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Case Report

Mechanical Thrombectomy Using a Large Dual-Layer Stent Retriever for Near-Occlusion of the Common Carotid Bifurcation Caused by a Giant Free-Floating Thrombus

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Objective: We report a case of near-occlusion of the common carotid bifurcation caused by a giant free-floating thrombus (FFT) successfully treated with mechanical thrombectomy using a large dual-layer stent retriever.
Case Presentation: A 51-year-old man presented to our hospital with dysarthria, right hemiparalysis, and paresthesia. MRI revealed an acute infarction of the left cortical watershed zone, and MRA revealed decreased signals in the left common carotid bifurcation. Carotid ultrasonography demonstrated a giant FFT in the left common carotid bifurcation. Angiography revealed a giant thrombus extending from the left common carotid artery (CCA) to the internal carotid artery (ICA) and the external carotid artery. As direct aspiration from both a balloon-guided catheter (BGC) and an aspiration catheter (AC) was ineffective, we deployed a large dual-layer stent retriever from the ICA to the CCA with an AC-connected aspiration pump and retrieved it under manual aspiration through the BGC. The giant thrombus was successfully removed, and complete recanalization was achieved without distal embolisms.
Conclusion: Although there is no established treatment for giant thrombi in the carotid artery, mechanical thrombectomy using a large dual-layer stent retriever may be an effective treatment option.

Keywords mechanical thrombectomy, large dual-layer stent retriever, near-occlusion of the common carotid bifurcation, giant free-floating thrombus

Introduction

A giant free-floating thrombus (FFT) that may occlude large vessels such as the common carotid artery (CCA) is a rare etiology of ischemic stroke and can cause extensive cerebral infarction and serious sequelae. The complete retrieval of giant thrombi using conventional mechanical thrombectomy techniques is difficult because of their size and instability. We report a case of near-occlusion of the common carotid bifurcation caused by a giant FFT that was successfully treated with mechanical thrombectomy using a large double-layer stent retriever, EmboTrap III (Johnson & Johnson, New Brunswick, NJ, USA).

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Case Presentation

A 51-year-old man presented to our hospital with dysarthria, right hemiparalysis, and paresthesia. He had a medical history of hyperthyroidism but had self-interrupted oral medication.

On arrival at our hospital, his blood pressure was 142/71 mmHg and his heart rate was 102 beats/min (irregular). Electrocardiography showed atrial fibrillation. The Glasgow Coma Scale was 14 (E4V4M6). He had mild dysarthria and moderate right upper and lower extremity paralysis with a manual muscle test score of 3 and paresthesia of

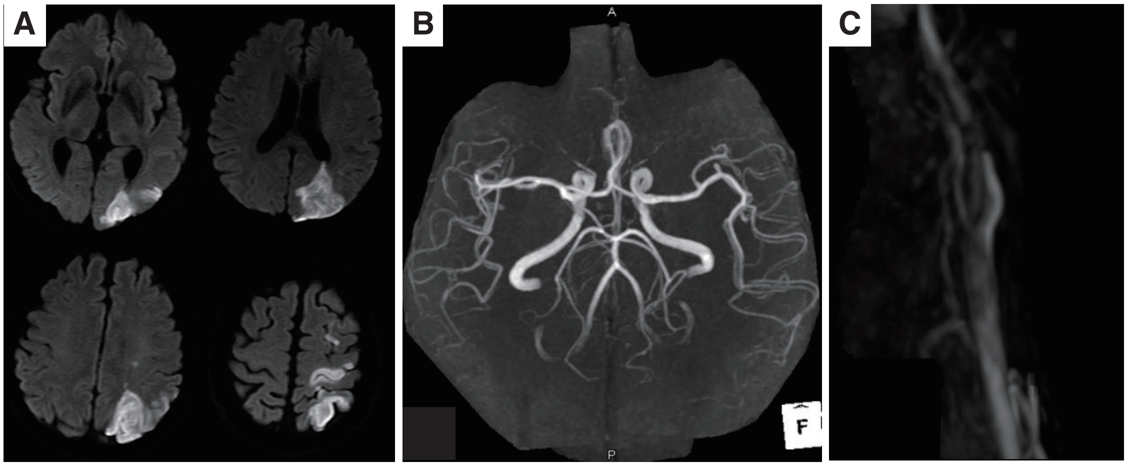

Fig. 1 Images on admission. (**A**) Axial diffusion-weighted images showed acute cerebral infarction in the left cerebral cortical watershed zone. (**B**) Cranial MRA showed no obvious signal deficits. (**C**) Carotid MRA showed a signal deficit in the left common carotid bifurcation.

