Cerebral Collateral Imaging in Patients with Carotid Stenosis Using MR Perfusion Territory Arterial Spin Labeling, Compared with DSA

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INTRODUCTION AND PURPOSE:
Current knowledge of the collateral circulation remains sparse, and a noninvasive method to better characterize the role of collaterals is desirable. Recently, vessel encoded arterial spin labeling (VE-ASL) MR imaging [1] was introduced as a noninvasive means of studying the selective contribution of three major arteries to brain perfusion. The aim of our study was to investigate the presence of collaterals in patients with carotid stenosis and the change of perfusion territory after internal carotid artery (ICA) stent therapy using the MR perfusion territory imaging.

METHODS:
Twenty-five patients (44-83 yrs; 12 men, 13 women) with ICA or middle cerebral artery (MCA) severe stenosis were identified by ultrasound. VE-ASL was achieved to assess the presence of collateral flow on 3T MR scanner. In order to encode all vessels of interest, a pseudo-continuous tagging pulse train [2] was modified using additional transverse gradient pulses and phase cycling to place some arteries in a tag condition, while others passing through the same tagging plane were in a control condition. Other MR parameters were as follows: TR/TE=3s/3.1ms, slice thickness/slice gap=8mm/2mm, FOV=240mm; matrix=128, number of slices=7. The selectivity of this method was demonstrated using three different color maps. High SNR 3-colored maps of left carotid, right carotid, and basilar territories were generated in 6 minutes of scan time. The results were compared with intraarterial digital subtraction angiography (DSA) in crosstable, and kappa coefficient was calculated to determine the agreement between different methods. For 4 of involved patients, ICA stent therapy was accomplished, and the change of the perfusion territories before and after therapy was shown.

RESULTS:
The kappa value of VE-ASL and DSA was 0.914 (P<0.05). VE-ASL showed collateral flow via both Circle of Willis and leptomeningeal anastomoses. The perfusion territories changed significantly after ICA stent therapy.

CONCLUSION:
VE-ASL could show the presence of collateral flow, and could be helpful to evaluate the efficacy of ICA stent therapy.