



# Repeated Re-occlusion during the Procedure of Mechanical Thrombectomy with Retrograde Approach for Tandem Occlusion Including T Occlusion: A Case Report

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**Objective:** Two mechanical thrombectomy techniques are proposed for tandem occlusion of the anterior circulation: treating the extracranial carotid artery lesion first via an antegrade approach and treating the intracranial lesion first via a retrograde approach. Previous reports show that the retrograde approach has a shorter reperfusion time and a better prognosis, but re-occlusion of the intracranial lesion after recanalization may occur. We describe a case of tandem occlusion with repeated intracranial occlusions for mechanical thrombectomy using the retrograde approach and discuss possible countermeasures.

**Case Presentation:** A 94-year-old woman presented with acute cerebral ischemia due to tandem carotid T occlusion of the left internal carotid artery (ICA) and severe stenosis of the cervical carotid artery. Mechanical thrombectomy via a retrograde approach was performed using a stent retriever, resulting in complete recanalization of the anterior circulation through the ICA after 1 pass. The thrombus dispersed distally from the cervical artery and re-occluded the M1 twice, requiring thrombus re-retrieval each time.

**Conclusion:** The retrograde approach to tandem occlusion can result in repeated re-occlusion after recanalization of the intracranial lesion. Thrombi in cervical carotid lesions are usually fragile. Prior thrombus aspiration from the balloon guiding catheter at the carotid lesion may prevent re-occlusion after recanalization of the intracranial lesion without sacrificing the time advantage of early recanalization via the retrograde approach.

**Keywords** ▶ tandem occlusion, carotid T occlusion, mechanical thrombectomy, retrograde approach, prior aspiration technique

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## Introduction

Tandem occlusion of the anterior circulation is defined as acute occlusions with severe stenosis or an occlusive lesion in the cervical carotid artery, resulting in acute occlusion of the large intracranial vessels. Two mechanical thrombectomy techniques for tandem occlusion have been proposed: an antegrade approach, treating the extracranial cervical carotid lesion first with percutaneous transluminal angioplasty (PTA) and a retrograde approach, treating the intracranial lesions first with mechanical thrombectomy.

The retrograde approach is preferred at our hospital because the intracranial circulation can be reperfused early with a balloon guiding catheter (BGC), which can pass through the cervical carotid lesion. However, this approach

may not be better. Ipsilateral angiography is required to evaluate recanalization after thrombus retrieval before treating the extracranial lesion in the first approach. Intraoperative distal embolization from the extracranial lesion to intracranial vessels may occur, but specific examples have not been reported. Herein, we report a case of tandem occlusion, including intracranial T occlusion that was repeatedly re-occluded during the mechanical thrombectomy, using the retrograde approach. Possible preventive measures are discussed.