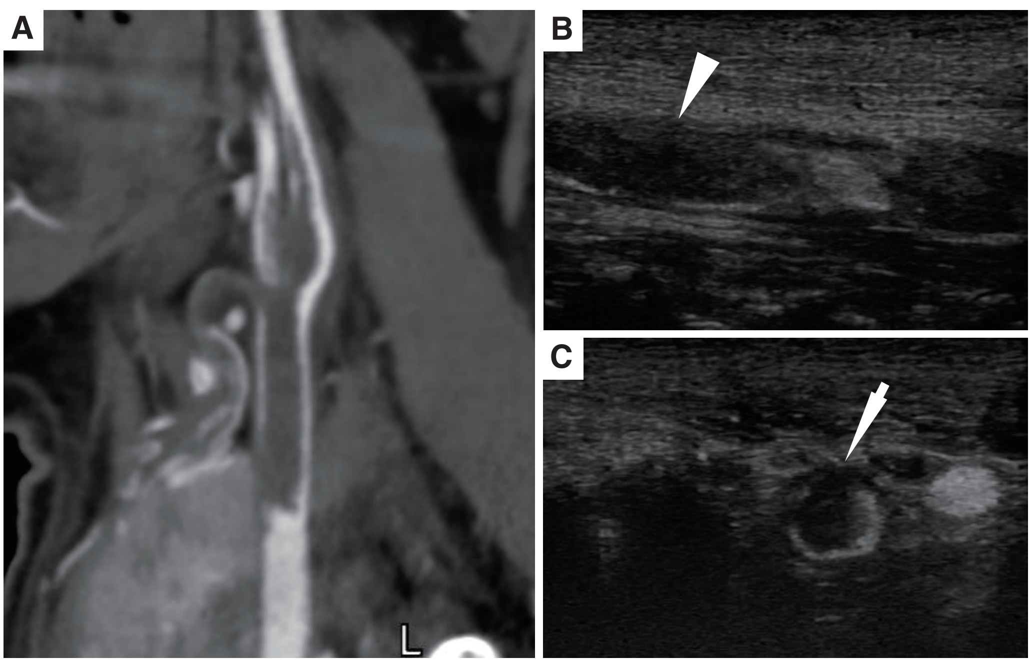

Fig. 2 Images on admission. (**A**) CTA revealed a contrast deficit in the left common carotid bifurcation. (**B** and **C**) Short and long axis views of carotid ultrasonography demonstrated a mobile hypoechoic lesion (arrow and arrowhead).

the right upper and lower extremities with a National Institutes of Health Stroke Scale (NIHSS) score of 6.

MRI showed acute cerebral infarction in the left cerebral cortical watershed zone on diffusion-weighted images (**Fig. 1A**), and MRA showed a signal deficit in the left common carotid bifurcation with patent main cerebral arteries (**Fig. 1B** and **1C**). A contrast defect in the left common carotid bifurcation was observed on CTA (**Fig. 2A**). Carotid ultrasonography revealed a mobile hypoechoic lesion (**Fig. 2B** and **2C**). We diagnosed a giant FFT in the left common carotid bifurcation and decided to perform a mechanical thrombectomy to ameliorate the risk of distal embolization.

