CASE REPORT

New Vessels or MCA Stem: A Case of Asymptomatic Chronic Middle Cerebral Artery Occlusion on TCCS

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Abstract: We present a case of an asymptomatic chronic middle cerebral artery (MCA) occlusion that was incidentally detected on transcranial color-coded sonography (TCCS) and confirmed by magnetic resonance angiography (MRA). Besides the presence of accelerated blood flow velocity in the ipsilateral anterior cerebral artery (ACA) and posterior cerebral artery (PCA), which is known as signs of pial collaterals, TCCS specifically visualized some deep anastomoses and new vessels running along the occluded MCA stem course. Therefore, TCCS showed transcortical collaterals indirectly and deep anastomoses and neovascularization directly, providing at least as much information as MRA in explaining patient's lack of symptoms and predicting his outcome. However, during TCCS procedures, we should be aware of the possibility of mistaking neovascularization as a patent MCA stem, tortuous MCA, or indistinct MCA influenced by poor temporal bone window.

Key words: Middle cerebral artery; Transcranial color-coded sonography; Occlusion; Collaterals

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Case Report

A 44-year-old male was admitted to our hospital after suffering from intermittent melena and fatigue for 7 days. The patient complained of slight abdominal distension without abdominal pain and hematemesis. The patient denied dizziness, headache, or palpitation. Past medical history included a blood transfusion and a 20-year smoking history (1 pack/day). No hypertension, diabetes, heart disease, dyslipidemia, or excessive alcohol consumption was found. There was no personal or family history of cerebrovascular events.

On clinical examination, the patient was fully oriented with a blood pressure of 124/62 mmHg and a heart rate of 88 beats/min. Neurological and other clinical examinations were essentially normal. Routine blood tests showed a red blood cell count 3.0×10^{12} /L and hemoglobin 90.0 g/L. Other laboratory examinations, including urine analysis, blood glucose, serum lipid, and liver and kidney function, were normal. Fecal occult blood test was negative. Enhanced CT scan of upper abdomen showed multiple hepatic and renal cysts. Gastroscopy indicated duodenal bulbar ulcer.

Because the patient requested a detailed physical examination, an echocardiography, a carotid ultrasonography and a TCCS were also performed. The first two examinations were normal. On TCCS, B-mode images showed a clear delineation of hypoechoic butterfly-shaped midbrain, which was surrounded by hyperechoic subarachnoid cisterns, and hyperechoic lesser sphenoid wing (LSW) (Fig. 1A). On color mode, a discontinuous, dim color-coded signal was shown in the region of the left MCA (LMCA) stem (Fig. 1B). Moreover, the size

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of lumen seemed normal on power mode (Fig. 1C). The color signals of the right MCA (RMCA), bilateral ACA, and PCA were rich and continuous. Notably, an obvious branch coming from the left ACA (LACA) was unusually shown and joined tortuously in the color signal of the region of the LMCA stem (Fig. 1D). The proximal, mid, and distal velocity of the color signal in the region of the LMCA stem was 94 cm/s, 77 cm/s, and 45 cm/s, respectively, while the velocity of the LACA and left PCA (LPCA) was 173 cm/s and 96 cm/s. The velocity of the RMCA, right ACA (RACA), and right PCA (RPCA) was 199 cm/s, 136 cm/s, and 84 cm/s, respectively. The Doppler flow spectrum mentioned above was completely normal. The vertebral basilar arteries were uneventful. Further, the MRA indicated chronic LMCA occlusion with some light high signals around it as collateral circulations (Fig. 2A and B). The recurrent artery of Heubner from LACA was shown to extend to the head of the caudate nucleus and the lateral fissure of the cerebrum (Fig. 2C and D).

