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ABSTRACT

SUMMARY: Basi-parallel anatomic scanning has been widely used for assessing the vascular morphology of vertebral basilar arteries. Previous studies have demonstrated its efficacy in evaluating the morphology of the MCA, which we refer to as MCA parallel anatomic scanning MR imaging (MCPAS). In this study, we present our experience with the application of MCPAS in patients with MCA occlusion. Endovascular treatment was performed on the patients with intact MCA morphology visible in on MCPAS, with no intracranial hemorrhage, occlusion, or other complications observed. No severe stenosis or re-occlusion was observed at the 12-month postoperative follow-up. In conclusion, MCPAS is an effective method for assessing the outer contour of an occlusive MCA. Endovascular treatment can be considered a safe and efficient option for patients who show a favorable MCA through MCPAS assessment.

ABBREVIATIONS: BPAS = basi-parallel anatomic scanning; EVT = endovascular treatment; MCPAS = MCA parallel anatomic scanning MR imaging

Basi-parallel anatomic scanning (BPAS) is a MR imaging technique developed for visualizing the morphology of intracranial vertebrobasilar arteries.[1] It has been developed to demonstrate the outer contour of the vertebrobasilar artery and assist in guiding the treatment of vertebrobasilar lesions.[2-4] The high-resolution vessel wall imaging showed the direct visualization of lesions on blood vessel walls[5] and improved the prediction of recurrence in cases of intracranial atherosclerotic stroke within the MCA territory.[6] However, high-resolution vessel wall imaging still faces the challenge in distinguishing abnormal blood vessel walls from surrounding tissues in cases of chronic vascular occlusion. Therefore, we applied the pattern of BPAS to the MCA, resulting in a technique called MCA parallel anatomic scanning MR imaging (MCPAS). CTA and DSA provide information about the inner diameter of the vessel through contrast flow. Whereas, MCPAS displays information closer to the outer wall of the vessel by specific parameters that are independent of blood flow and thrombus. In a previous study, MCPAS was used to reconstruct the distal vascular bed in patients with acute MCA occlusion, aiding neurologists in endovascular treatment (EVT) .[7]

Chronic occlusion of the MCA is always accompanied by atherosclerotic plaques, fresh and muscular thrombosis in the diseased segment, and vascular degeneration. This condition leads to chronic ischemia and hypoxia. Meanwhile, chronic occlusion of the MCA is an important risk factor of ischemic stroke recurrence. While EVT is the preferred approach for patients with acute cerebrovascular occlusion, it remains controversial for patients with chronic vascular occlusion.[8] However, with the advancement of equipment and technology, some operators have already started trying to treat the chronic, occluded MCA by EVT. When considering EVT for these patients, it is necessary to exclude the cases of congenital vascular malformation and significant postocclusive vascular regression. The MCPAS technique, which displays the outer wall morphology and the main direction of the occluded MCA, can help the operator understand the hidden vascular pathway and assess the feasibility of recanalization through EVT.

Here, we present our single-center experience with MCPAS-guided EVT for chronic MCA occlusion. These patients had progressive neurologic deficits despite receiving intensive drug therapy. MCPAS revealed favorable distal vascular conditions of the

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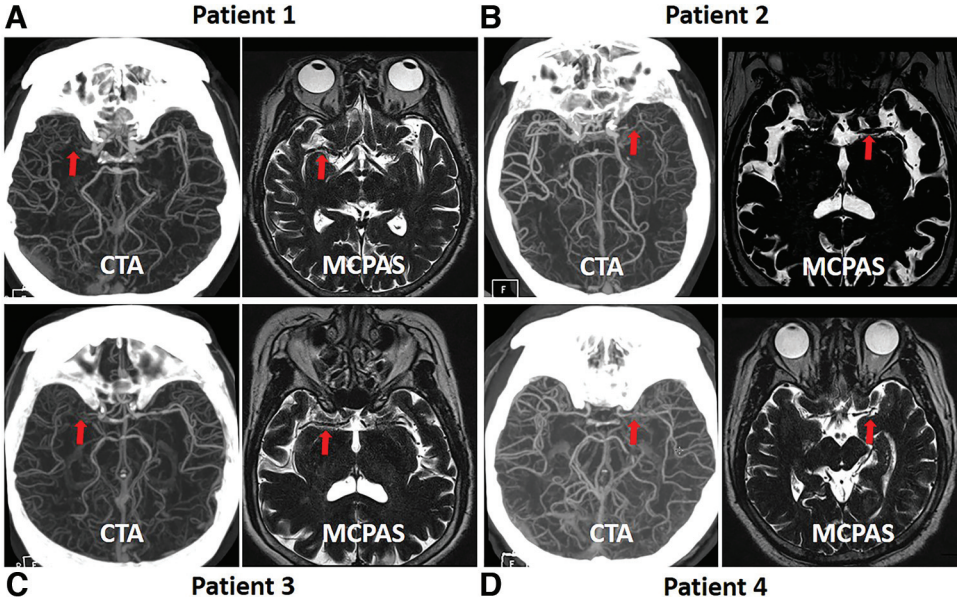

FIG 1. The image data of patients 1–4. *A–D*, The CTA and MAPAS images of 4 patients with MCA occlusion (including 2 right MCA occlusions and 2 left MCA occlusions). The red arrows indicate the vessels with lesions.

relevant MCA and provided a foundation for performing EVT in these patients.

