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A Case of Endovascular Treatment for Acute Cerebral Infarction with Middle Cerebral Artery Fenestration

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Abstract

The fenestration of cerebrovascular vessels is a rare anatomic variant, it is usually detected incidentally during autopsies or cerebral angiography. Fenestration of the Middle Cerebral Artery (MCA) is even rarer of all variants. Previously reported cases of fenestration of the MCA with cerebral infarction are also rare. Moreover, when the infarction site is located in the fenestrated site, it brings challenges to the identification and recanalization of the infarction, which affects the treatment and prognosis of patients. We report a case of infarction of the fenestrated superior limb of the M1 segment of the MCA and the A1 segment of the Anterior Cerebral Artery (ACA) with endovascular treatment. This is not easy to diagnose before surgery, and it has a great influence on the disease progression and prognosis of patients. It is suggested that we should pay attention to identifying fenestration in clinical and improve clinical diagnosis and treatment.

Keywords: Middle cerebral artery; Fenestration; Cerebral Infarction

Introduction

Cerebral infarction is a major cause of death and long-term disability worldwide [1,2]. Currently, the main treatment for acute cerebral infarction are intravenous thrombolytic therapy with recombinant tissue Plasminogen Activator (rt-PA) in the time window [3] and endovascular therapy [4]. Fenestration of MCA is a rare congenital vascular variation, its detection and diagnosis is of great significance for clinical work in the context of acute cerebral infarction and other cerebrovascular diseases.

Illustrative Case

A 47-year-old male patient with weakness of the right limb for 6 h and no response. At 4:00 am, patients suddenly laughed when playing with mobile phone, and then the right limb was weak. Arrived at the emergency department by ambulance at 05:00 am. National Institutes of Health Stroke Scale (NIHSS) score was 12 points, Glasgow Coma Scale (GCS) score was 10 points, head Computed Tomography (CT) scan results showed no bleeding, left basal ganglia and pontine may be exist ischemic focus (Figure 1A, 1B). Electrocardiogram and blood examination showed no obvious abnormality. The patient was given emergency treatment of antiplatelet and lipid-lowering. The onset was less than 4.5 h, within the time window of emergency thrombolytic, the patient was given emergency thrombolytic therapy at 05:51 am. The patient's symptoms were not significantly improved after thrombolytic therapy, and the NIHSS score was 14 points one hour later. CT Perfusion (CTP) imaging suggested abnormal cerebral perfusion, which was processed by commercial software MIStar (Apollo Medical Imaging Technology, Melbourne, VIC, Australia), showing infarct-penumbra mismatch in the left MCA territory (Figure 1C). Combined with the onset time and imaging results of the patient, considering the large vascular lesions of the patient, there were indications for further interventional treatment, and emergency endovascular treatment was performed.

Patients were performed aortic arch and bilateral common carotid angiography, indicating occlusion of the A1 segment of the left ACA and suspected mural thrombosis of the M1 segment of the left MCA (Figure 2A), and endovascular treatment was performed. Microcatheter lined with micro-guide wire was sent to M2 segment of left MCA. Microcatheter angiography indicated that the microcatheter was in the true vascular lumen (Figure 2B). The 4 mm × 20 mm Solitaire FR stent (Medtronic, Irvine, CA) was sent along the microcatheter to M1 segment of left MCA (Figure 2C). The retraction microcatheter successfully opens the stent, and the blood flow in the

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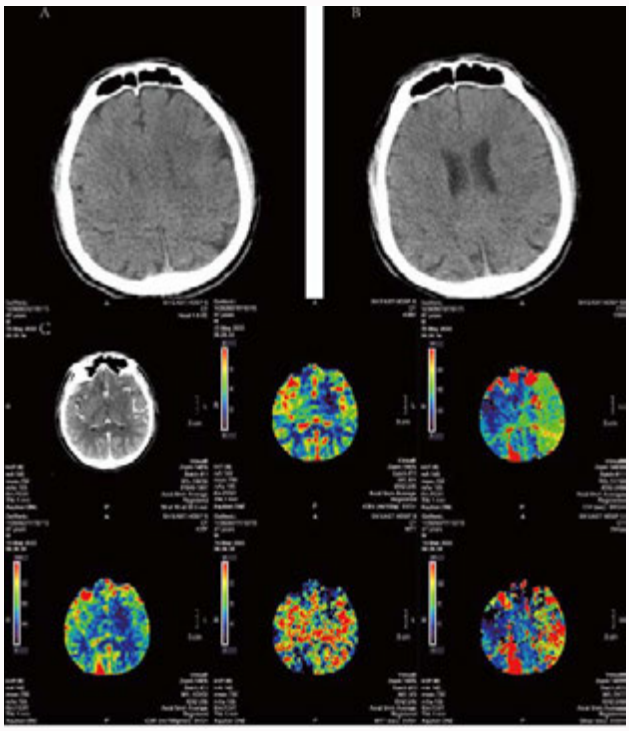

