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Vessel wall imaging in Clinical practice

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Intracranial magnetic resonance (MR) angiography is widely used to diagnose cerebrovascular diseases such as infarction, vasculitis, aneurysm and moyamoya disease. MR angiography noninvasively shows luminal narrowing of the intracranial arteries. However, most vascular diseases, especially atherosclerosis, do not show luminal narrowing in early stage. Recently, high-resolution (HR) intracranial vessel wall imaging is used to demonstrate intracranial vessel wall abnormality. HR intracranial vessel wall imaging clearly shows vessel wall pathologies such as wall thickening or enhancement at the stenotic portion detected on MR angiography.

Intracranial vessel wall imaging has several characteristics. Intraluminal imaging such as angiography shows steno-occlusive lesion only, but vessel wall imaging shows vessel wall pathology directly, such as atherosclerotic plaque, inflammation, smooth muscle proliferation, and vessel wall remodeling. First, intracranial vessel wall imaging requires high resolution, because the diameter of MCA is only 2-3mm, and the thickness of normal vessel wall is less than 0.4 mm. In addition, high resolution 3D imaging with multiplanar reconstruction is helpful in the intracranial vessel wall imaging, because the intracranial vessel is not parallel to orthogonal plane, multiplanar reconstruction or curved planar reconstruction is needed to get images perpendicular or parallel to the course of vessels and minimize partial volume averaging artifact. Second, in contrast to angiography, in the vessel wall imaging, the blood signal should be black to identify the boundary between vessel wall and lumen, therefore we need special techniques to suppress the blood signal. (spatial presaturation, double inversion recovery, iMSDE (improved motion-sensitized driven-equilibrium), DANTE (delay alternating with nutation for tailored excitation), etc.)

The indications of intracranial vessel wall imaging are as follows: 1) Differential diagnosis of distal ICA/MCA stenosis/occlusion (e.g. Atherosclerosis vs Moyamoya disease), 2) differential diagnosis of infarction mechanism (e.g. Branch occlusive disease (BOD) vs nonBOD stenosis (embolism or in-situ thrombosis)), 3) differential diagnosis of vertebral artery stenosis/occlusion (e.g. Dissection vs Atherosclerosis), 4) differential diagnosis of multiple intracranial stenosis with thunderclap headache (e.g. RCVS vs Vasculitis), 5) evaluation of treatment response of various vascular disease (e.g. statin treatment for atherosclerosis, steroid or immunosuppressant treatment for vasculitis, follow up of dissection, etc), 6) evaluation of ruptured or unruptured aneurysms. The representative cases of intracranial vessel wall imaging will be discussed in this lecture.

Keywords: Vessel wall imaging, high resolution MRI, stroke