MCPAS

Each patient was placed in the supine position, and MCPAS was performed using a 3T scanner (Signa HDx 3T; GE Healthcare) in coronal or horizontal sections parallel to the clivus. The fast spin-echo sequence was used for imaging. We used the following imaging parameters: TR of 4720 ms, TE of 197 ms, and number of excitations of 1. The field of view was 180 × 180 mm, with a matrix size of 384 × 192 mm and a section thickness of 1.2 mm. The acquisition time was 68 seconds by pulse sequences.

Study Population

This study recruited 8 patients with MCA occlusion or severe stenosis at the stroke center of Daping Hospital from May 2021 to June 2022 (Online Supplemental Data). The time taken from the discovery of blood vessel occlusion or severe stenosis to undergoing the MCPAS evaluation among these patients ranged from 5 months to 1 year. This judgment of the occlusion time is based on the patient's medical history, with the appearance of vascular lesions possibly occurring earlier. These patients had a chronic course with recurrent symptoms, including weakness in the limbs, speech difficulties, facial paralysis, dizziness, and so forth. Craniocervical CTA and CTP were used to evaluate the cerebrovascular lesions and cerebral perfusion (Fig 1 for patients 1–4; Online Supplemental Data for patient 5). Four patients showed a significant decrease in perfusion in the responsible cerebrovascular area (Online Supplemental Data). In patient 5, the left MCA had occlusion and the right MCA had severe stenosis (Online Supplemental Data). MCPAS was used to show the occluded segment of the MCA in all patients. Among patients 1–4 and the right MCA of patient 5, relatively complete arterial morphology was shown in MCPAS (Fig 1), while the left MCA of patient 5 was discontinuous in MCPAS (Online Supplemental Data). For patient 2, in addition to CTA and MCPAS, high-resolution MR imaging was also performed. We measured the luminal cavity of the occluded left MCA in the high-resolution MR imaging and MCPAS images, which was approximately 1.4 mm in high-resolution MR imaging compared with 2.4 mm in MCPAS (Online Supplemental Data). In these 5 patients, successful recanalization was achieved in the vessels with a good display in MCPAS. Additionally, the occluded MCA branch was not visualized in the MCPAS for the other 3 patients (Online Supplemental Data). Therefore, EVT was not performed on these 3 patients.

Endovascular Treatment

EVT was performed and achieved successful revascularization in the vessels with good display in MCPAS. Patients 2 and 4 underwent balloon angioplasty, while patients 1, 3, and 5 received stent implantation after balloon angioplasty. The vessels with good display in MCPAS achieved TICI 3-level reperfusion (Online Supplemental Data). Four patients received general anesthesia during surgery, while 1 patient (patient 5) received local anesthesia. There were no relevant complications during or after the surgery. At the 6-month follow-up, all 5 patients had an mRS score of 0–1, and a follow-up of CTA at 1 year after surgery showed no recurrent arterial occlusion.

DISCUSSION

Five patients underwent EVT treatment in this study, all of whom presented with chronic lesions of the MCA. Four of them showed the presence of a primitive official lumen on MCPAS, while the remaining patient showed the presence of a vascular lumen on the right MCA on MCPAS, but no significant vascular lumen on the left MCA. All patients had progressive neurologic deficits even after intensive antithrombotic therapy. Therefore, these patients had an urgent need for vascular reconstruction. According to the results of CTA and BPAS scans, we found that

although no blood flow passed through the vessel in these patients, the outer wall of the occluded MCA was still present. Therefore, EVT was performed to restore blood flow in the MCA. The posttreatment review revealed that all patients had a satisfactory restoration of blood flow in the target MCA, with significantly improved perfusion in the respective brain regions. No re-occlusion of the treated artery was found at the 1-year follow-up evaluation, lower than the rate of re-occlusion in a previous study.[9]

In some patients, MCPAS is unable to depict the occluded MCA. For the patients who did not show good vascular morphology in the MCPAS examination, we suggested drug therapy or a bypass operation instead of EVT. The main debate on the recanalization of chronic cerebral vascular occlusion is the trade-off between the benefit and risk of the operation. In patients with asymptomatic MCA occlusion, dehydration, decreased cardiac function, or infection can jeopardize the blood supply to the brain. In addition to the risk of physiologic lesions, patients will inevitably experience the psychological burden of stroke. Psychological problems such as depression and anxiety are common in these patients, severely decreasing the quality of life. Therefore, reperfusion of the occluded MCA by EVT can effectively reduce the long-term risk and reduce the psychological burden of patients.

A preoperative MCPAS examination was conducted to assess the presence of the outer contour of the occluded MCA, avoiding the use of blind invasive procedures. MCPAS provides the operator with the direction of the occluded segment and the direction of the vessels beyond the occluded segment, preventing the operator from steering the guidewire in the wrong direction during the procedure and reducing vascular injury related to the operation. Meanwhile, MCPAS can also provide morphologic information of the occluded segment vessels including the vessel outer diameter, which can help the operator choose appropriate instruments, such as balloons, stents, and so forth.

In this study, successful EVT procedures were performed on 5 patients, guided by MCPAS, resulting in satisfactory revascularization. Therefore, EVT can be considered for patients with MCA occlusion whose condition continues to worsen despite drug treatment. MCPAS plays a crucial role in applying EVT to anterior circulation vascular occlusions, so it is worth further research.

Disclosure forms provided by the authors are available with the full text and PDF of this article at www.ajnr.org.

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