Figure 1: CT and CTP imaging before surgery. A) Non-enhanced Computed Tomography (CT) scan of the head (a) showing ischemic focus may exist in the left basal ganglia. B) The same with A. C) CT perfusion imaging showed abnormal blood flow and perfusion in the left basal ganglia.

Figure 2: Digital subtraction angiography at surgery. A) Digital subtraction angiography showing a thrombus attached to the wall of the M1 middle cerebral artery, and A1 of anterior cerebral artery infarcted; B) The micro-guidewire was delivered to the M2 segment of the left middle cerebral artery; C) The Solitaire FR stent was delivered along the microcatheter into the M1 segment of the left middle cerebral artery; D) After complete reperfusion, a fenestration of the M1 segment of the middle cerebral artery where the thrombus was initially located was confirmed, and A1 of anterior cerebral artery also restores blood flow.

stent and the distal part of the lesion was restored by re-examination and angiography, with thrombus shadow in A1 segment of the left ACA and M1 segment of the left MCA. After 5 min of placement, the intermediate catheter was sent along the microcatheter to the bifurcation between left ACA and MCA. Solitaire stent thrombolysis was performed once with negative pressure assisted suction of the intermediate catheter. Re-examination and angiography showed that the A1 segment of the left ACA had restored blood flow, while the M1 segment of the MCA had a fenestration. The M1 segment and the distal part had restored blood flow (Figure 2D), and Thrombolysis in Cerebral Infarction scale 3 flow restoration was achieved, and no contrast agent spilt. Postoperative Dyna CT showed no bleeding.

At first day of postoperative, the patient's consciousness was restored, limb weakness was significantly improved, aphasia was improved, and articulation was also slightly impaired. NIHSS score was 5. CT examination indicated the possibility of hemorrhage in the left basal ganglia region (Figure 3A, 3B).

The sixth day of hospitalization, the patient's consciousness and speech were clear. The right nasolabial fold was shallower, and the tongue was extended to the right. Muscle tone of limbs was normal, muscle strength of left limbs was grade I, muscle strength of right limbs was grade I. Tendon reflex in extremities was positive (++), and the right Babinski sign was positive (+). Re-examination of Magnetic Resonance Imaging (MRI) (Figure 3C, 3D) revealed cerebral hemorrhage in the left basal ganglia region and cerebral infarction in the left occipito-parietal lobe. NIHSS score was 5, and modified Rankin Scale (mRS) score was 2, discharged from hospital.

Discussion

Cerebrovascular fenestration is a disease caused by congenital abnormal vascular development, mainly manifested by the localized repetition of blood vessels. It is characterized by a normal starting and running position of cerebral artery, bifurcated or double-branched, each branch has its own endothelial and muscular layer, and has the common adventitia [5]. The most common sites of these fenestrations are located in the anterior communication artery or basilar artery region [6-8], and the MCA is less common. It is usually detected at autopsy [9] or angiography [10], the incidence was 16% at autopsy or 12% at angiography. Although they are considered benign, many reports have reported their association with vascular abnormalities such as aneurysms, to a lesser extent, with ischemic and bleeding complications [11].

Previous studies have reported few cases of MCA fenestration with infarction. Jeong [12] reported 5 cases of cerebral ischemia related to the fenestration of the MCA, and the change of hemodynamics at fenestration could lead to atherosclerosis. In addition, the diameter difference between the two limbs may cause a change in flow rate, resulting in slower blood flow in the limb with smaller diameter, thereby increasing the risk of thrombosis. Due to branching and flow separation, the side wall on the fenestrated side is more prone to low shear, eddy current and flow reversal [13]. The interference of local hemodynamics by fenestration may be the cause of cerebral ischemia. Pleş [14] also reported a case of cerebral ischemia caused by reduced blood flow due to fenestration. At the same time, these 5 patients all had one or more of the risk factors for cerebrovascular disease such as hypertension, diabetes, hyperlipidemia, smoking or drinking history, which also suggested that the interaction between vascular risk factors and fenestration might aggravate vascular injury. The patient reported in this study had a history of smoking, which

