

Assessment of Pial Branches Using 7-Tesla MRI in Cerebral Arterial Disease

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The diagnosis of cerebral arterial diseases such as central nervous system (CNS) vasculitis is often based on angiographic findings [1–3]. However, transfemoral cerebral angiography (TFCA) is occasionally associated with procedure-related complications, while the diagnostic validity of MR angiography (MRA) remains questionable due to its low resolution [3–5]. Recently, it has been shown that the 7-tesla MRI with ultra-high resolution accurately demonstrates small intracranial perforators [6, 7]. We describe visualization of diseased pial branches with the 7-tesla MRI in a patient with cerebral arterial disease.

Case Report

A 21-year-old previously healthy man developed several episodes of transient left limb weakness 5 months before the admission. He denied ingesting any drugs or smoking cigarettes. Brain MRI showed an acute ischemic lesion at the right frontal lobe and an old cystic lesion at the right basal ganglia (fig. 1A, B). TFCA showed multifocal narrowing of medium-sized vessels that were compatible with CNS vasculitis (fig. 1C). Laboratory results including anti-double-stranded DNA, c- and p-ANCA, lupus anticoagulant, anticardiolipin antibodies and CSF findings were normal. Brain biopsy, performed on his right frontal lobe, failed to show evidence of CNS vasculitis. Under the tentative diagnosis of isolated CNS vasculitis, high-dose prednisolone (60 mg/day) was administered and tapered to 10 mg/day.

Five months later, he was readmitted because of recurrence of transient left hand weakness. Follow-up TFCA showed aggravated stenosis/occlusion of pial branches (fig. 1D). The 7-tesla time-of-flight (TOF) MRA was performed 3 days later, using a birdcage type radiofrequency coil specifically designed for an angiographic application (Magnetom, Siemens AG) [6]. A 3-dimensional fast low-angle shot gradient echo sequence was used. The acquired nominal voxel size was 250 × 250 × 360 μm and the total acquisition time was 9 min 15 s. For monitoring the safety, we measured the transmission power and the specific absorption rate for the total imaging time, which were 174 V and 36% of the FDA limit, respectively. For comparison, we also used 3-tesla MRA (Verio, Siemens AG) with the total acquisition time of 8 min 40 s.

The 7-tesla TOF MRA showed stenosis, occlusion and collateral vessels of pial branches that were detected on the TFCA (fig. 1E, F). Three-tesla TOF MRA, done soon after with similar qualifications, failed to visualize such details (fig. 1G).

Discussion

Although clinical, laboratory and TFCA findings were consistent with isolated CNS angiitis, given the negative results in brain biopsy, the definitive diagnosis remains unclear in this patient. Nevertheless, we found that 7-tesla TOF MRA accurately revealed stenosis, occlusion and fine collaterals of pial arteries. The resolution was far superior to that of 3-tesla TOF MRA and seems to be equivalent to that of TFCA (fig. 1E–G). Considering small but significant procedure-related complications of TFCA, our results suggest that 7-tesla MRA may be used as an alternative method or even replace TFCA in the assessment of cerebral arterial disease such as CNS vasculitis. Further studies with a larger number of patients are required to confirm our preliminary observation.

