TIME-RESOLVED CONTRAST-ENHANCED MR ANGIOGRAPHY OF INTRACRANIAL LESIONS

Z. ZOU[1], L. MA[1], L. CHENG[1], and Y. CAI[1]

[1]Radiology, Chinese People's Liberation Army General Hospital, Beijing, China, People's Republic of

Purpose:

To investigate the utility of time-resolved contrast-enhanced (CE) MR angiography in adding additional diagnostic information when used in conjunction with the routine brain CE MR protocol for the intracranial lesions.

Methods:

Ninety-six patients with suspected intracranial lesions underwent MR scan of the brain on GE 3.0T (n=40) and 1.5T (n=56) using an 8-channel phased array head coil. Before the routine contrast brain protocol, time-resolved CE MRA (3D-TRICKS) was applied with bolus injection of Gd-DTPA at a rate of 3 ml/sec and a dosage of 0.1mMol/kgBW. The parameters of 3D-TRICKS were as follows: TR/TE=3.4ms/1.3ms, flip angle=35°, FOV=26cm, matrix=320 x 192, slice thickness= 2.4mm interpolated to 1.2mm. A slab of 36~42 partition was sagittally or coronally localized to cover the circle of Willis and the entire lesion. The temporal resolution was 3~4s for each phase and a total of 15 phases were acquired within 2 min. Automatic subtraction was performed using the pre-contrast phase as background. The time intensity curve of 3D-TRICKS data was plotted on the FuncTool™ program on the workstation. The time to peak (TTP) of internal carotid artery (ICA), middle cerebral artery (MCA), superior sagittal sinus (SSS) and jugular vein as well as the lesions was calculated, respectively. MIP processing was performed taking the peak enhanced phase of the lesion to delineate the spatial relationship of the lesion and the vasculature. The routine brain protocol included pre-contrast axial, coronal, sagittal T1WI and T2WI, and post-contrast axial, sagittal and coronal T1WI.

Results:

Time-resolved CE MRA detected 1 aneurysm and 2 severe stenoses on IAC, 10 left and 2 right hypoplastic transverse sinus, which could not be easily detected on the routine protocol because of limited FOV or low temporal resolution. Angiographic or histo-pathological verification of brain lesions was available in 56 patients. More malignant tumors tended to have faster enhancement with shorter TTP (<30s) (Table 1). Meningiomas enhanced rapidly except for the epithelial type. Another exception was adenocarcinoma brain metastases which enhanced slowly while the hypervascular carcinoid metastasis enhanced rapidly. Aneurysms and AVM enhanced as quickly as MCA but intraaxial cavernoma enhanced very slowly. The average TTP of all patients in ICA, MCA, SSS and jugular vein were 19.1s, 19.4s, 25.9s and 26.4s, respectively. SNR was higher at 3T compared to 1.5T in ICA (13 vs 8; p=0.006) and jugular vein (18 vs 12; p=0.03).

Table 1. Intracranial lesion enhancement TTP on TRICKS

Rapid enhancing lesions	Number	TTP
Aneurysm or AVM	6	= MCA
Clivus squamous cell carcinoma	1	16s
Carcinoid metastasis	1	18s
Cellular ependymoma	1	20s
Pediatric pleomorphic astrocytoma	1	20s
Neuroglioma	1	23s
Anaplastic oligodendroglioma	1	25s
Hemangioblastoma	2	25s
Glioblastoma Multiforme	4	26s
Pineal germinoma	1	27s
Posterior commissure lymphoma	1	27s
Fibrous and transitional meningioma	7	30s
Slow enhancing lesions		
Frontal germinoma	1	64s
Intraaxial lymphoma	2	69s
Intraaxial cavernoma	4	72s
Epithelial meningioma	2	80s
Adenocarcinoma metastasis	2	80s
Frontal cyst	1	109s
Adult low grade glioma (WHO II)	17	>240s
Total	56	

Discussion:

In 22 out of 96 patients, additional important findings were acquired with time-resolved CE MRA, including aneurysms, vascular anomalies, stenoses and the relationships between lesions and nearby vessels which could not be seen on other sequences. In addition, time-resolved CE MRA has the ability to observe the hemodynamics within cerebral circulation and provide information on lesion enhancement kinetics to help predict glioma grading and meningioma types. This suggests that time-resolved CE MRA can be a useful additional sequence in patients undergoing brain CE MRI.

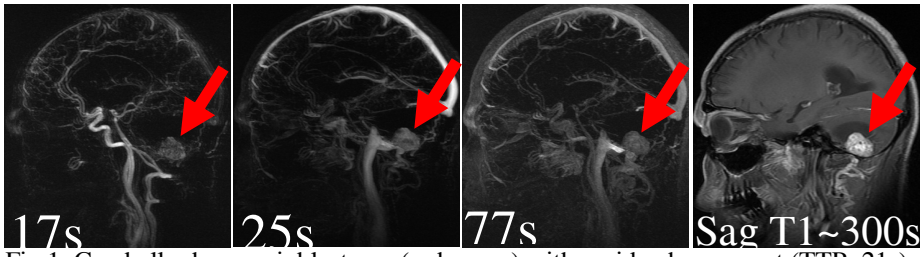

Fig.1. Cerebellar hemangioblastoma (red arrow) with rapid enhancement (TTP=21s).

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