Prognostic value of minimum apparent diffusion coefficient for patients with hypopharyngeal cancer

Y-C. Lin[1,2], S-H. Ng[1], Y-Y. Wai[1], Y-H. Tsai[3], and J-J. Wang[3]

[1]Department of Diagnostic Radiology, ChangGung Memorial Hospital, KweiShan, Taoyuan, Taiwan, [2]Department of Electrical Engineering, ChangGung University, KweiShan, Taoyuan, Taiwan, [3]Department of Medical Imaging and Radiological Science, ChangGung University, KweiShan, Taoyuan, Taiwan

Introduction: It is of critical interest to predict the tumor response to therapy and the survival [1]. Hypopharyngeal cancers are usually with the worst overall survival rate among the head and neck cancers [2]. The prognosis is primarily determined by the size and extent of local spread of the primary tumor. Because the measured apparent diffusion coefficient (ADC) is inversely related to tumor cellularity within the voxel of interest, the minimum ADC, as related to the highest cellularity, could be more sensitive for prognosis than the mean ADC. The current study proposed to evaluate the prognostic sensitivity of minimum ADC of the tumor from the pretreatment patients with hypopharyngeal cancer.

Materials and Methods: Thirty nine patients with hypopharyngeal cancer, staged at T3 or T4, were included. Diffusion weighted images were acquired using a single-shot spin-echo echo-planar imaging sequence with the following parameters: TR=8200 ms/TE=84 ms /b value = 800 sec/mm^2. ADC map was calculated from three orthogonal directions. Regions of interest were carefully delineated in the whole tumor volume. Three parameters were measured for evaluation: whole tumor volume, the mean and minimum ADC. Patients were divided into subgroups based on thresholds in each parameter. Receiver operating characteristic (ROC) curves were analyzed to determine the best thresholds of each subgroup and to estimate its sensitivity and specificity. The survival rate at 16 months was estimated by the Kaplan–Meier survival analysis. The log-rank test was used to determine the significance of comparison between subgroups.

Table 1. ROC analysis for optimal thresholds.

*: in unit of 10^{-3} mm^2/sec	Optimal threshold	AUC	Sensitivity	Specificity
minADC*	6.94	0.79	84%	75%
meanADC*	73.4	0.71	73%	60%
tumor volume	21.2ml	0.73	74%	82%

Results: Table 1 summarizes the results of the ROC analysis. The minimum ADC has the largest Area Under Curve (AUC) and the highest sensitivity for the determination of survival. Figure 1 shows the results of the Kaplan–Meier survival analysis of minimum ADC (a), mean ADC (b) and tumor volume (c). The difference in 16-month overall survival rate, predicted by minimum ADCs, was significant (50% for low and 84% for high). In mean ADCs and tumor volumes, the differences between subgroups were not significant.

Conclusion: The minimum ADC at pretreatment is a useful clinical prognostic biomarker for survival in patients with hypopharyngeal cancer.

References: [1] Pope WB et al., Radiology 2009.
[2] Chen SW et al., Head Neck. 2009.