC value of neoplasm involving the pharynx and oral cavity

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Introduction:

In head and neck, the abundant air in the aerodigestive tract including nasopharynx, oropharynx, oral cavity and hypopharynx usually lead to severe inhomogeneity of local magnetic susceptibility and imaging distortion on echoplanar diffusion-weighted imaging EP-DWI. Such imaging distortion and signal mis-registration hamper the usefulness of EP-DWI in investigating the head and neck cancer, especially the mucosal lesions of the aforementioned aerodigestive tract. In this study, we aimed to investigate the diffusivity of head and neck cancers in these air-mucosal interfaces by quantifying the apparent diffusion coefficient (ADC) using PROPELLER-DWI.

Materials and Methods:

This study enrolled 10 patients (6 men and 4 women; 53.3 ± 13.1 years) with pathological proven neoplasms, including squamous cell carcinoma in 6, nasopharyngeal carcinoma in 3 and lymphoma in 1, in head and neck (nasopharynx: 3; palatine tonsil: 4; oral tongue: 3). Another 3 patients (3 men; 61.0 ± 7.1 years) with inflammatory disease involving the nasopharynx were also recruited for comparison. All MR scans were performed at a 1.5 T whole-body scanner (GE Healthcare, Signa HDx, US) (maximum gradient of 50mT/m; 8NV head and neck array coil). All patients received axial fast spin-echo (FSE) T1-weighted images (T1WI) (TR/TE/Nex/ETL: 750ms/11ms/1/4) with injection of 0.1 mmol/kg of gadolinium-DTPA (Megavist) and T2-weighted images (T2WI) (3150ms/87ms/2/22) were acquired with field of view (FOV) of 240×240 mm, matrix size of 128×128 , slice thickness of 5 mm and slice spacing of 1.0 mm. DW-MRI were obtained with motion-probing diffusion gradient ($b = 0$ and 1000 s/mm^2) being applied on each of three orthogonal directions. The geometry, FOV, matrix size, slice thickness and slice spacing were identical to that used with the FSE T1WI/T2WI. For PROPELLER-DWI, FSE sequences (7000ms/122 ms/1.8/24) as described by Pipe et al. (3) were undergone with and without fat saturation. ADC maps were generated on personal computer by using a pixel-by-pixel computation according to the logarithmic equation: $\text{ADC} = \ln[S_0/S_{1000}]/(b_{1000}-b_0)$, where S_0 and S_{1000} was the signal intensity of DW images corresponding to the b value of 0 and 1000 s/mm^2 , respectively. The ADC of parotid glands and gray matter of cervical cord were analyzed using a region of interest (ROI) method. Student t test was used for group comparisons of ADC. A P value of less than .05 was considered as statistically significant.

Results:

PROPELLER-DWIs were free from geographic distortion in all patients in this study. Fig. 1 showed the axial images through the palatine tonsils, including T1WI with Gadolinium enhancement, T2WI, PROPELLER DWI ($b=0$ and 1000 s/mm^2), and ADC maps (gray scale and color map) in a female patient with squamous cell carcinoma involving the left palatine tonsil. The ADC of the neoplasm was $1.04 \pm 0.16 \times 10^{-3} \text{ mm}^2/\text{s}$, which was significantly lower than the normal tissue in the opposite site ($1.21 \pm 0.26 \times 10^{-3} \text{ mm}^2/\text{s}$; $P < 0.05$) and the inflammatory lesions ($1.68 \pm 0.38 \times 10^{-3} \text{ mm}^2/\text{s}$; $P < 0.05$).

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Discussion & Conclusion: Our study shows that PROPELLER-DWI provides a distortion-free DWI for assessing the ADC of neoplasm along the air-mucosal surface, where geographic distortion and signal mis-registration (signal loss or signal pile-up) is not uncommonly encountered on EP-DWI. Without the interference of the geographic distortion, PROPELLER-DWI allows us a chance to investigate the ADC of neoplasm in head and neck especially at the location with abundant air as in our study. The lower ADC of the neoplasm is believed to be due to the hypercellularity in neoplasm with restriction water diffusion in contrast to the facilitated water diffusion in the inflammatory disease, in which edema is a common phenomenon due to increased permeability of capillary endothelium during inflammation.

Reference:

1. Martinez-Madrigal F, et al. Am J Surg Pathol 1989;13:879.

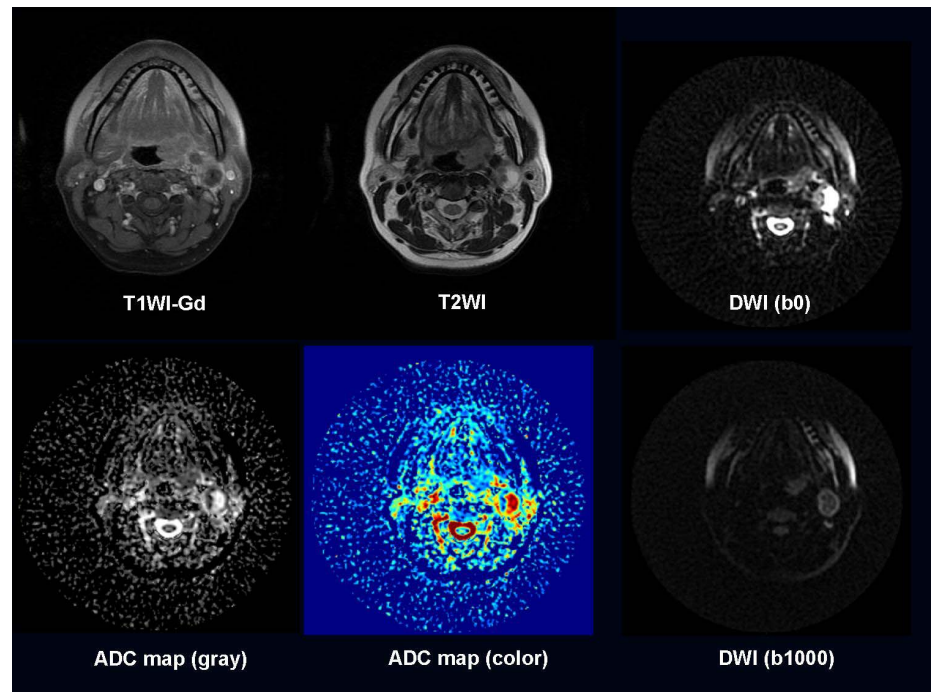


Fig. 1. A 49-year-old woman with squamous cell carcinoma involving the left palatine tonsil and ipsilateral cervical nodal metastasis and necrosis.