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EDITORIAL

Evaluation of intracranial artery stenosis using time-of-flight magnetic resonance angiography: new wine in an old bottle

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Key Points

- *TOF MRA is very important in the evaluation of cerebrovascular stenosis, and a novel evaluation system can further enhance its strengths.*
- *This evaluation system is more accurate based on the fact that cerebral vascular stenosis alters hemodynamics and leads to different imaging presentations.*

Key words Intracranial Arteriosclerosis · Magnetic Resonance Angiography · Diagnosis

For the diagnosis and grading of intracranial atherosclerotic disease (ICAD), Digital subtraction angiography (DSA) is still the current reference standard; however, it is associated with limitations such as increased costs, patient acceptance, and complications as well as ionizing radiation exposure [1]. So, magnetic resonance angiography (MRA) is being proposed as a replacement for the gold standard, intra-arterial angiography [2]. Based on the advantages of non-invasive, no contrast injection and no ionizing radiation hazards, time of flight MRA(TOF-MRA) is currently the most commonly used pulse sequence in the screening of people at high risk of stroke, which has generated promising results for diagnosis of vascular diseases [3]. Nevertheless, TOF-MRA is sensitive to disturbance of intraluminal blood flow, particularly leading to overestimation of intracranial stenosis, or even its misdiagnosis as occlusions [4, 5]. The hemodynamic changes caused by different degrees of stenosis are different, and consequently the lumen imaging appearances in TOF-MRA are also different. So, it is important to incorporate the influence of hemodynamics on TOF-MRA into diagnostic considerations and to use that influence to aid in diagnosis of different degrees.

With a growing clinical need for accurate assessment of the degree of arterial stenosis on TOF-MRA, You et al developed a novel visual grading system for ICAD using TOF-MRA [6]. A total of 132 segments with intracranial atherosclerotic stenosis from 71 patients were enrolled after the criteria of patient selection. Percent stenosis was calculated using the WASID method on DSA (DSAWASID, from two neuroradiologists) and TOF-MRA (MRAWASID, from a neurointerventional radiologist) for each segment. Then four visual grades from two neuroradiologists, named MRAVICAST (visual grading system for ICAD on TOF-MRA), were defined comparing to percent stenosis in the following: mild, decreased flow diameter of the stenotic segment and preserved flow diameter of the post-stenotic segment (corresponding WASID < 49%); moderate, thread-like or non-existent (invisible) flow diameter of the stenotic segment and preserved flow diameter of the post-stenotic segment (corresponding WASID 50-69%); severe, thread-like or nonexistent (invisible) flow diameter of the stenotic segment and diffusely decreased flow diameter of the post-stenotic segment compared to that of the pre-stenotic segment (corresponding WASID 70-99%); and occlusion, no distal flow (Corresponding WASID 100%). Their results showed the overall diagnostic accuracy of MRAVICAST (93.9%, 124/132) was higher than that of MRAWASID (50.8%, 67/132) for each grade. The degree of stenosis did not differ significantly between MRAVICAST and DSAWASID (p = .849). Regarding reproducibility, MRAVICAST demonstrated

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excellent interobserver agreement (ICC, 0.989; 95% CI, 0.979–0.999). The positive predictive values of MRAVICAST for the diagnosis of > 50% and > 70% stenosis were 97.3% and 100.0%, respectively. The authors concluded that the new intuitive grading system (MRAVICAST) accurately and reliably determined the degree of stenosis in intracranial arterial atherosclerosis patients.

Further, with the advent of high-resolution vessel wall imaging (HR-VWI), it appears that the clinical status of MRA in the assessment of ICAD has been challenged. HR-VWI can clearly and directly display the vessel wall and its lesions, more visually evaluate the structural characteristics of the diseased vessel, diagnose the type of vascular lesion responsible for stroke, predict the risk of stroke caused by the diseased vessel, and provide a more accurate imaging tool for clinical diagnosis, treatment and prognostic assessment [7, 8]. HR-VWI is being increasingly used as a diagnostic tool in daily practice. However, it is important to know the limitations and potential pitfalls besides the many advantages of HR-VWI. HR-VWI is sensitive to motion artifacts due to relatively long acquisition times. The enhancement of the venous structures adjacent to arteries or low-velocity flow within the vessel lumen resulting in loss of flow voids can mimic vessel wall enhancement [9]. Compared to the requirements of HR-VWI techniques, 3D TOF MRA has a lower threshold of applicability and is less selective for patients, making it easier to perform daily clinical work. For daily use in a clinical setting, TOF-MRA provides expedient and rapid identification of cerebral artery stenosis, increasing efficiency for treatment within the time window [10]. With the novel grading system to accurately estimate the degree of stenosis, TOF-MRA will be a more effective screening technique for patients with suspected intracranial arterial stenosis and to indicate the deeper need for HR-VWI to accurately image the stenotic features.

To conclude, this study topic is clinically important to build a novel visual grading system for ICAD using TOF-MRA. This enables the use of hemodynamic information to assist in the evaluation of the degree of stenosis while identifying the hemodynamic impact on the lumen imaging.

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Methodology
- Invited editorial comment

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