## Case Presentation

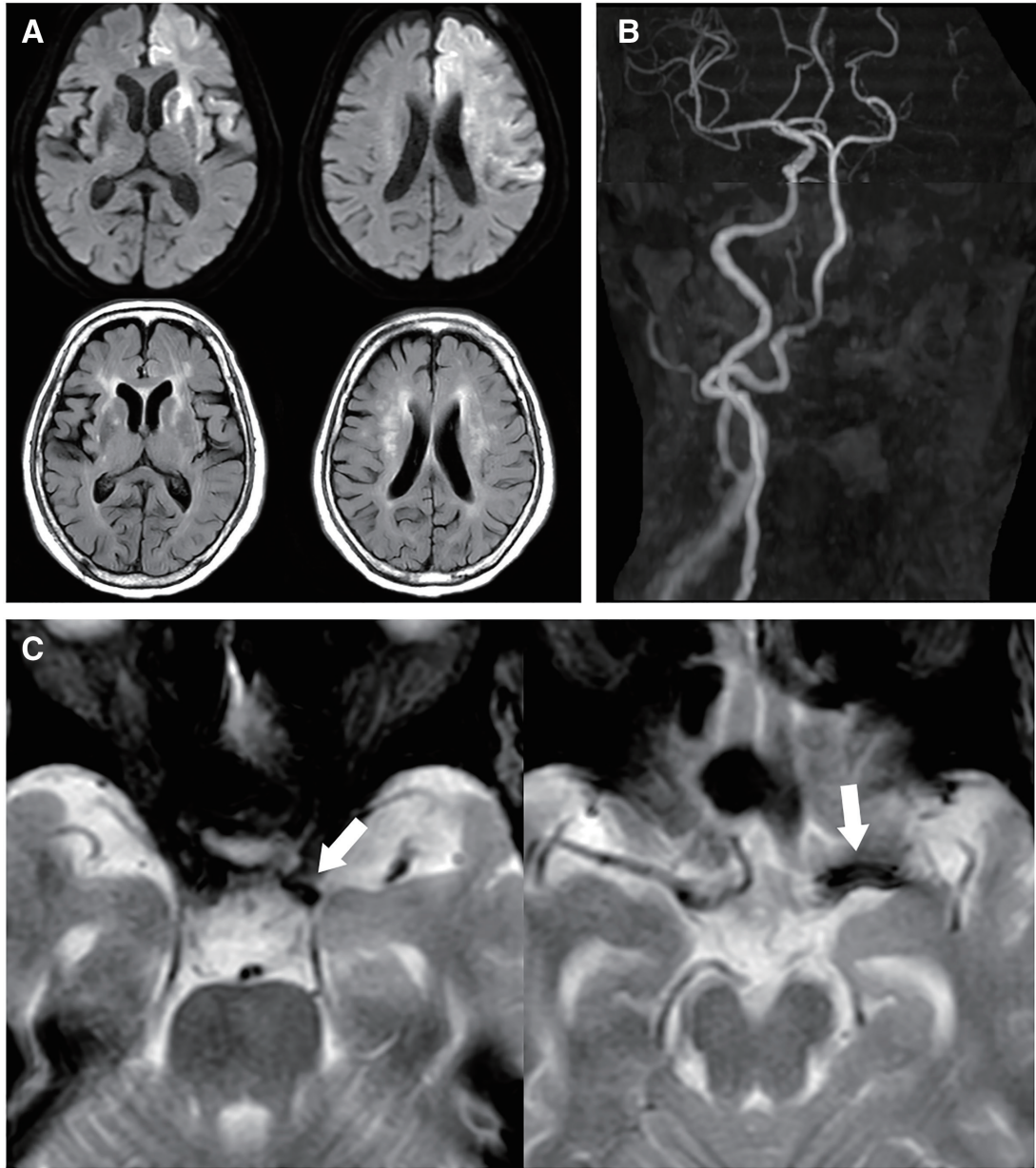
A 94-year-old woman presented with loss of consciousness, severe right-sided paralysis, and sensory disturbance. The patient had a history of coronary stenting for myocardial infarction, chronic heart failure, dyslipidemia, and type 2 diabetes mellitus. No arrhythmias were noted, and the electrocardiogram on admission showed a normal sinus rhythm. The patient was receiving antithrombotic medications such as aspirin and prasugrel. Blood tests revealed a D-dimer of 5.9  $\mu\text{g/mL}$ . Platelet aggregation capacity testing using the Hematracer 804 (DS Medical, Tokyo, Japan) revealed adenosine diphosphate (ADP) and collagen scores of 5 and 3, respectively. The National Institutes of Health Stroke Scale score was 29, the diffusion-weighted imaging-Alberta Stroke Program Early Computed Tomography Score (DWI-ASPECTS) was 2, and DWI-fluid-attenuated inversion recovery (FLAIR) mismatch was observed (**Fig. 1A**). Magnetic resonance angiography showed the absence of the left cervical carotid artery and intracranial arteries of the anterior circulation (**Fig. 1B**). T2\*-weighted images showed the susceptibility vessel sign for the left M1 and the terminal of the internal carotid artery (ICA), suggesting that the tandem occlusion included a T occlusion (**Fig. 1C**). Although the prognosis was poor due to the low ASPECTS, the patient was treated with intravenous tissue-type plasminogen activator and mechanical thrombectomy at her family's request.

