Intraplaque Hemorrhage Detected by High resolution 3D T1-SPACE in Symptomatic Intracranial Atherosclerotic Disease

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Introduction: Intracranial atherosclerosis is an important cause of cerebral ischemic events. Little is known about the composition of plaques and how plaque morphology in the intracranial arteries is related to clinical status because there is currently no established method for identifying intraplaque hemorrhage(IPH). Previous studies have shown that within carotid plaque, high signal on T1-weighted fat-suppressed images is highly suggestive of fresh or recent intraplaque hemorrhage and is a well-described predictor of ischemic events.

Purpose: The aim of this study was to examine the occurrence of high signal on 3D T1-SPACE of Middle cerebral artery (MCA) and basal artery (BA) plaques, which are highly suggestive of fresh or recent IPH.

Methods: Fifty-seven subjects (30 males. mean age 51 years) with recent ischemic stroke underwent 3D T1W-SPACE vessel wall imaging at a 3T MRI system (Magnetom Tim Trio, Siemens, Germany) together with a 32-channel head coil. MR imaging: FOV=160mm×160mm; partition thickness=0.5mm; ETL=33; ESP=5ms; base matrix=320×320 (isotropic voxel size of 0.5mm); bandwidth=500Hz/pixel, TR 900ms; TE=25ms, slice=64, iPAT=2, scan time=8~10min. The atherosclerotic plaque was defined as local wall thickening on MCA and BA. MCA and BA stenosis were defined as symptomatic if there was an ischemic stroke in the distribution of the stenotic vessel within 1 month of stroke onset. MCA and BA stenosis was defined as asymptomatic if there was no history of cerebrovascular events or if an ischemic event occurred in a vascular territory outside the affected vessel. The maximum wall thickness, length, and luminal stenosis for each lesion were measured. Presence or absence of IPH were identified for each lesion. Differences between the 2 observers were solved by consensus.

Results: 3D T1-SPACE was successfully completed in all patients. The time from stroke onset to MRI examination in symptomatic patients was 12 ± 9 days. All patients with stroke in this study had positive findings on diffusion-weighted imaging sequences. Twenty-five MCA stenoses and 10 BA stenoses (14 symptomatic and 21 asymptomatic) were found by T1-SPACE. IPH was identified in 3 symptomatic vessels and in 1 asymptomatic vessels. The occurrence rate of IPH between symptomatic and asymptomatic MCA stenosis was significantly different ($p<0.01$). Example images is shown in Fig 1.

Discussion and Conclusion: To the best of our knowledge, this is the first study to investigate IPH on MCA and BA using 3D MR black-blood vessel wall imaging. We found that IPH is more common in symptomatic compared to asymptomatic MCA and BA stenosis. Due to their large coverage, 3D imaging protocol enables fast comprehensive assessment of neurovascular plaque burden and intraplaque hemorrhage that are related to plaque vulnerability both on MCA and BA. IPH within an intracranial plaque can be a valuable marker for stratification of stroke risk.

Reference:1. Kasner SE, Chimowitz MI, et al. Circulation 2011;113:555–563. **2.** Klein IF, Lavallee PC, et al. Neurology 2006;67:327–329.
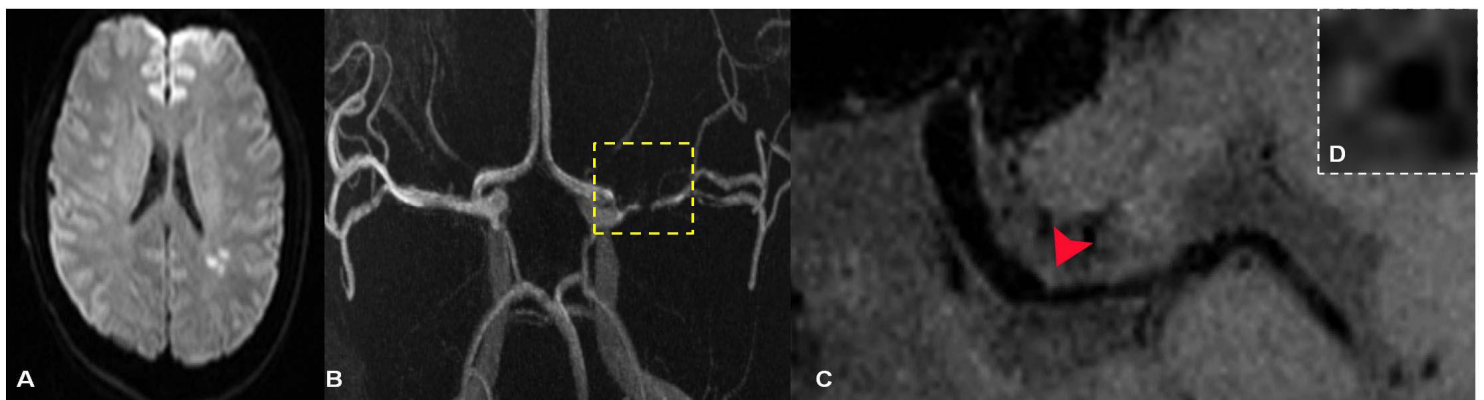
Fig. 1: In a patient with (A) multiple ischemic lesions on diffusion-weighted images of the brain, magnetic resonance angiography shows (B) high-grade left middle cerebral artery stenosis. On high-resolution magnetic resonance imaging, an eccentric plaque (arrow head) is identified on T1-SPACE (C) and reformatted T1-weighted imaging (D) shows intraplaque hemorrhage.