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Case Report

# A Case of Acute Embolic Occlusion of the Common Carotid Artery in Which a Giant Thrombus Was Retrieved Using the Parallel Stent Retriever Technique

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**Objective:** We report a case of embolic occlusion of the common carotid artery (CCA) in which a giant thrombus was retrieved using the parallel stent retriever technique.

**Case Presentation:** An 84-year-old woman without anticoagulant therapy despite a history of cardioembolic stroke presented to our hospital because of left hemiparesis after developing sudden vision loss in her right eye. Emergency angiography revealed a giant thrombus in the right CCA. After arresting flow in the CCA using a balloon-guided catheter (BGC), we deployed two stent retrievers in parallel from the internal carotid artery to the CCA, and slowly retrieved them simultaneously under manual aspiration through the BGC. As a result, complete recanalization was achieved.

**Conclusion:** Thrombi causing acute embolic occlusion of the CCA are often too large to be completely retrieved using conventional thrombectomy techniques. The parallel stent retriever technique may be effective in such cases.

**Keywords** ▶ giant thrombus, embolic occlusion of the common carotid artery, endovascular thrombectomy, cardiogenic embolism

## Introduction

Advances in devices for thrombectomy, such as stent retrievers and aspiration catheters, have led to established thrombectomy procedures for acute embolic occlusion of the anterior circulation system, increasing the recanalization rate.[1)] However, it is difficult to achieve recanalization using standard thrombectomy procedures in patients with giant thrombi that may occlude large vessels such as the common carotid artery (CCA) and brachiocephalic artery. Surgery or hybrid treatment consisting of surgery and endovascular treatment has been reported.[2–4)]

In this study, we report a patient in whom thrombectomy for a giant thrombus in the CCA using the parallel stent retriever technique with two Solitaire (Medtronic, Minneapolis, MN, USA) devices led to complete recanalization.

## Case Presentation

The patient was an 84-year-old woman with independent domestic activities of daily living (ADL). She had a history of cardiogenic cerebral embolism related to atrial fibrillation. She received edoxaban, but discontinued it before 2 months. The visual acuity of the right eye abruptly decreased and she consulted the Department of Ophthalmology of our hospital. Occlusion of the central retinal artery was suspected and treatment was performed. On the way home, she fell down. In addition, weakness of the left upper and lower limbs was noted after returning home. On the same day, she consulted our hospital again (8 hours and 43 min after the decline in vision).

On arrival, the blood pressure, pulse rate, and body temperature were 210/90 mmHg, 60/min (regular) (after pacemaker insertion), and 36.5°C, respectively. Concerning the

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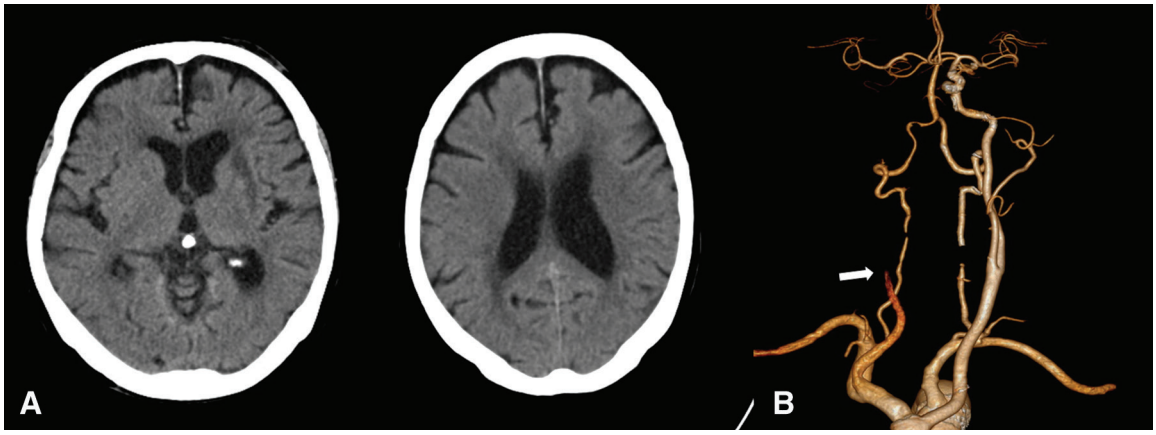


