Quantitative Evaluation of Collateral Perfusion Using Multi-delay 3D pCASL in Patients with Middle Cerebral Artery Stenosis

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PURPOSE

Patients with the same intracranial artery stenosis may have significantly different outcomes based on their ability to recruit collateral pathways to restore flow to the ischemic region during the times after stenosis. However, cerebral collateral flow is poorly understood despite its importance in maintaining the cerebral circulation due to lake of ideal or specific imaging modality [1,2]. The purpose of this study was to explore whether three dimensional pseudo-continuous arterial spin-labeling (3D pCASL) perfusion imaging could be used to quantitative the collateral flow by comparing the cerebral blood flow (CBF) map at multiple post labeling delay (PLD) times in symptomatic and asymptomatic patients with middle cerebral artery (MCA) stenosis.

METHODS

Thirty-three symptomatic patients (male, 26, age, 46 ± 8.9 years) and 24 asymptomatic patients (male, 15, age, 44 ± 7.8 years) with severe unilateral MCA stenosis (>70%) were enrolled in this study. The perfusion data were obtained using 3D pCASL sequence on 3.0-T MR scanner (Discovery 750, GE Medical Systems). The 3D pCASL data with two PLD of 1.5 and 2.5 seconds (S) was acquired. Bilateral MCA territories in two typical slices were manually drawn as region of interest (ROI) on GE ADW 4.5 workstation. The CBF values and hypoperfusion areas were compared between two groups (Figure).

RESULTS

The degree of MCA stenosis was similar between the two groups (66.5% vs 64.1%, P = 0.397). In symptomatic patients, the mean CBF of stenosis side is lower than the contralateral side at PLD 1.5 S (p = 0.027) and 2.5 S (p = 0.038). In asymptomatic patients, the mean CBF of stenosis side is lower than the contralateral side at PLD 1.5 S (p = 0.0064) but no difference at PLD 2.5 S (p = 0.689). Compared with the asymptomatic group, symptomatic MCA stenosis had lower CBF of stenosis side with longer PLD (2.5 S) (P = 0.011), and smaller difference of hypo-perfusion areas between two PLDs (P = 0.023) (Table).

CONCLUSION

Different perfusion properties on multi-delay 3D pCASL imaging were observed between symptomatic and asymptomatic MCA stenosis. Multi-PLD 3D pCASL technique may be a useful non-invasive tool to quntitative the collateral perfusion in patients with intracranial arterial stenosis.

REFERENCES

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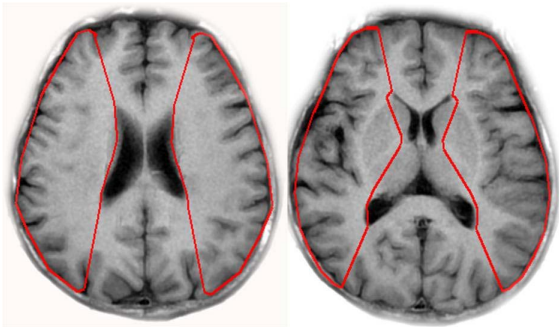2. Kishi T. Hypertens Res 2013, 36:845-851

Figure. Bilateral MCA territories in two typical slices were manually drawn as region of interest.

	Symptomatic MCA stenosis (n=32)	Asymptomatic MCA stenosis (n=24)	P
Mean CBF value of stenosis side (PLD = 1.5 s)	28.29 ± 10.45 ml/100g/min	36.89 ± 7.72 ml/100g/min	0.037
Mean CBF value of contralateral side (PLD = 1.5 s)	46.52 ± 8.93 ml/100g/min	47.11 ± 9.52 ml/100g/min	0.796
Mean CBF value of stenosis side (PLD = 2.5 s)	32.37 ± 8.63 ml/100g/min	46.37 ± 8.63 ml/100g/min	0.011
Mean CBF value of contralateral side (PLD = 2.5 s)	47.74 ± 9.11 ml/100g/min	48.64 ± 10.09 ml/100g/min	0.832
Hypoperfusion area of stenosis side between two PLDs	32.79 ± 14.56 cm²	56.22 ± 11.32 cm²	0.023

Table. The quantitative measurement of collateral perfusion in patients with unilateral MCA stenosis.