A 9 Fr Optimo (Tokai Medical, Aichi, Japan) was guided into the left common carotid artery (CCA). Imaging revealed severe stenosis at the bifurcation of the CCA due to thrombus and occlusion at the terminal portion of the ICA (**Fig. 2A–2C**). The BGC passed easily through the ICA origin without angioplasty; therefore, we chose a retrograde approach. After placement of the BGC distal to the stenosis, an AXS Vecta 71 (Stryker, Portage, MI, USA) was guided to the pre-petrous portion of the ICA,

and the intracranial occlusion was crossed with a Phenom 27 (Medtronic, Minneapolis, MN, USA) and a Synchro standard (Stryker). Embotrap III 5  $\times$  37 mm (Johnson & Johnson, New Brunswick, NJ, USA) was deployed from the M2 inferior trunk. After inflating the BGC balloon, the thrombus was collected using a combined technique. After deflating the BGC, imaging showed recanalization reaching thrombolysis in cerebral infarction (TICI) 3 (**Fig. 3A**). However, immediately afterward, imaging revealed occlusion of the left M1 (**Fig. 3B**). The thrombus was retrieved using the same procedure, resulting in recanalization of TICI 3 again. A FilterWire EZ (Boston Scientific, Marlborough, MA, USA) was deployed in the pre-petrous portion of the ICA to treat the cervical lesion. However, imaging revealed left M1 re-occlusion before distal protection. After re-sheathing the FilterWire EZ, the thrombus was retrieved using the same technique, and recanalization of TICI 3 was achieved for the third time (**Fig. 3C**). No blood clots were collected in the FilterWire EZ. Immediately after inflating the BGC, the FilterWire EZ was distally deployed again. After deflating the BGC, imaging showed no intracranial re-occlusion. The deflated BGC was lowered to the CCA proximal to the cervical lesion. Imaging revealed no thrombus or stenosis at the origin of the ICA. However, the external carotid artery (ECA) was still occluded (**Fig. 3D**). All clots collected during each retrieval procedure were red blood clots. Ten minutes later, no restenosis or re-occlusion was observed. After re-sheathing the FilterWire EZ, no blood clots were collected. Three hours after the procedures, head computed tomography revealed cerebral infarction and severe swelling in the area where the high intensity was observed on preoperative DWI. The patient passed away the next day.

## Discussion

Both retrograde and antegrade approaches have been proposed for tandem occlusion. Each approach has advantages and disadvantages. The advantages of the retrograde approach include achieving rapid intracranial reperfusion and the ability to perform carotid artery stenting after antiplatelet agents. The major disadvantage of the retrograde approach is that the guiding catheter (GC) may not pass through the cervical carotid lesion, forcing a switch to the antegrade approach. Even if the GC passes through the cervical carotid lesion, dissection of the cervical carotid artery or distal embolization from the lesion may occur.



**Fig. 1** Magnetic resonance imaging on admission. **(A)** DWI-ASPECTS was 2 except for M3 and internal capsule, and a DWI-FLAIR mismatch was observed. **(B)** Magnetic resonance angiography shows the absence of the left cervical carotid artery and intracranial arteries in the anterior circulation. **(C)** T2\* showed the susceptibility vessel sign at the left M1 and the terminal of the ICA (white arrow). These images indicated the tandem occlusion including a carotid T occlusion. DWI-ASPECTS, diffusion-weighted imaging-Alberta Stroke Program Early Computed Tomography Score; DWI-FLAIR, DWI-fluid-attenuated inversion recovery; ICA, internal carotid artery

The advantages of the antegrade approach include easier passage of the GC through the cervical carotid lesion and the possibility of spontaneous recanalization due to increased perfusion pressure. The disadvantages of this approach include the time-consuming intracranial reperfusion, the possible deterioration of intracranial perfusion due to hypotension during PTA or stent placement, the struts of the carotid stent and the stent retriever may

interfere with each other if the GC or the aspiration catheter cannot be delivered distal to the carotid stent, acute in-stent thrombosis or occlusion may occur due to insufficient antiplatelet agent effects, and possible postoperative cerebral hemorrhage due to hyperperfusion and/or additional antithrombotic therapy.<sup>1-7</sup> The prognoses for the 2 approaches are not significantly different, but preferences for the 2 approaches are controversial.<sup>3,4,8</sup> The retrograde