Mechanical thrombectomy was performed under local anesthesia. A 9-Fr sheath was inserted into the right femoral artery. Systemic heparinization was not performed. A 9-Fr Optimo (Tokai Medical Products, Aichi, Japan) was guided coaxially into the left CCA using a 5.5-Fr SEL-B (Medikit, Tokyo, Japan). Left CCA was performed after blocking the blood flow in the left CCA with the Optimo to

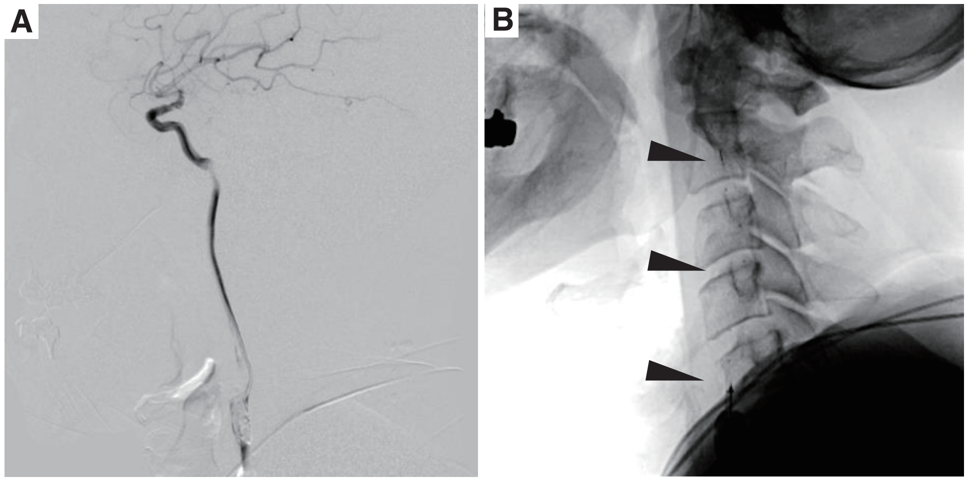

Fig. 3 Mechanical thrombectomy. (**A**) Lateral view on left common carotid angiography. As in the CTA, there is a contrast defect suggestive of a giant thrombus in the left common carotid bifurcation. (**B**) An EmboTrap III 6.5 × 45 mm (Johnson & Johnson) was deployed from the cervical ICA to the CCA (arrowhead). ICA: internal carotid artery; CCA: common carotid artery

prevent distal embolization. Angiography revealed a giant thrombus extending from the CCA to the origin of the internal carotid artery (ICA) and external carotid artery (ECA). Anterograde blood flow from the CCA to the ICA remained; however, the ECA was occluded (**Fig. 3A**).

First, we attempted to retrieve the thrombus by continuous direct aspiration from the Optimo while blocking the anterograde blood flow of the CCA; however, the thrombus was not aspirated. Thereafter, a large-bore aspiration catheter (AC), Penumbra ACE 68 (Penumbra, Alameda, CA, USA), was guided proximal to the thrombus for direct aspiration; however, this method also did not work because of the difference in diameter between the CCA and the AC.

We then decided to use a large dual-layer stent retriever, EmboTrap III 6.5 × 45 mm (Johnson & Johnson). Using a Penumbra ACE 68, a Phenom 21 (Medtronic, Minneapolis, MN, USA), and a CHIKAI 0.014-inch 200 cm (ASAHI INTECC, Aichi, Japan), the CHIKAI and Phenom 21 were advanced across the lesion. The Penumbra ACE 68 was placed in the CCA. An EmboTrap III was deployed across the thrombus from the distal cervical ICA to the CCA (**Fig. 3B**). The EmboTrap III and Penumbra ACE 68 were collected into the Optimo in unison, and continuous aspiration was performed with the Penumbra ACE 68 connected to an aspiration pump system under manual aspiration through the Optimo.

On this occasion, the Optimo was occluded by the thrombus and was temporarily removed from the body while manual aspiration was continued. When the Optimo passed through the sheath, aspiration was also applied from the sheath. Angiography confirmed the complete recanalization of the CCA to the ICA and the ECA without distal embolisms (**Fig. 4A** and **4B**). A large amount of thrombus was retrieved from the EmboTrap III, Penumbra ACE 68, and Optimo (**Fig. 4C**).

Pathological examination of the retrieved thrombus revealed that it was a fibrin thrombus containing red blood cells and a few neutrophils, with no evidence of plaque, calcification, fibrous tissue, malignancy, bacteria, or cholesterin (**Fig. 5A** and **5B**).