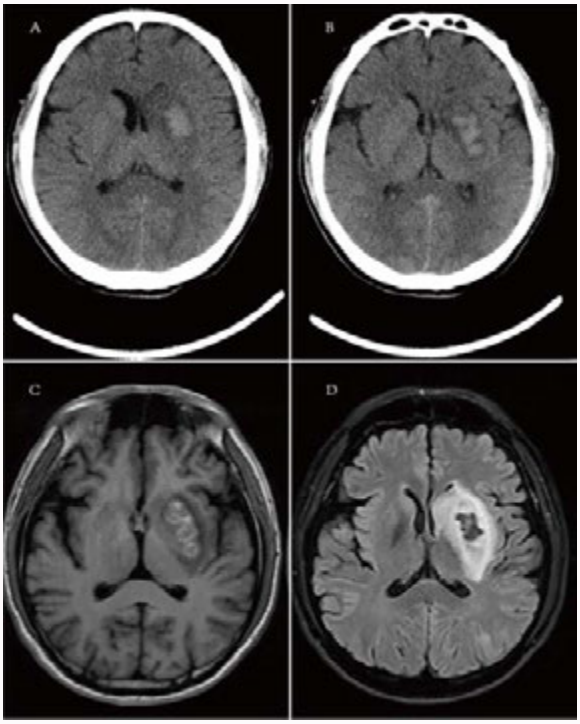

Figure 3: CT imaging and MRI of one day after surgery. A, B) CT imaging suggested there was possible cerebral hemorrhage in the left basal ganglia region at one day after surgery; C) T1 flair imaging of Magnetic Resonance Imaging (MRI) analysis. D) T2 flair imaging of MRI analysis. C and D showed left basal ganglia cerebral hemorrhage and left occipital parietal subcortical cerebral infarction at five days after surgery.

was a risk factor for vascular injury. However, in some reported cases, there were no vascular risk factors or other diseases, suggesting that fenestration itself may also be the cause of cryptogenic cerebral infarction [15-17].

At the same time, the current mechanism linking fenestration with stroke is only speculative, and computerized hemodynamic models will be needed in the future to solve this problem in the future.

The patient presented with A1 of the ACA infarction accompanied by fenestrated superior limb infarction in M1 of MCA. The patient's symptoms and imaging examination suggested the possibility of cerebral infarction. Due to it is in the time window of 4.5 h, thrombolytic therapy was immediately performed, but the symptoms did not improve significantly after thrombolytic therapy. Combined the time of onset with imaging of the patient, considering the lesion of large vessels, and endovascular therapy was performed. Before vascular treatment, fenestration was not detected, and the possibility of mural thrombosis was considered at the beginning of Digital Subtraction Angiography (DSA). However, the patient had severe clinical symptoms, hemiplegia of the right limb, which did not conform to the image, so this possibility was ruled out. Considering the possibility of dissection or vascular fenestration. After the thrombus was removed by endovascular treatment, the superior limb was recanalized, which showed fenestration of M1 segment of MCA. Fenestrated superior limb is the main blood supply branch of the Lenticulostriate Arteries (LSAs), which causes ischemia in the basal ganglia region after infarction, causing obvious clinical symptoms. After thrombectomy, the blood flow of M1 segment was restored, and the blood supply of LASs were restored, and the symptoms were significantly relieved after thrombectomy. MCA fenestration and MCA dissection must be distinguished during diagnosis and treatment to prevent further inappropriate treatment.

Fenestration of MCA combined with cerebral infarction are rare and difficult to diagnose clinically, which suggests that we should consider this rare vascular variation in clinical work, improve the diagnosis rate by combining clinical symptoms and imaging examination, and provide timely and accurate treatment. Currently, there is no conclusion on the treatment of cerebral artery fenestration with cerebral infarction. In this case, the patient was in the acute stage, and received thrombolytic therapy, intravascular thrombectomy and conventional treatment, and the patient recovered well. In the non-acute stage, conventional treatment was used, including antiplatelet therapy and anticoagulant therapy [18], there were no recurrent symptoms of cerebral infarction or transient ischemic attack during the follow-up period.

Conclusion

This case gives us some enlightenment that we should pay attention to these rare vascular mutations in clinical, because the risk of vascular injury is very high in the fenestrated intravascular operation, and clinical workers must be aware of this. At the same time, these variations may be the cause of cryptogenic cerebral infarction, which give us some ideas to improve our clinical diagnosis. It is also necessary to further combine imaging methods to improve the diagnosis and treatment level and avoid potential complications and unnecessary treatment.

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