**Fig. 1** Imaging on arrival. (**A**) Axial section on plain CT. There was no early ischemic change. (**B**) Rearranged 3D image on CTA. There was a contrast defect involving the right CCA (white arrow) to ICA and ECA. The right MCA was visualized via the A-com. A-com: anterior communicating artery; CCA: common carotid artery; ECA: external carotid artery; ICA: internal carotid artery; MCA: middle cerebral artery

consciousness level, the Japan Coma Scale (JCS) score was I-2. The visual acuity of the right eye was evaluated as counting fingers. Left incomplete hemiplegia involving the face was observed. The National Institutes of Health Stroke Scale (NIHSS) score was 6.

Non-contrast head CT did not demonstrate early ischemic change (**Fig. 1A**). A contrast defect involving the right CCA to internal carotid artery (ICA) and external carotid artery (ECA) origin was observed on CTA. The right middle cerebral artery (MCA) was visualized via the anterior communicating artery (A-com) (**Fig. 1B**).

Thrombectomy was started 84 min after the second consultation. Under local anesthesia, a 9-Fr sheath (Medikit, Tokyo, Japan) was inserted into the right femoral artery and a 4-Fr sheath (Medikit) was inserted into the left femoral artery. Systemic heparinization was performed. A 4-Fr SY3 (Gadelius Medical, Tokyo, Japan) was placed in the left CCA for A-com-mediated angiography. Initially, the right MCA was visualized via the A-com on the left CCA angiography, but distal embolism occurred when guiding a 9-Fr Optimo (Tokai Medical Products, Aichi, Japan) into the right CCA, leading to occlusion at the terminal of the right ICA. Therefore, initially, intracranial thrombectomy was conducted. A Penumbra JET 7 (Penumbra, Alameda, CA, USA) was placed at the ICA siphon, and a Marksman (Medtronic, Minneapolis, MN, USA) and CHIKAI 0.014 inch 200 cm (ASAHI INTECC, Aichi, Japan) were guided beyond the site of occlusion. A Solitaire Platinum 6 × 40 mm (Medtronic) was deployed in the right M2 segment to the ICA. After elevating the JET 7 to the ICA terminal, the Solitaire was pulled into the JET 7 for thrombus retrieval, leading to recanalization of the ICA to MCA. Cervical thrombectomy was subsequently started.

Angiography through the Optimo placed in the right CCA revealed a giant thrombus involving the CCA to ICA and ECA origin. Occlusion of the ECA was observed and anterograde ICA blood flow was present, but contrast medium did not reach the intracranial ICA (**Fig. 2A**). Initially, right CCA blood flow was blocked with the Optimo, and angiography through the left CCA while aspirating from the right CCA was performed, but the right ICA was not retrogradely visualized. Subsequently, the JET 7, Marksman, and CHIKAI were guided beyond the thrombus in the right CCA to the ICA, and the JET 7 was placed before the petrous part of the ICA. The Solitaire Platinum 6 × 40 mm was deployed in the right M1 segment to the petrous part of the ICA, and angiography through the left CCA was performed while aspirating from the JET 7. The C2 or lower segments of the right ICA were retrogradely visualized (**Fig. 2B**). In addition, in this state, anterograde angiography through the right CCA confirmed that the thrombus was absent in the intracranial ICA where the stent was deployed and that it involved the CCA to cervical ICA alone (**Fig. 2C**). Subsequently, the Solitaire Platinum 6 × 40 mm, which was deployed in the intracranial ICA, was transiently resheathed and again deployed in the cervical ICA to CCA where the thrombus was present (**Fig. 3A**). However, there was no immediate flow restoration (IFR). Furthermore, the diameters of the carotid artery bifurcation and CCA were greater than the maximum diameter of the full deployed Solitaire; thrombus retrieval was considered difficult. The second Solitaire was deployed in parallel to the first one, which was deployed with the Marksman and CHIKAI, through its side (**Fig. 3B**).


