

SERIAL MEASUREMENT OF ARTERIAL SPIN LABELING FOR EVALUATION OF VASOSPASM AFTER SUBARACHNOID HEMORRHAGE

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Introduction

Angiographic vasospasm after subarachnoid hemorrhage (SAH) occurs in 30-70% of patients with aneurysmal SAH, with a typical onset 3-5 days after the hemorrhage, maximal narrowing at 5-14 days (1). On the contrary, the occurrence of symptomatic vasospasm remains between 20-40%, however, vasospasm has been thought to be associated with delayed ischemic neurological deficits and approximately 15-20% of patients suffered stroke (2). Imaging studies including DSC-PWI, SPECT, PET, and CT perfusion have been applied for management of vasospasm, however, diagnostic accuracy varies with time and serial measurements are necessary. The purpose of this study was to investigate capability of ASL to evaluate vasospasm during the postoperative course of aneurysmal SAH.

Patients and Methods

Eight patients with SAH underwent serial ASL at 3T (Magnetom Verio, Siemens) on days 1-2, 9-11 and 13-21, and several additional measurements of ASL were performed when necessary. Four patients represented symptomatic vasospasm and angiography showed spasm of MCA. Pulsed ASL (Q2TIPS) acquisition was conducted with the following parameters: TR 3000 ms, TE 14ms, FOV 256×256mm, matrix 64×64mm, slice thickness 8mm, interslice gap 2mm, TI1 700 ms, TI1s 1600 ms, TI2 1800 ms, 45 pairs of control and tags. ASL images were anatomically normalized and MCA territory was analyzed serially according to angiographic findings. CBF ratio of day X / day 1 was calculated for each patient.

Results

CBF ratio decline of ipsilateral (affected) side was shown in symptomatic vasospasm (Fig. 1). ROIs of distal areas (light color markers) showed more prominent decrease which was consistent with pathogenesis of vasospasm. A serial change of representative case was shown (Fig 2). CBF ratio of contralateral side showed only slight decrease. Plots of all ROI values on the day of vasospasm onset (or day 9-10 for non-symptomatic patients) were also presented (Fig. 3). CBF of symptomatic vasospasm patients was significantly decreased compared with CBF of non-symptomatic cases ($P < 0.01$).

Discussion and Conclusion

Serial ASL measurements are useful for monitoring vasospasm. It is preferable to perform intensive prophylactic therapy such as hypervolemia, hypertension, and hemodilution (triple-H) for impaired CBF after SAH. Serial ASL imaging showed a gradual decrease in CBF before clinical symptoms or DWI abnormalities became evident. Serial ASL may reveal an early CBF change of vasospasm for each patient and give us appropriate timing of multimodality therapeutic approach to treat vasospasm with such methods as endovascular treatment, clot removal, CSF drainage. ASL is suitable for repeated examinations because it can be conducted non-invasively without using any contrast media or radiation exposure.

References

(1) Bederson JB, Stroke. 2009, (2) Weidauer S, Stroke. 2007

Fig. 1

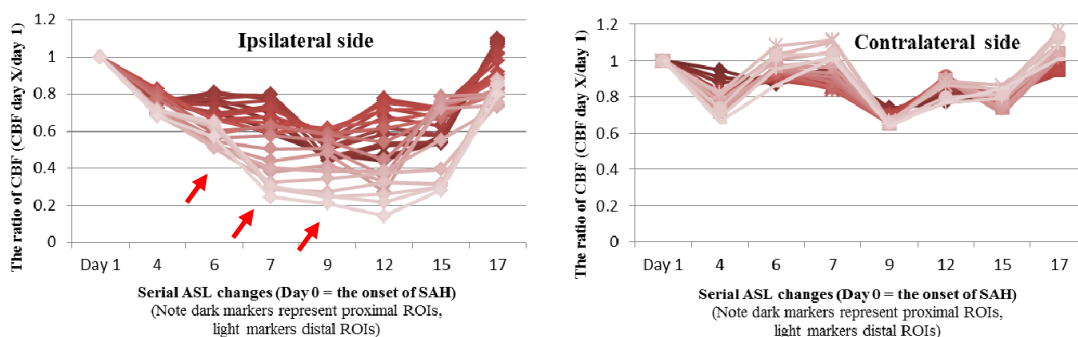


Fig. 2

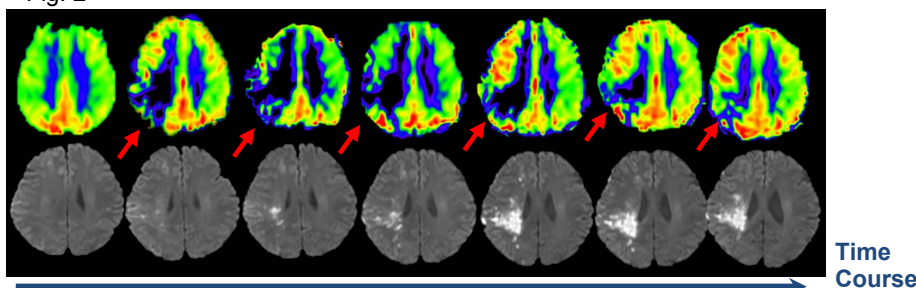


Fig. 3