Postoperative carotid ultrasonography showed no evidence suggesting endothelial injury, erosion, or atherosclerotic plaque. In addition, transthoracic echocardiography showed no evidence of intracardiac thrombi or valvular heart disease. Because paroxysmal atrial fibrillation was confirmed by electrocardiography at presentation and after admission, edoxaban was administered on the third postoperative day, and no recurrent stroke or hemorrhagic complications were observed thereafter.

The dysarthria and right upper and lower extremity paralysis gradually improved postoperatively, with an NIHSS score of 4 on the seventh postoperative day. Although mild sensory paresthesia persisted, the patient could independently walk and perform activities of daily living after rehabilitation. The patient was discharged with a modified Rankin Scale score of 1 on the 81st postoperative day.

Discussion

FFT of the carotid artery is a rare condition, occurring in only 0.4% of ischemic stroke cases.[1] The etiology of FFT involves various diseases and background factors, such as plaque rupture of atherosclerosis,[2] a hypercoagulable state,[3]

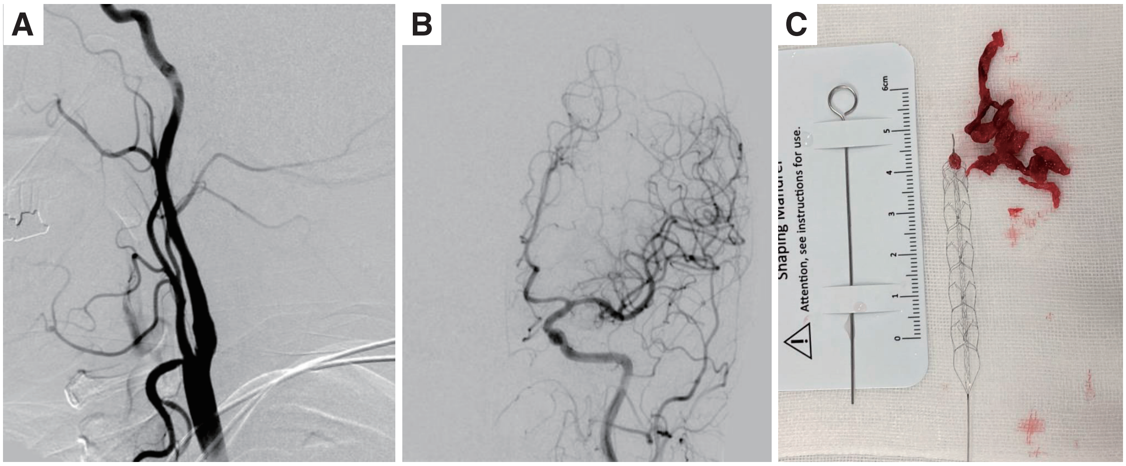

Fig. 4 Angiography and photograph after thrombectomy. (**A**) Lateral view of left common carotid angiography showed complete recanalization without residual thrombus. (**B**) Frontal view of left common carotid angiography showed no avascular area or distal embolisms. (**C**) A large amount of the thrombus was retrieved.

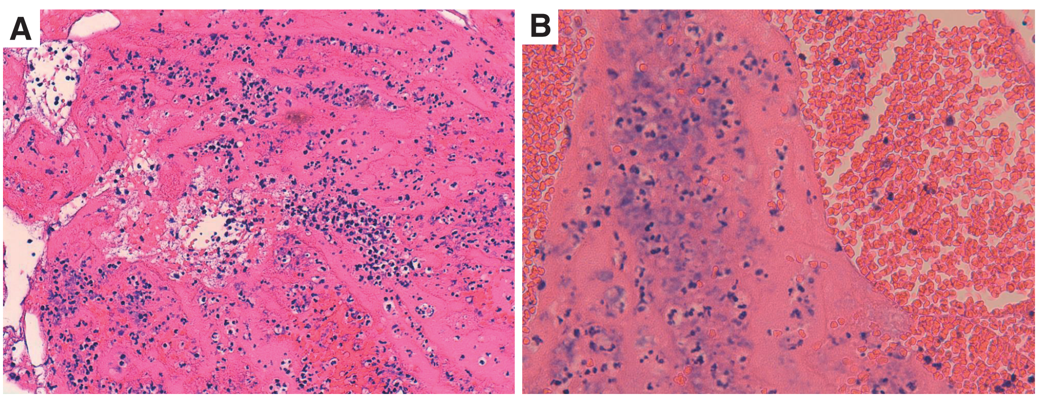

Fig. 5 Pathology of the thrombus (**A**: 200× magnification; **B**: 400× magnification). The thrombus was fibrin based, with a mixture of red blood cells and a few neutrophils.