**Fig. 2** Mechanical thrombectomy (1). (**A**) Lateral view on right common carotid arteriography. Occlusion of the ECA (arrowhead) was observed and anterograde ICA blood flow was present, but contrast medium did not reach the intracranial space (arrows). (**B**) Frontal view on retrograde angiography through the left CCA. The C2 or lower segments of the right ICA were retrogradely visualized (arrow). (**C**) Frontal view on right common carotid arteriography. There was no thrombus in the intracranial ICA. Cervical ICA to CCA translucency was noted, suggesting a thrombus (arrowheads). CCA: common carotid artery; ECA: external carotid artery; ICA: internal carotid artery

Immediately, IFR was confirmed (**Fig. 3C**). After 3 min, blood flow was blocked with the Optimo and aspiration was conducted. The two Solitaire devices were simultaneously retrieved. During the course, the Optimo was occluded with the thrombus and the Solitaire devices were unable to be pulled into the Optimo. Blood flow blockage was relieved, and the two Solitaire devices and Optimo were collected in union while continuing aspiration (**Fig. 3D**). Upon pulling them out of the sheath, aspiration was also conducted through the sheath. Subsequently, the sheath was occluded and exchanged for a new one while continuing aspiration. A large volume of thrombus was retrieved from the Solitaire, the Optimo (**Fig. 4C**), and the removed sheath (**Fig. 4D**). Angiography confirmed complete recanalization of the CCA to ICA (**Fig. 4A** and **4B**).

There was no perioperative complication. Left hemiplegia slightly reduced immediately after treatment and the NIHSS score after 24 hours was 2. Head CT the day after treatment demonstrated a minor infarcted focus of the right basal ganglia, but there was no hemorrhagic change. There was slight improvement in the visual acuity of the right eye in comparison with that before surgery; however, it did not improve past counting fingers. Due to persistent left paralysis, the patient was referred to a rehabilitation hospital with a modified Rankin Scale score of 3.

## Discussion

In the present case, the parallel stent retriever technique with two Solitaire Platinum 6 × 40 mm devices was effective for a giant thrombus involving the CCA to ICA origin. To date, no endovascular treatment for giant thrombi of the CCA using thrombectomy has been established. Only a few case reports have been published. Several studies reported thrombus retrieval by manual aspiration through a balloon guide catheter (BGC)[5–7] or through several passes with a stent retriever under distal filter protection.[8,9] On the other hand, another study stated that thrombus retrieval was difficult and that the procedure was completed by embolizing the cervical ICA using a coil to prevent distal embolism because collateral flow through A-com was favorable.[5] Aspiration through a BGC was conducted before the development of current devices for thrombectomy. This method is effective when a thrombus can be completely aspirated. However, in the case of intra catheter occlusion, it is necessary to remove it from the body once, and the distal region of the thrombus is not secured, so the thrombus may be crushed and distal embolism may occur. A method to promote several passes under distal filter protection is not covered by health insurance in Japan. Regarding the efficacy of a procedure to retrieve a thrombus by deploying two stent retrievers, a method to deploy two stents in the superior and inferior trunks to M1 segment for a thrombus at the MCA bifurcation and simultaneously collect them,[10–13] and a method to shift two stents back and forth or deploy them in parallel for retrieval of a long, large thrombus involving the ICA to MCA[14] was previously reported. However, to the best of our knowledge, no study has reported retrieval of a giant thrombus involving the CCA to ICA origin, as observed in our patient. In the present case, we considered

