Degree of differentiation and small foci of necrosis in head and neck squamous cell carcinoma evaluated by line scan diffusion-weighted imaging

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Introduction

The application of diffusion-weighted imaging (DWI) has been explored beyond the central nervous system diseases. Apparent diffusion coefficient (ADC) measurements may be useful for the characterization of head and neck tumors (1, 2). In this study, our purpose was to determine whether degree of differentiation (well, moderately, and poorly differentiated) and small foci of necrosis influence ADC values of head and neck squamous cell carcinoma (SCC).

Materials and Methods

Thirty-nine patients with SCC (8 women and 31 men, 41-84 years; mean age, 64.6 years) were studied on a 1.5T MR system using a neurovascular array coil. Degree of differentiation in SCC was classified as well differentiated (n=8), moderately differentiated (n=27), or poorly differentiated (n=4). Axial spin-echo T1-weighted and fast spin-echo T2-weighted sequences were acquired for morphological evaluation. Line scan diffusion-weighted imaging (LSDWI) images were acquired using the following scan parameters: TR = 2376-3124 ms, TE = 57.1-70.7 ms, one excitation, field of view of 20×20 to 22×22 cm, matrix size of 128×128 columns, and bandwidth of 3.91 kHz. The effective section thickness was set to 5 mm with an inter-section gap of 1 mm. LSDWI images were obtained with two different b values, with the maximum b value applied along the three orthogonal directions: one with a low diffusion weighting (b factor) of 5 s/mm^2 and the other with a high (maximum) b factor of 1000 s/mm^2. ADC value measurements were obtained from the trace ADC maps using regions of interest (ROI) placed over the tumors. In ROI measurement of tumors, special care was taken to include the solid-appearing portions of the tumors and to exclude obviously necrotic or cystic regions demonstrated in the corresponding T2-weighted and contrast-enhanced MR images. Pathological evaluation was performed for small foci of necrosis in 35 patients with SCC. Four patients with a diagnosis of SCC had undergone biopsy at other institutions, and their pathological specimens were therefore not available for review. When small foci of necrosis were seen in the pathological specimen, the degree of necrotic foci was graded as mild or conspicuous, with "mild" corresponding to a ratio of necrotic areas to tumor areas of less than 0.2 and "conspicuous" corresponding to a ratio of 0.2 or more.

Results

Mean ADC values for well differentiated (n=8), moderately differentiated (n=27), and poorly differentiated (n=4) SCC were $1.01 \pm 0.08 \times 10^{-3}$ mm^2/s, $0.94 \pm 0.11 \times 10^{-3}$ mm^2/s, and $0.97 \pm 0.12 \times 10^{-3}$ mm^2/s, respectively. There were no significant differences in ADC values between the types of differentiated SCC. The degree of small foci of necrosis and the corresponding ADC values are summarized in Table. Although ADC values increased slightly with the degree of small foci of necrosis, there were no statistically significant differences in ADC values according to degree of small foci of necrosis.

Table.   ADC of SCC vs. the degree of necrosis in pathologic specimen

	no necrosis	mild type of necrosis	conspicuous type of necrosis
SCC (n=35)	0.93 ± 0.06 (n=13)	0.96 ± 0.12 (n=19)	1.01 ± 0.09 (n=3)

Conclusion

Our results showed no significant differences in ADC values according to degree of differentiation in SCC. This suggests that degree of differentiation is determined by specific findings such as the keratinization, stratification and atypia of cells, and degree of cellularity may not be particularly significant in the histological grading of SCC. Our results suggest that small foci of necrosis of tumors are not the main reason for a high ADC value. The degree of massive necrosis could be correlated with ADC value but not the degree of small foci of necrosis, because the size of small foci of necrosis may be smaller than the voxel size of the MR images.

References

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