iron deficiency anemia,[4] essential thrombocytopenia,[4] and drugs (steroids).[5] In the case of FFT caused by atherosclerosis, the common site of occurrence is the origin of the ICA; however, there have been reports of FFT from other causes, occurring in the CCA,[6] the ICA siphon,[7] and other sites.

Regardless of the site, FFT is caused by anatomical factors such as the bifurcation and bending of the artery, combined with inflammation and abnormal coagulation. In this case, since there was no atherosclerosis or endothelial injury in the carotid artery on carotid ultrasonography; no coagulation abnormality on blood testing; and no calcification, fibrous tissue, atheromatous plaque, or tumor on pathological examination of the thrombus, the etiology was presumed to be thromboembolism due to nonvalvular atrial fibrillation with secondary thrombus formation in the carotid artery.

The frequency of FFT without stenotic lesions, as in this case, is not high (0.18%) among patients with ischemic stroke due to FFT[8]; however, >90% of patients with FFT have neurological symptoms and require prompt and appropriate treatment.[3]

Regarding the treatment of FFT, the efficacy of medical, surgical (carotid endarterectomy), and endovascular treatments has been reported, although it is unclear which treatment is superior. Medical therapy may include anticoagulants, antiplatelets, or a combination of both.

Postoperatively, in this case, anticoagulation with edoxaban was undertaken according to secondary prevention therapy for cardiogenic cerebral embolism. Although the optimal timing for initiating anticoagulation after acute ischemic stroke remains unclear, the “1-3-6-12-day rule” is known as the consensus opinion with graded increase in delay of anticoagulation according to neurological severity.[9] We followed this rule and started anticoagulation on the third postoperative day. Kimura et al. reported the new “1-2-3-4-day rule” for starting direct oral anticoagulants after ischemic stroke with atrial fibrillation.[10] According to this rule, the earlier initiation of anticoagulation may be considered.

Resolution of FFT without worsening neurological symptoms occurs in 86% of medically treated patients.[3] Nonetheless, recurrent thrombosis[11] or distal embolization of thrombi[12] has also been reported in these patients. In this case, distal embolization was highly likely because the thrombus was giant and had a large volume. Therefore, mechanical thrombectomy was performed.

With the advances of endovascular devices, more reports have shown the efficacy of endovascular therapy for FFT, especially mechanical thrombectomy. Several studies have reported mechanical thrombectomy using aspiration through a balloon-guided catheter (BGC)[13,14] or an AC,[15] with a stent retriever under distal protection[11] or two parallel stent retrievers.[16] As mentioned above, aspiration with a BGC or an AC was ineffective in this case; therefore, a combined technique with a stent retriever was chosen. EmboTrap III 6.5 × 45 mm is a stent retriever with the largest diameter usable in Japan. EmboTrap III is a unique stent retriever featuring a two-tiered inner channel and outer cage structure and a closed-end basket design that prevents distal embolization. The outer cage is designed to engage the clot with minimal maceration and pin it into the inner channel during retrieval.[17] This structure is considered advantageous for preventing distal embolization of easily fragmented clots and retrieving large clots at the bifurcation without dislodging.[18,19] In this case, not only the size of the EmboTrap III but also its structure may have been a factor in the complete retrieval of the giant thrombus without distal embolization.

Conclusions

Mechanical thrombectomy using a large dual-layer stent retriever, EmboTrap III, was effective for near-occlusion of the common carotid bifurcation caused by a giant FFT. The size and structure of EmboTrap III may be advantageous for the complete retrieval of giant thrombi without distal embolization.

Disclosure Statement

The authors declare no conflict of interest.

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