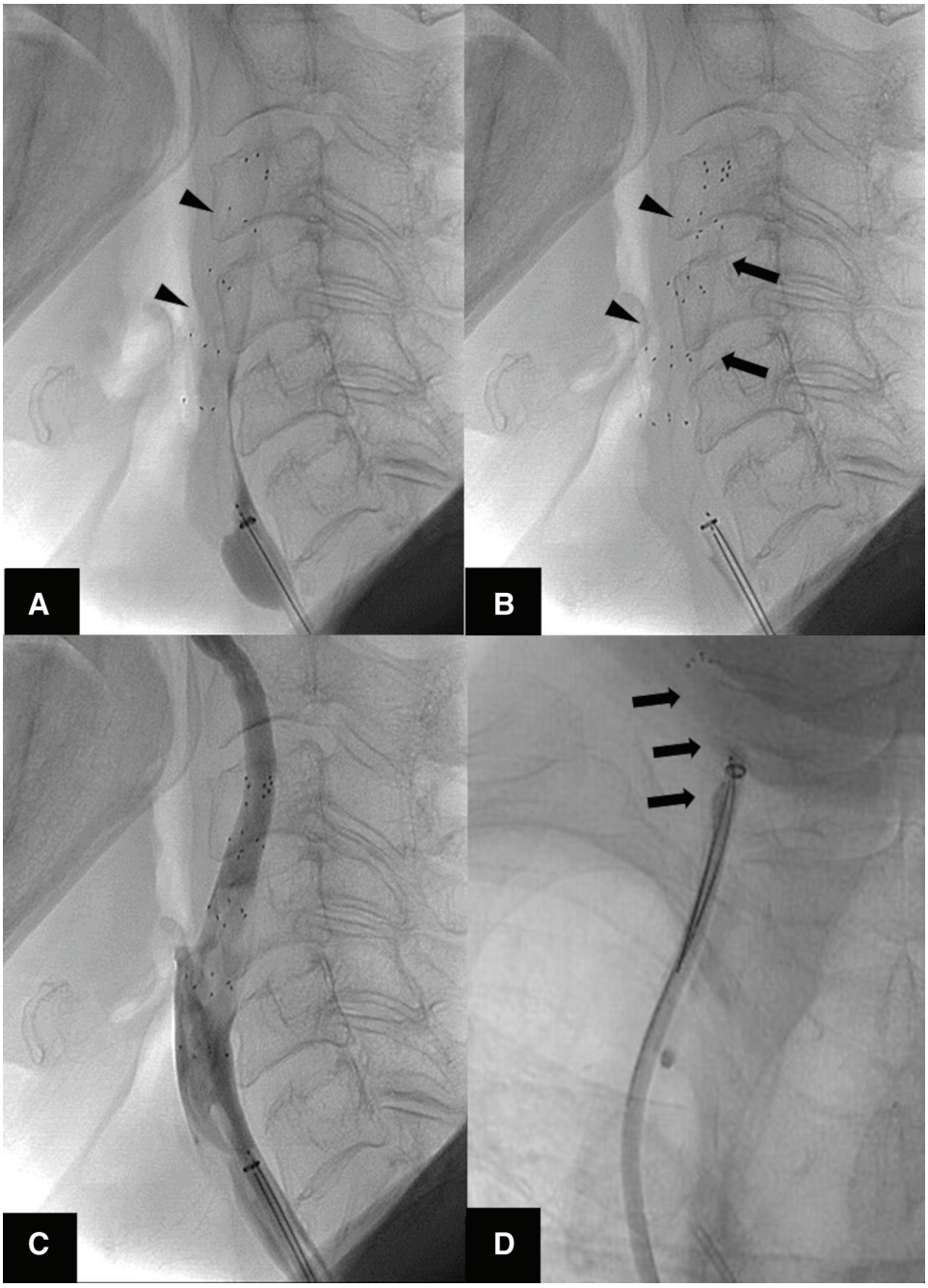


**Fig. 3** Mechanical thrombectomy (2). (**A**) A Solitaire was deployed in the proximal ICA to CCA (arrowhead). (**B**) The second Solitaire (arrows) was deployed in parallel to the first one (arrowhead) in the proximal ICA to CCA. (**C**) After deploying two Solitaire devices, immediate flow restoration was observed. (**D**) While conducting manual aspiration with the two Solitaire devices and Optimo in union, the thrombus was retrieved (arrow). CCA: common carotid artery; ICA: internal carotid artery