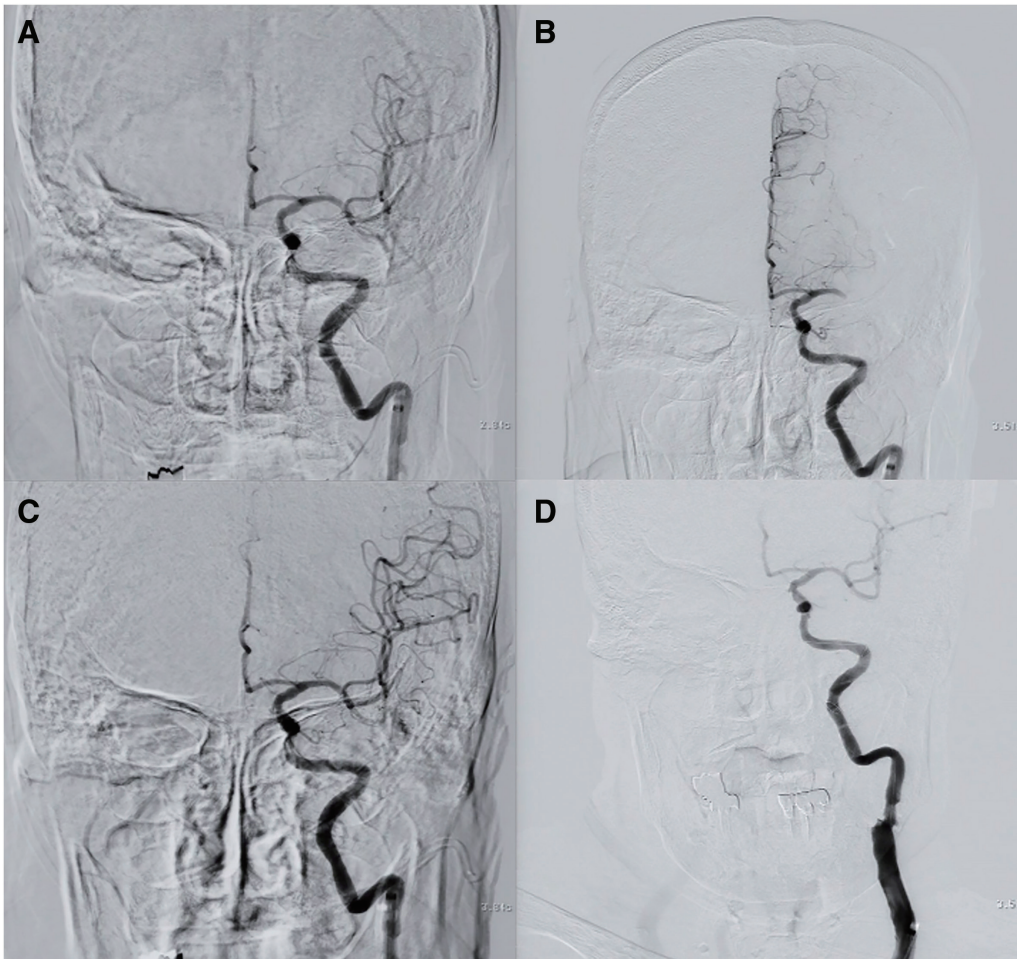
**Fig. 2** Preprocedural digital subtraction angiography of the left CCA. (A and B) Frontal and lateral images. The thrombus was in the bifurcation of the common carotid artery (white arrow). (C) The left ICA was occluded at the terminal portion. CCA, common carotid artery; ICA, internal carotid artery

approach may have a better prognosis with higher reperfusion rates and the reperfusion times may be shorter.<sup>1,2,5,9,10</sup> Therefore, we choose the retrograde approach when the BGC can easily pass through the cervical lesion.

