Hyperintense vessels on FLAIR: A useful non-invasive method for assessing intracerebral collaterals

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Objective: This study was aimed to evaluate relationship between hyperintense vessels (HV) on fluid-attenuated inversion recovery (FLAIR) and artery steno-occlusion related intracerebral collaterals.

Materials and methods: A total of 233 patients with 260 atherosclerotic lesions in the M1 segment of the middle cerebral artery (MCA) were examined with FLAIR and digital subtraction angiography (DSA). HV were graded as 0, 1, 2 and 3 by its distributions in the MCA territory. Grade 0 indicated no HV; Grade 1 indicated the HV limited in Sylvian fissure; Grade 2 indicated the HV limited in Sylvian fissure and the temporal–occipital junction; Grade 3 indicated the HV extended to frontal–parietal lobes. Collateral blood flows were classified by DSA results. The relationship between HV grades and patterns of collateral flows was analyzed.

Results: HV were observed in 76 out of 260 hemispheres. For patients with Grade 1 HV, most of their collateral flows (80.8%) were antegrade; for patients with Grade 2, the retrograde leptomeningeal flows were commonly manifested as anterior cerebral artery to MCA (75%); for patients with Grade 3 HV, most of the retrograde leptomeningeal flows were manifested as posterior cerebral artery to MCA (81.8%). As the grade HV increased, the frequency of retrograde leptomeningeal collateral from ACA to MCA decreased (100% to 75% and to 18.2%), and increased (0% to 25% and to 81.8%) for the retrograde leptomeningeal collateral via PCA to MCA (P < 0.001).

Conclusions: The HV could assess non-invasively intracerebral collaterals in patients with steno-occlusive lesions of M1 segment of MCA.

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1. Introduction

Hyperintense vessels (HV) on fluid-attenuated inversion recovery (FLAIR) MR images refer to focal hyperintensity. HV can be frequently observed near the cerebral surface along the cortical sulci in patients with ischemic stroke [1–4]. Although HV have non-invasively diagnostic value for intracerebral artery steno-occlusive lesion [2], the influence of degree of stenosis on the presence of HV is unclear. A recent study revealed that HV are associated with slow collateral blood flow in the setting of acute ischemic stroke [5], though the correlation of the location of HV with the patterns of collaterals is still unclear.

Atherosclerotic steno-occlusive disease in the M1 segment of the middle cerebral artery (MCA) can recruit the different patterns of collaterals, including the low grade of leptomeningeal retrograde collateral from anterior cerebral artery (ACA) to MCA and the high grade of leptomeningeal retrograde collateral from posterior cerebral artery (PCA) to MCA [6,7]. These patterns of collaterals may provide a setting helping to understand the underlying mechanism of HV. In this study, we aimed to investigate the relationship between the location of HV and these patterns of collaterals by contemporaneously comparing findings on FLAIR images with digital subtraction angiography (DSA) in the setting of patients with atherosclerotic steno-occlusive disease in M1 segment of MCA.

2. Patients and methods

2.1. Subjects

A total of 233 consecutive patients with atherosclerotic steno-occlusive lesions in M1 segment of the MCA were included as subjects, of which 57 were diagnosed with transient ischemic attacks (TIA), and 176 with cerebral infarctions (CI). These patients
Our study showed that the location of HV was more predominant in the Sylvian fissure than the other MCA territory in patients with intracerebral arterial steno-occlusive lesions, which was consistent with previous studies [1–3,5]. The retrograde flow via leptomeningeal anastomoses require time to develop and are not recruited unless primary collaterals at the circle of Willis have failed [6], and therefore the antegrade residual collateral are relatively common compared with the retrograde leptomeningeal collateral in these patients.

Some studies have postulated that the leptomeningeal collaterals may be the underlying structures for HV. [1,3,12,13]. Indeedly, our study demonstrated angiographically that the slow residual antegrade and leptomeningeal retrograde blood flows are the origin of HV. Moreover, our results indicated that retrograde blood flow was more sluggish than antegrade flow and was commonly seen during the angiographic venous phase, which was consistent with a recent study [5]. Additionally, the more recent report revealed that the leptomeningealivy sign, namely HV, was decreased in on FLAIR imaging after cerebral revascularization in patients with moyamoya disease, and also supported that ivy signs are correlated with slow blood flows [15]. However, the other recent research presumed that HV are described as maximally dilated pial vasculature rather than the leptomeningeal collateral arteries from the PCA [9]. According to our result from a subtle analysis of collateral flow patterns on DSA, we do not completely agree the opinion.

There are several limitations in this study. First, the FLAIR images were obtained by 1.5 T and 3.0 T field strengths, and their sensitivity for the HV may be different. Second, we only assessed the relationship between HV and the intracerebral collaterals, and the potential extracranial arterial collaterals may influence these results. Finally, this study was a single centre, across-sectional and retrospective study, and a longitudinal study investigating the correlation of the change of HV and the progression of collateral is needed.

5. Conclusion

This study indicated that the HV show up at a degree of M1 stenosis of greater than or equal to 90%, and more importantly, the location of HV are indicators of the different patterns of collaterals. The HV could assess non-invasively the patterns of collaterals in patients with steno-occlusive lesions in the M1 segment of MCA.

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References