it impossible to completely aspirate the giant thrombus using a BGC alone. Furthermore, the risk of distal embolism related to thrombus crushing on retrieval was considered high. Initially, a Solitaire was deployed to secure a distal area, but the diameters of the carotid artery bifurcation and CCA were greater than the maximum diameter of the full deployed Solitaire; therefore, we expected the thrombus not to be completely captured in the stent. Lesion crossing was again conducted through the side of the stent. The thrombus was sandwiched with two stents by deploying the second stent in parallel to the first one. Under blood flow blockage, two stents were pulled into a BGC and stopped when there was resistance. After that, the two stents and the BGC involving the thrombus was slowly retrieved

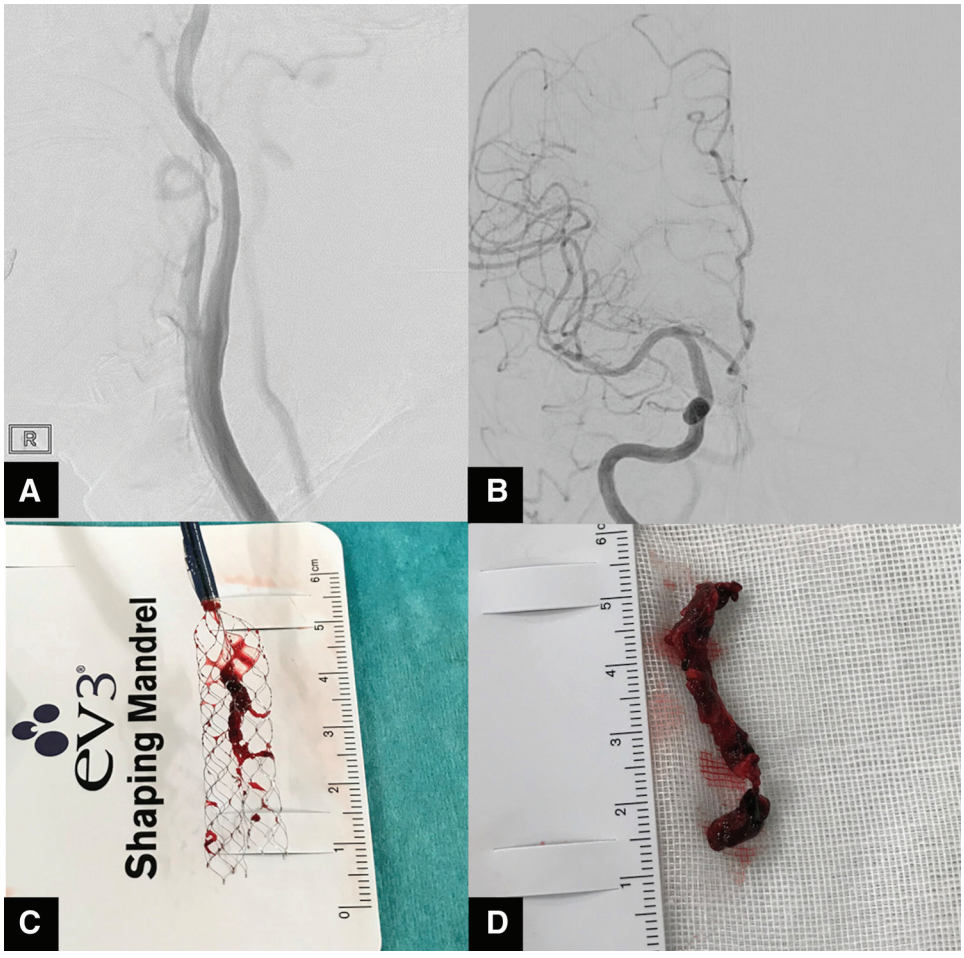


**Fig. 4** Angiography after recanalization and thrombus. (**A**) Lateral view on right common carotid arteriography after thrombus retrieval. Recanalization of the cervical CCA, ICA, and ECA was achieved. (**B**) Frontal view on right common carotid arteriography. Recanalization of the intracranial ICA and MCA was achieved. (**C**) The thrombus was sandwiched between two Solitaire devices. (**D**) A large volume of thrombus was retrieved from the sheath. CCA: common carotid artery; ECA: external carotid artery; ICA: internal carotid artery; MCA: middle cerebral artery

simultaneously under manual aspiration through the BGC. In addition, manual aspiration through a sheath was added during removal. The sheath was occluded with the giant thrombus, so it was carefully exchanged with guidewire while conducting manual aspiration. In the present case, the entire thrombus was captured with two stent retrievers and the proximal end of the thrombus was aspirated and captured with a catheter, facilitating thrombus retrieval as a mass. This complex procedure is an application of a method termed Solumbra[15] or aspiration-retriever technique for stroke (ARTS)[16] that is adopted in the intracranial artery occlusion. It may be an option for giant thrombi of the proximal carotid artery, as demonstrated in the present case. Furthermore, when retrieving a thrombus and BGC in union from body the thrombus may be scattered, inducing distal embolism of limbs and abdominal blood vessels. Therefore, the presence of obstruction of organ/peripheral limb vessels should be carefully examined after surgery based on hematological and physical findings, even with continuous manual aspiration. In the present case, there was no finding suggesting distal embolism after treatment.

