Apparent Diffusion Coefficient in Malignant Lymphoma and Carcinoma Involving Cavernous Sinus Evaluated by Line Scan Diffusion-weighted Imaging

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PURPOSE

Although echo-planar DWI has been widely used for evaluation of CNS diseases including tumors, a drawback is the technical difficulty in assessing diffusion in the skull base regions. We propose using line scan DWI (LSDWI) in the skull base and parasellar regions because this technique is inherently insensitive to susceptibility artifacts. This study evaluates the ADC of malignant lymphomas and carcinomas involving cavernous sinus by LSDWI and determines the usefulness of this method for differentiating between the two tumors.

METHODS

Four patients with malignant lymphomas (one woman and three men; mean age, 62 years) and six patients with carcinomas (three women and three men; mean age, 61 years) were studied prospectively. In all cases, the final diagnoses were made pathologically through biopsy of the primary site. The lymphomas were classified into diffuse large B cell lymphoma in all cases. The carcinomas included squamous cell carcinoma (n=4), undifferentiated carcinoma (n=1), and carcinoma *ex* pleomorphic adenoma (n=1). All patients presented with acute symptoms of cavernous sinus syndrome such as diplopia. The mean maximum diameters of tumors were 19 mm for malignant lymphoma and 28 mm for carcinoma.

The LSDWI images were acquired using the following scan parameters: TR = 3124 ms, TE = 56.5 ms, one excitation, matrix size of 128 × 128 columns, a field of view of 20 × 20 cm, and section thickness of 3 mm with an inter-section gap of 0.5 mm. The LSDWI images were obtained with two different *b* values of 5 s/mm^2 and 1000 s/mm^2, with the maximum *b* value applied along the three orthogonal directions. The scan time per slice was 39 s; and three to five slices were obtained in the coronal plane according to the lesion size. The ADC value measurements were performed from trace ADC maps by placing regions of interest over the tumors.

The Mann-Whitney *U* test was used to detect significant differences in mean ADC values between lymphoma and carcinoma. A *P* value of less than 0.05 was considered to indicate a statistically significant difference.

RESULTS

Diagnostic images were provided by LSDWI with minimal distortion; the images enabled the ADC measurements. The T2-weighted images showed lower signal intensity in both types of tumors than that of normal brain parenchyma. However, LSDWI images at 1000 s/mm^2 showed that the signal intensity of lymphomas was higher than that of a normal brain, whereas the signal intensity of carcinomas was lower than that of a normal brain. The ADC maps depicted that the signal intensity of lymphomas was lower than that of normal brain, whereas the signal intensity of carcinomas was almost equal to or slightly higher than that of a normal brain (Figs. 1,2). The ADC value (mean $\pm$ SD) was $0.51 \pm 0.06 \times 10^{-3}$ mm^2/s in malignant lymphomas and $0.99 \pm 0.08 \times 10^{-3}$ mm^2/s in carcinomas. A significant difference in ADC values was found between the two (p<0.01).

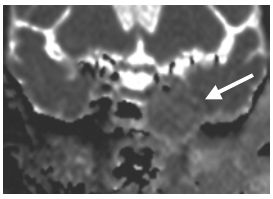

Fig.1

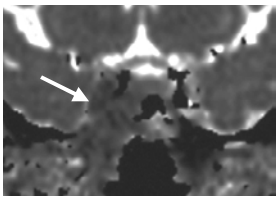

Fig. 2

Fig.1 ADC map of carcinoma Fig. 2 ADC map of lymphoma
Note that the signal intensity of the carcinoma (arrow) is slightly higher than that of normal brain while the signal intensity of the lymphoma (arrow) is lower than that of normal brain, indicating ADC of the lymphoma is lower than that of the carcinoma.

CONCLUSION

The LSDWI technique is robust and is applicable to evaluation of diffusion in tumors involving cavernous sinus, where insensitivity to susceptibility artifacts is crucial. LSDWI permits excellent image quality with minimum susceptibility artifacts. It further allows quantitative assessment of diffusion in malignant tumors involving cavernous sinus. Malignant lymphomas showed significantly lower ADC values than carcinomas. ADC provides useful information for differentiation between these tumors.