

Validity of Three Dimensional Pseudo-Continuous Arterial Spin Labeling in Leptomeningeal Collaterals Assessment for Patients with Unilateral Middle Cerebral Artery Stenosis

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Purpose:Leptomeningeal collaterals were recruited to balance the cerebral blood perfusion and prevent brain tissue from ischemic stroke when middle cerebral artery(MCA) or internal cervical artery(ICA) stenosed or occluded¹. Assessment of these collateral vessels was essential for the secondary prevention management of patients with this disease. A non-invasive and effective approach was desired. Our study was to evaluate the validity of three dimensional pseudo-continuous arterial spin labeling(3D pCASL) with multiple post labeling delay(PLD) in leptomeningeal collaterals assessment in these patients.

Method:Patients with unilateral MCA severe stenosis(70%-99%) were consecutively enrolled. Those who had multiple intracranial moderate to severe stenosis were excluded. Conventional angiography and MRI including 3D pCASL with PLD 1.5s and 2.5s were performed. Conventional angiography studies were obtained from arterial to late venous phase. Capillary Index Score(CIS) was applied according to the previous study². MCA downstream territory was divided into three equal sections. Each section with capillary blush from retrograde flow more than 1/3 areas would count 1, or would be 0. Total CIS was calculated from 0-3. Cerebral blood flow(CBF) map of 3D pCASL with PLD 1.5s and 2.5s were postprocessed on the AW4.6 workstation. Subtraction images were obtained by CBF 2.5s subtracted CBF 1.5s. Slices involving MCA downstream territory were equally separated as upper slices, middle slices and inferior slices corresponding to CIS system. Slices with residual signal areas more than 1/3 MCA territory involved would count 1, or would be 0. Total ASL collateral score(ASLCS) was calculated from 0-3. Then ,favorable collaterals were graded as total CIS 2-3 /total ASLCS 2-3 and poor collaterals were graded as total CIS 0-1/ total ASLCS 0-1(Figure). Two experienced neuroradiologists and two neurointerventionists were trained and scored with consensus, respectively. Kappa value was calculated to determine the reliability for the two methods and inter-readers in collaterals grading.

Results:Fourteen patients(mean age, 49.6 ± 9.0 years, 10 men) were included in this study. The reliability for CIS method and ASLCS method in collaterals grading was found to be $\text{Kappa}=0.811(p=0.002)$, which implied a good agreement. An unanimous consensus was achieved for different reader because it might be feasible to identify 1/3 area in MCA territory on axial CBF subtracted images.

Conclusion:Three dimensional pCASL with multiple PLD is able to assess leptomeningeal collaterals non-invasively in patients with unilateral MCA stenosis. Perspective study associated long term outcome is expected.

References: 1.Liebeskind DS. Collateral circulation. Stroke. 2003;34:2279-2284
2.Al-Ali F, Jefferson A, Barrow T, et al. Journal of neurointerventional surgery. 2013;5:139-143

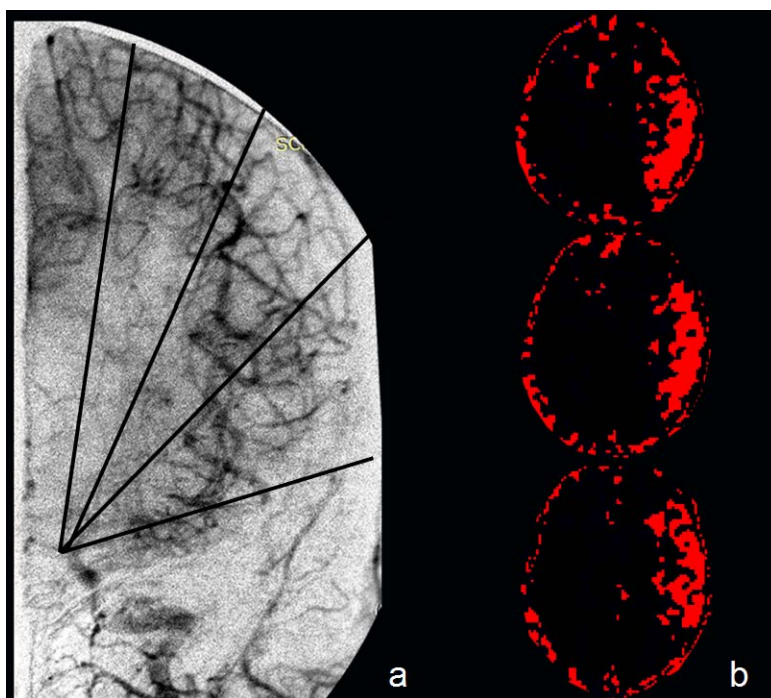


Figure. Total CIS equals 3 (a) and total ASLCS equals 3 (b). Favorable collaterals are graded on conventional angiography(a) and subtraction CBF map of 3D pCASL(b) in a 45-year-old female patient with left MCA severe stenosis.