Furthermore, in the present case, acute embolic occlusion of the CCA was noted and an etiological factor was atrial fibrillation. However, ocular symptoms developed prior to cerebral hemisphere symptoms. Concerning fundus findings on consultation with the Department of Ophthalmology, a cherry-red spot was observed and occlusion of the central retinal artery was suspected. Retinal artery occlusion (RAO), consisting of occlusion of the central and branching retinal arteries, is associated with carotid artery or cardiac embolism. One study reported that diffusion-weighted MRI confirmed cerebral infarction in 25% of patients with RAO within 7 days

after onset and that heart disease was present as the source of embolism in 31% of these patients.[17] According to a large-scale study involving 4871 patients, cerebral infarction with intracranial artery occlusion occurred within 30 days after the onset of RAO in approximately 4% of the patients, approximately 3% were readmitted with cerebral embolism, and approximately 5% were readmitted with atrial fibrillation.[18] In the present case, two hypotheses were proposed: cervical occlusion related to a giant thrombus led to embolism of the retinal artery through partial dispersion, gradually reducing the right cerebral hemisphere perfusion pressure; or a heart-derived thrombus initially developed, inducing embolism of the retinal artery, followed by cervical embolism related to a giant thrombus. Cardiac embolism is observed in some patients with RAO and the possibility of concomitant major cerebral artery occlusion in the acute stage must be considered. In RAO patients, heart disease as the source of embolism must be investigated in addition to carotid artery stenosis in cooperation with the Department of Ophthalmology.

## Conclusion

The parallel stent retriever technique in which two stents are deployed in parallel for thrombus retrieval was effective for a giant thrombus involving the CCA to ICA origin. For giant thrombus retrieval, continuous aspiration through a guiding catheter or sheath is important, in addition to proximal blood flow blockage. Attention must be paid to distal embolism on retrieval. Furthermore, physicians should be aware of RAO with major cerebral artery occlusion, as demonstrated in the present case.

## Disclosure Statement

The authors declare no conflict of interest.

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