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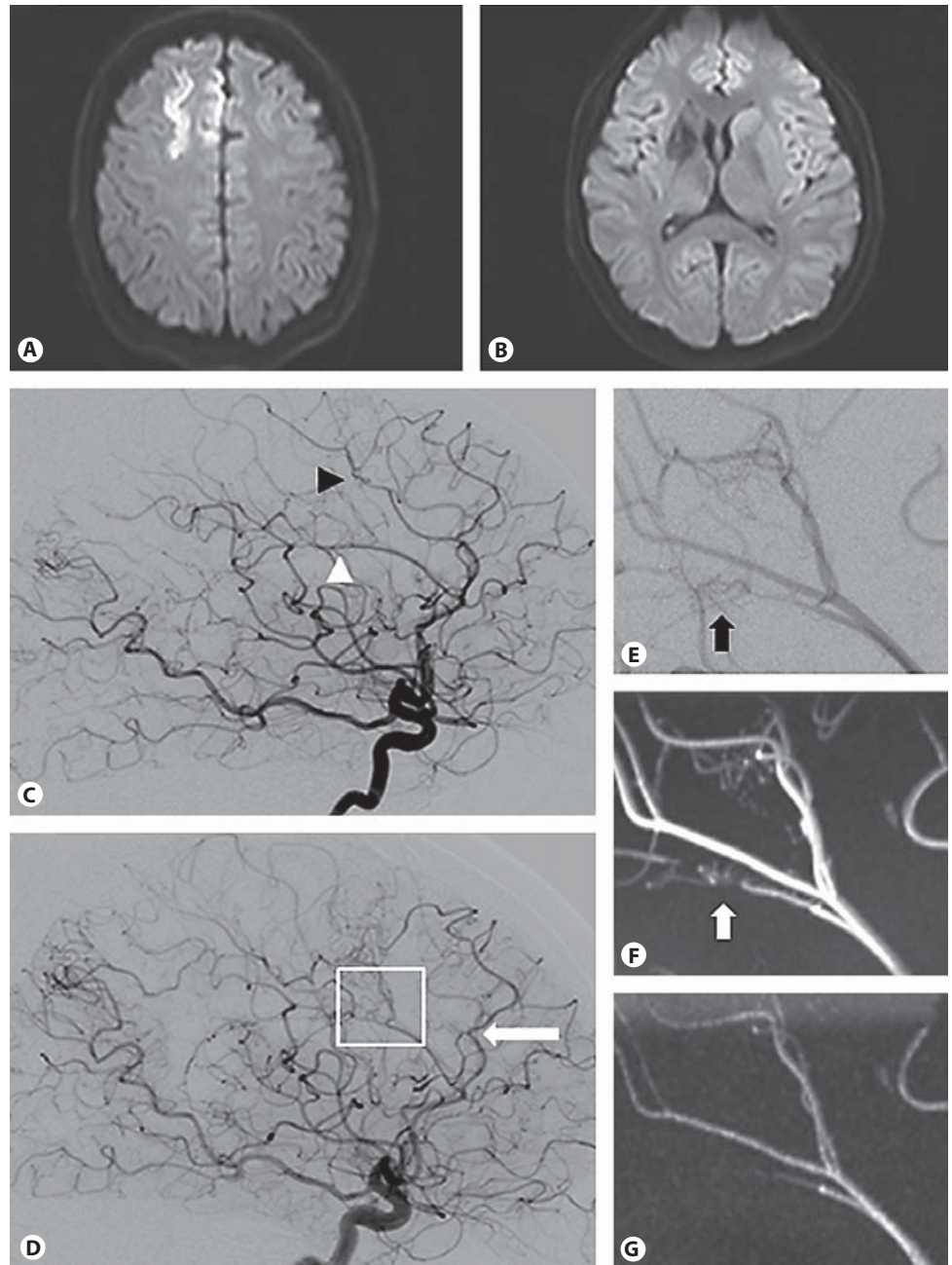


Fig. 1. **A, B** Diffusion-weighted imaging after the onset of transient left limb weakness showed an acute ischemic lesion in the right frontal lobe (**A**) and an old cystic lesion in the right basal ganglia (**B**). **C** Initial angiography showed irregular stenoses in the right callosomarginal artery (black arrowhead) and the pericallosal artery (white arrowhead). **D** Angiography performed 5 months later showed occlusion of the right callosomarginal artery

(long white arrow) and aggravated focal irregular stenosis in the right pericallosal artery (white square area). **E, F** Magnification of the white square area (**E**) showed steno-occlusive lesions and collateral vessels (black arrow), which were similarly demonstrated in 7-tesla TOF MRA (**F**, white arrow) performed 3 days after the transfemoral angiography. **G** The resolution was much worse in the 3-tesla TOF MRA performed soon after the 7-tesla TOF MRA.