ASSESSMENT OF TUMOR BLOOD FLOW IN SKULL BASE MENINGIOMAS AND SCHWANNOMAS USING PULSED-CONTINUOUS ARTERIAL SPIN LABELING IMAGES AND ITS CORRELATION WITH HISTOPATHOLOGIC FEATURES

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Purpose: Although arterial spin labeling (ASL) perfusion imaging has been used to assess tumor blood flow (TBF) without administration of contrast media, the accuracy of TBF evaluations by pulsed-continuous ASL (pcASL) in skull base lesions remains unclear. The purpose of this study was to evaluate TBF using pcASL imaging, and to investigate the correlation between TBF and the histopathologic features of skull base meningiomas and schwannomas.

Materials and Methods: Perfusion-weighted MRI using pcASL was performed in 73 patients with meningiomas (n = 27) or schwannomas (n = 46) located in the skull base. Among these, 14 meningiomas and 21 schwannomas were pathologically confirmed. The other diagnoses were derived from MRI imaging features. A 3-dimensional spiral fast spin echo sequence, with background suppression, covering the entire brain was used for the pcASL perfusion imaging [1]. Other acquisition parameters for pcASL were as follows: duration = 1.5 s, 8 arms with 512 points in each spiral arm, phase encoding in the z direction = 34-40 steps, section thickness = 5 mm, TR/TE = 6000/21 ms, post-labeling delay = 1.5 s, image matrix = 128 × 128, and NEX = 3. We developed a region-of-interest (ROI) selection software tool (IDL) that enabled placement of the ROI on contrast-enhanced T1-weighted (CE-T1W) images and the automatic acquisition of pcASL TBF values corresponding to the ROI on the tumor. The ROI was set in the tumor and in a normal cortex section with a CE-T1W image and the TBFs were calculated. In addition, a relative ratio (%TBF) was also calculated using the mean cerebral blood flow in the centrum semiovale. Immunohistochemical analysis of CD34 was also performed. Slides were examined at low-power magnification to identify the areas with the highest density of microvessels. In each case, the most vascularized area was selected, and the microvessels within one high-power magnification (200×) field were counted. The stained vascular area rate (%area) was calculated using MacSCOPE. The differences in the %TBF between the meningioma and schwannoma were examined. The correlation between %TBF and %area was evaluated using a single linear regression analysis and a Spearman's rank correlation coefficient (r_s) test.

Results: There was a significant difference ($p < 0.01$) in the %TBF between a skull base meningioma and a schwannoma (Fig.1). In addition, a strong correlation was noted between the %area and %TBF ($p < 0.01$, $r_s = 0.83$) in analysis involving all tumors (Fig.2), but was not observed ($r_s = 0.40$) in analysis involving only schwannoma.

Discussion and Conclusion: This study demonstrated a significant difference in the TBF between skull base meningiomas and schwannomas. Because there was a significant correlation between %TBF and the total tumor vessel luminal area, precise evaluation of tumor perfusion using pcASL imaging was possible. Thus, differential diagnosis of a skull base tumor may be possible to some extent even if contrast material is not used.

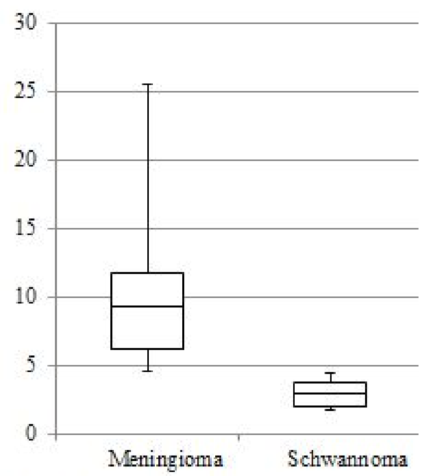

Fig.1 Relative tumor blood flow in meningiomas and schwannomas.
Note the significant difference between meningiomas and schwannomas ($p < 0.01$).

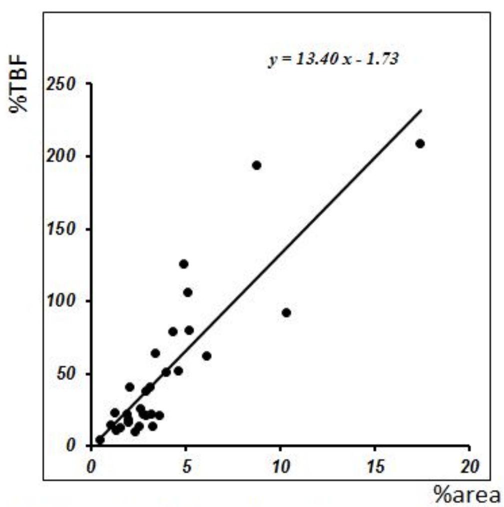

Fig.2 Scatter plot of the stained vascular area rate (%area) with respect to the relative tumor blood flow (%TBF) in 35 tumors. The regression line is shown (y = 13.4x - 1.73, where x indicates the %area and y indicates the %TBF; $r^2 = 0.75$; rs = 0.83, $p < 0.01$). Note the positive correlation between the %area and the %TBF.

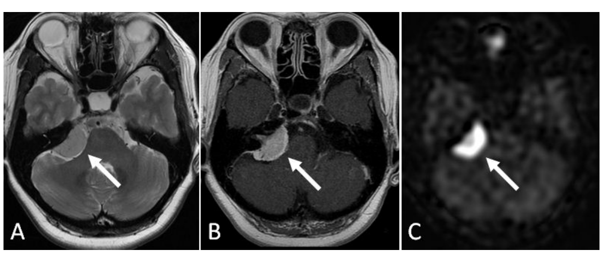

Fig.3 Representative case of meningioma.
A. T2WI; B. Gd-T1WI; C. ASL-CBF image

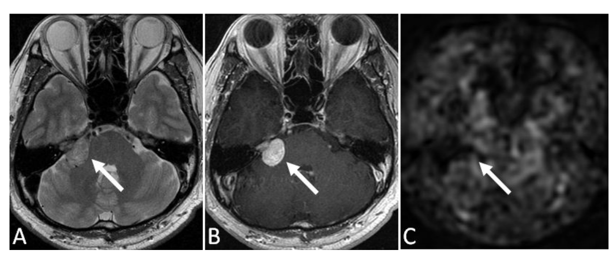

Fig.4 Representative case of schwanoma.
A. T2WI; B. Gd-T1WI; C. ASL-CBF image

Reference

1. Dai W, et al. *Magn Reson Med.* 2008;60: 1488-1497