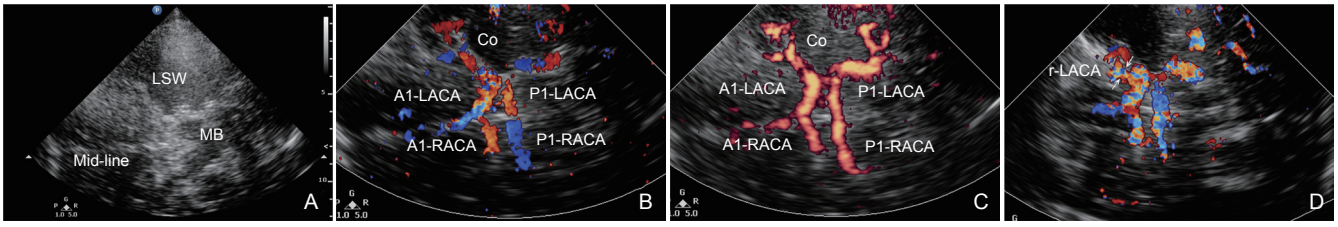

Figure 1 Representative images on TCCS. (A) A clear delineation of hypoechoic butterfly-shaped midbrain and hyperechoic lesser sphenoid wing (LSW) was shown on B mode. (B) Collaterals (Co) were shown as discontinuous, dim color-coded signals in the region of the LMCA stem and bilateral ACA and PCA were shown as rich and continuous color signals. (C) The size of Co, shown on power mode, appears to be a normal LMCA. (D) An obvious, rich color signal arose from the LACA, which was confirmed by MRA to be the recurrent artery of Heuber (r-LACA). Arrows pointed to the r-LACA.

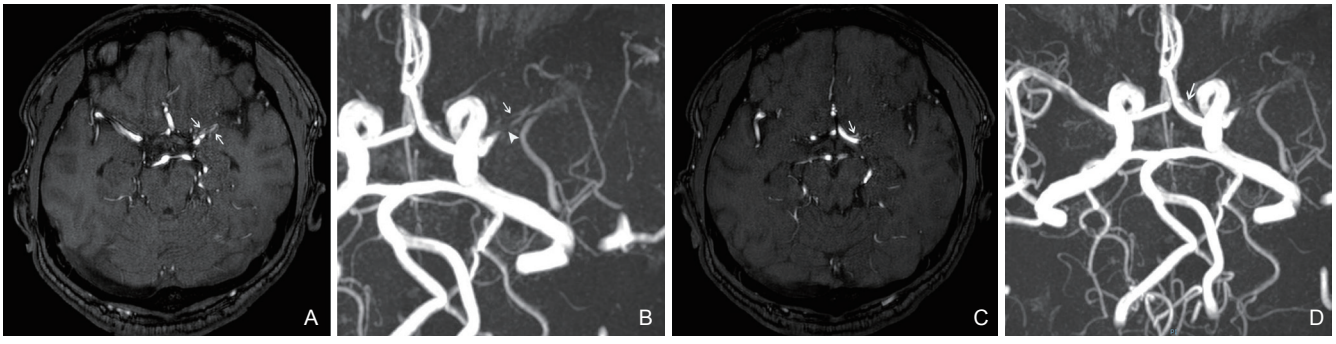

Figure 2 Representative images on MRA. (A and B) The signal of the LMCA stem was interrupted, and some light high signals were shown around it as collateral circulations. Arrows point to the collateral vessels. Arrowhead points to the site of the occluded LMCA stem. (C and D) The recurrent artery of Heubner from the LACA was shown to extend towards the region of the occluded LMCA stem. Arrows point to the recurrent artery.

Discussion

Unlike transcranial doppler sonography (TCD), which is restricted to Doppler spectrum, TCCS is used not only to monitor hemodynamic changes in the focal area but also acts as a roadmap to visualize the vascular anatomy [1], thus providing more information. However, whether TCCS could detect MCA stem occlusion accurately has been questionable. In general, MCA stem occlusion is defined as the absence of the MCA signal and the visibility of signals on the reference arteries, including the ipsilateral ACA, PCA, or contralateral MCA stem [2]. Whereas missing color signal of the MCA stem could result from various causes, including supplying artery stenosis, insufficient temporal bone window (TBW), arterial tortuosity or shifting, ethnicity, gender, and age, as well as occlusion [2].