We experienced a case of tandem occlusion, including T occlusion, that repeatedly re-occluded during mechanical thrombectomy using the retrograde approach. The repeated re-occlusion may have occurred for 2 reasons. First, the retrograde approach involves intracranial thrombectomy to treat the cervical carotid lesion, and the thrombus may migrate distally from the cervical lesion, resulting in re-occlusion after recanalization of the intracranial lesion, as in this case. Approximately 60%–70% of extracranial lesions in tandem occlusions are atherothrombotic, 20%–30% are dissections, and 10% are cardiogenic.<sup>11,12</sup> In the present case, although there were risk factors for atherosclerosis like dyslipidemia and diabetes mellitus, we believe there was no atherosclerosis because of the confirmed efficacy of antiplatelet agents and the absence of stenotic lesions in the carotid artery after treatment. Moreover, there were no findings of characteristics of dissection, such as irregular stenosis starting about 2–3 cm distal to the carotid bulb or aneurysm formation<sup>13</sup> after treatment. However, a cardiogenic thrombus was suspected based on the following reasons, although this is not pathologically confirmed. The D-dimer level was high, and the patient had a history of chronic heart failure, though atrial fibrillation was not observed. Moreover, the collected thrombus was a red

blood clot, similar to a fibrin-rich clot. In addition, the ECA and the cervical ICA were occluded (**Fig. 1B**). Therefore, a cardiogenic thrombus was suspected, though not confirmed by pathology. In addition, the BGC was guided distal to the ICA cervical lesion, and the stent retriever was retrieved without scratching the cervical lesion. Thus, the fragile thrombus presumably caused distal embolization. The potential risk of repeated distal embolization from the cervical carotid lesion should be considered when using the retrograde approach.

Second, the intracranial lesion was a T occlusion, which required ipsilateral imaging to confirm recanalization. The rate of T occlusion among intracranial lesions of the anterior circulation is 18.5%–30%.<sup>3,14</sup> For non-T occlusions of the ICA, the recanalization of the intracranial lesion can be confirmed during contralateral ICA imaging while the ipsilateral BGC is inflated and contrast medium is aspirated from the BGC to prevent distal embolization.<sup>15,16</sup> However, for T occlusions such as the present case, preoperatively evaluating the development of collateral vessels such as the ipsilateral A1, anterior communicating artery, or posterior communicating artery is difficult. Therefore, ipsilateral imaging is required to confirm the recanalization of the intracranial lesion. In addition, imaging with an inflated BGC carries the risk of serious complications due to vascular injury if the lesion has not been recanalized. If the contrast agents are injected slowly with the BGC inflated, distinguishing between recanalization and



**Fig. 3** Intraoperative digital subtraction angiography of the left CCA. **(A)** Complete recanalization was achieved after 1 pass. **(B)** Left M1 occlusion was seen just after recanalization. **(C)** Re-thrombus retrieval was performed several times and complete recanalization was finally achieved. **(D)** Thrombus and stenosis were not seen at the origin of the ICA, while the ECA remained occluded. CCA, common carotid artery; ECA, external carotid artery; ICA, internal carotid artery

flow pooling defeated by the collateral flow is difficult. Therefore, the BGC is deflated when imaging is required to confirm recanalization.

We propose the following measures to prevent repeated intracranial re-occlusion during the procedure for tandem occlusion, including T occlusions: (1) performing a retrograde approach after aspiration of a fragile thrombus at the cervical carotid lesion from the BGC and (2) performing an antegrade approach, even in cases where the BGC easily passes through a cervical carotid lesion. A previous case report has indicated the efficacy and safety of aspiration from the BGC against proximal ICA occlusion,<sup>17)</sup> wherein effective recanalization was achieved faster compared to previous reports that gently treated the diseased vessel by simple aspiration. The former measure may be better as the first technique to be attempted, considering the reports

showing that the retrograde approach has a better prognosis together, as mentioned above.

## Conclusion

We experienced a case of tandem occlusion including a T occlusion that repeatedly re-occluded during mechanical thrombectomy using the retrograde approach. We should not have performed distal thrombectomy first in this case. We should have performed the thrombus aspiration from the BGC at the cervical carotid lesion even if the BGC easily passed through the cervical lesion. By adding this procedure, we may have prevented intracranial re-occlusion during the mechanical thrombectomy procedure without sacrificing the time advantage of early recanalization using the retrograde approach.

## Disclosure Statement

The authors declare that they have no conflicts of interest.

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