Evaluation of brain-tumor interface on post-embolized intracranial meningiomas using time-resolved MRA; comparison with DSA

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Introduction

The most obvious reason for tumor recurrence of meningioma is the primary failure of complete microsurgical excision of the lesion. Although one of the most important factors in predicting the surgical outcome could be the brain-tumor interface of meningioma, the ability to predict the degree of brain-tumor interface has received little attention in the literature so far. Hypervascular meningeal tumors including meningioma have dual supply of meningeal-pial artery from external and internal carotid arteries in 60% of patients[1,2]. The existence of pial blood supply to meningiomas and its association with poor patient outcomes have been well reported in connection with petroclival meningiomas[3]. Although several articles reported about a significant positive correlation between bright signal intensity of peritumoral edema on T2-weighted images and brain-tumor interface, cerebral angiography was regarded as a standard method for evaluation of meningeal-pial blood supply[1,4]. Meningioma, which usually has dual feeding arterial supplies from external and internal carotid arteries, was inevitably partially embolized due to embolization was achieved through external carotid artery. We selected the meningiomas which must have taken partial embolization during procedure for localization of tumor-brain interface.

Our purpose of this study was to evaluate the pattern of brain-tumor interface on the post-embolized intracranial meningiomas in comparison with time-resolved MR angiography(MRA) and digital substraction angiography(DSA)

Methods

Eight patients with meningiomas which have dual feeding arterial supplies from external and internal carotid arteries, underwent DSA and time-resolved projection MRA before and after embolization on external carotid artery. All MR examinations were performed on 1.5 T scanner (Magnetom Vision, Siemens, Germany) with standard gradient system (25 mT/m and 600 microsec risetime) using head coil. We used snapshot FLASH optimized for projection imaging with minimum TR of 4.2 ms/TE 1.5 ms and a slab thickness of 60 mm, FOV was 220*220 and pixel 160*160. In coronal or sagittal direction, the images were acquired serially in the speed of 0.6sec/frame, totally 25frames/16sec. Single dose Gd-DTPA was supplied with automatic injector (volume 15 ml, flow rate 4 ml/s).

We evaluated the contrast staining territories of meningiomas in comparison with time-resolved MR angiography and digital subtraction angiography(DSA) before and after embolization for localization of brain-tumor interface.

Results

Meningiomas of four patients, who did not revealed peritumoral edema, showed feeding arteries from external carotid artery and extradural branches of internal carotid artery and located at skull base area. The remaining meningiomas of four patients showed peritumoral edema on T2-weighted brain MR images, had dual feeding arteries from internal and external carotid arteries on DSA and located at parasagittal area. Meningiomas of four patients, who had dual feeding arteries, showed double signal intensity of hyper-enhanced and faintly enhanced zone in the tumor on pre-embolization time-resolved MRA. The hyper-enhanced zone(Fig. 1) of tumor on time-resolved MRA was well matched with tumor feeding area from external carotid arteries on DSA. However, faintly enhanced zone of tumor was matched with contrast medium staining at brain-tumor interface on DSA. Time-resolved MRA image of meningiomas, which were taken post-embolization of feeding arteries from external carotid artery, showed focal signal defects at bright signal intensity zone, which was tumor feeding area from external carotid artery, and faintly enhanced peripheral zone of brain-tumor interface area(Fig. 2). All patterns of the time-resolved MRA were well matched with DSA findings.

Fig. 1 Double signal intensity zone of pre-embolization tumor on time-resolved MRA revealed brighter signal intensity zone of upper portion of tumor and faint signal intensity zone of lower portion of curvelinear peripheral zone of tumor.

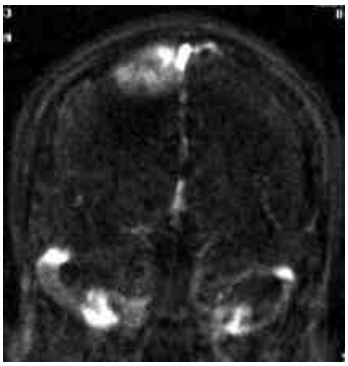

Fig. 2 Signal intensity of tumor center zone converted as signal defects on post-embolization time-resolved MRA. Faintly visualized lower peripheral portion of tumor suggested tumor brush from pial capillary feeding at tumor-brain interface area.

Discussion

The presence of brain-tumor interface of meningiomas was significantly related to the degree of pial blood supply and the location of pial brush. As pial brushes were composed of capillary back ground, tumor-brain interface in the peripheral portion of tumor could be faintly enhanced than in the arterial feeding zone of tumor center. Very fast MR imaging of time-resolved MRA could show signal difference between strongly enhanced central zone of tumor and faintly visualized peripheral zone of tumor-brain interface zone. The faintly enhanced zone of tumor can be regarded as tumor-brain interface zone due to contrast staining of the zone supplied from pial vessels on DSA. And faint signal intensities of the zone were constantly visualized on post-embolization of feeding arteries from external carotid artery. However, tumor center showed strong signal enhancement on time-resolved MRA due to direct arterial supply from feeding artery of original tumor pedicle.

Pre-operative information about presence of tumor-brain interface using time-resolved MRA will be an important finding to neurosurgeon for decreased local recurrence of meningioma.

References

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