The patient in this case was a 44-year-old Asian male with a normal carotid sonography. B-mode of TCCS showed clear contours of the LSW and midbrain, which represented his adequate TBW for visibility of LSW as reported to be an indicator of MCA detection [3]. However, in the region of the LMCA, we identified a discontinuous, dim blood flow that was almost equivalent to the diameter and length of a normal LMCA stem. In contrast, the blood flow in the LACA and LPCA as well as RMCA was prominent. When compared with the velocity in LACA and LPCA, the velocity throughout the region of LMCA was all reduced, although their Doppler spectrums were almost normal. No blunt or less pulsatile spectrum was found, although these spectrums often appear in vessels distal to severe stenosis or occlusion. Combined with the color width and spectral Doppler,

we basically eliminated the possibility of diagnosing a tortuous LMCA (for its focal velocity should be higher) or extremely severely stenotic LMCA (for its normal diameter and distal Doppler spectrum). Therefore, the most probable answer was LMCA stem occlusion. What we saw in the region of LMCA was not a true LMCA, however, but collateral establishment of new vessels, which was confirmed by the following MRA.

Leptomeningeal or pial collaterals (PCs) are known to be important for collateral flow in patients with MCA occlusion. PCs are preexisting direct anastomoses linking distal sections of the major cerebral arteries and providing arterial blood supply to the cortical surface [4, 5]. By joining MCA with the ipsilateral ACA and PCA, these anastomoses allow retrograde perfusion to the brain tissue supplied by an occluded MCA through PCs, which appears as accelerated blood flow velocity in the ipsilateral ACA and PCA on TCCS, leading to the reversed velocity gradient among three cerebral arteries. Many studies have focused on the role of PCs in predicting the outcome of arterial occlusion [4, 6, 7]. Unfortunately, in the case with this patient, TCCS did not display PCs directly but just brought up a hint of their formation by hemodynamic changes. MRA in this case did not present these PCs either.

However, the compensation of transcortical PCs was not enough specifically in the case of this patient. MCA occlusion would influence lenticulostriate arteries, deep branches of MCA, which supply the basal ganglia and internal capsule [8]. Thus some deep anastomoses between the MCA and the ACA or PCA would play a critical role, such as the anastomotic branch between the recurrent artery of Heubner arising from ACA and lenticulostriate arteries [9]. In this case, TCCS did show an obvious blood flow coming from the LACA and gradually joining with the color signal in the region of the occluded LMCA. The following MRA also confirmed the presence of the recurrent artery of Heubner, which is seldom seen under normal condition. Increased compensating blood supply probably made the recurrent artery of Heubner visible. Accordingly, we believed this blood signal from LACA on TCCS was probably the recurrent artery of Heuber.

Additionally, another important factor to keep the patient in this case intact could be new vessels along the occluded MCA trunk [9], shown as the color signal in the region of the LMCA. In MRA, these new collaterals were shown as small, light, high signals and were easy to identify. However, on TCCS, they possessed a similar appearance as MCA stem and were apt to be mistaken for the segments of a patent MCA, thus causing confusion. Therefore, just as missing color of MCA stem does not necessarily mean occlusion of the MCA, the presence of the color signal in the region of the MCA does not necessarily stand for a patent MCA. For a patient who has MCA stem occlusion but a good collateral establishment, color in the region of MCA would not disappear and care should be taken to avoid a false negative diagnosis.

Conclusion

With an adequate TBW, it is possible for TCCS to detect MCA occlusion and its various collaterals. It could, in fact, provide more information, including the diameter, length, and location, as well as hemodynamic changes of the blood flow in the region of the occluded MCA, which not only facilitates exclusion of various possibility and differential diagnosis but also contributes to the understanding of the disease evolution and predicts the outcome.

Conflict of Interest

The authors report no conflict of interest in this work.

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