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【 CASE REPORT 】

Long-sheath Introducer-assisted Revascularization (L-SHARE) Technique for Treating Large-vessel Occlusion by a Giant Clot

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Abstract:
Revascularization for common carotid artery (CCA) occlusion might be difficult. We reported our strategy for revascularizing CCA occlusion by giant clots. A 94-year-old woman was transferred to our hospital because of right hemiparesis and aphasia. CCA occlusion and giant clots were detected on ultrasonography. We performed mechanical thrombectomy using a 9-Fr balloon-guiding catheter, stent retriever, and aspiration catheter through a 9-Fr long-sheath introducer [long-sheath introducer-assisted revascularization (L-SHARE) technique]. We successfully recanalized CCA occlusion using this method. The L-SHARE technique might be useful for recanalization of CCA occlusion.

Key words: mechanical thrombectomy, long-sheath introducer, giant clot, cerebral large-vessel occlusion

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Introduction

Although the efficacy of endovascular treatment of cerebral large-vessel occlusion (LVO) in acute ischemic stroke patients was shown by a meta-analysis (1), the revascularization of extracranial internal carotid artery (ICA) and/or common carotid artery (CCA) occlusion due to giant clots might be difficult compared to that of intracranial LVO, such as middle cerebral artery (MCA) or intracranial ICA occlusion.

During treatment for extracranial ICA and/or CCA occlusion, obstruction of the balloon-guiding catheter (BGC) by a giant clot is often seen, and the catheter must then be removed through the sheath inserted at the groin. To determine whether or not additional mechanical thrombectomy (MT) is needed to revascularize vessels obstructed by residual clots, we must re-navigate the catheter to the target vessels. Efforts are thus needed to shorten the procedure time in order to improve the prognosis.

We performed MT after navigating a 9-Fr long-sheath introducer using a 9-Fr BGC as an inner catheter to treat a patient with extracranial LVO induced by a giant clot. Navigation of the long-sheath introducer to CCA can facilitate repeated aspiration of the clot from the BGC and enable digital subtraction angiography (DSA) through this long-sheath introducer, even if the BGC is removed when blocking of the BGC by a giant clot occurs. After reduction of the clot volume by repeated aspiration from the BGC, MT can be performed using a stent retriever (SR) and/or aspiration catheter (AC). We speculate that this method might be useful for revascularizing cases of LVO due to giant clots and help reduce the puncture to revascularization time (Fig. 1).

Case Report

The patient was a 94-year-old woman with no remarkable

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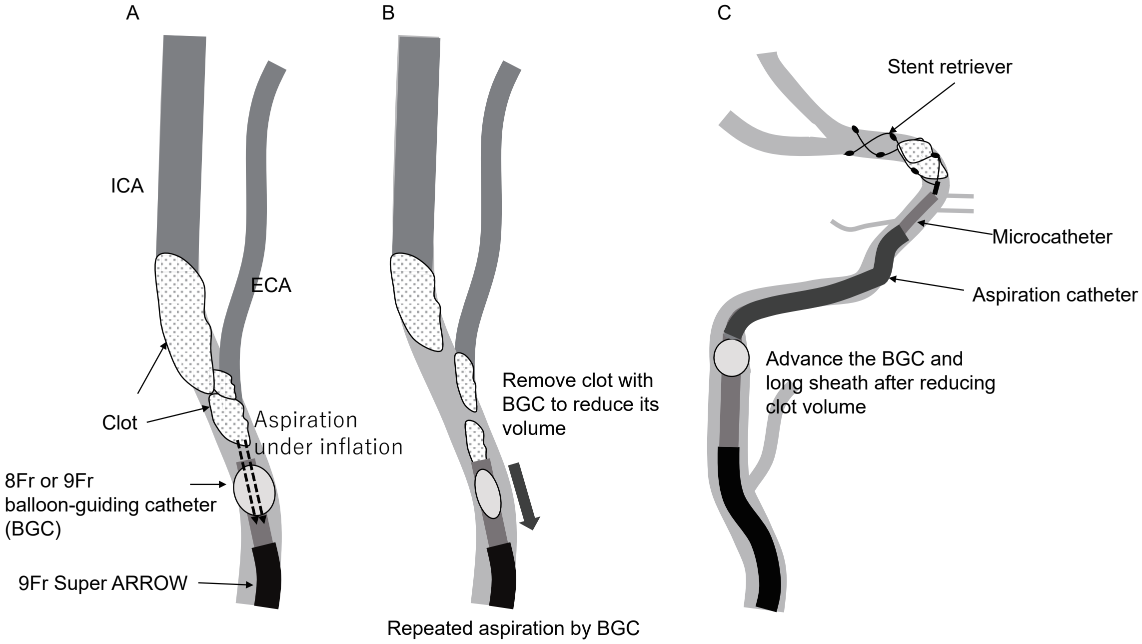

Figure 1. A: Illustration of common carotid artery (CCA) occlusion. Before mechanical thrombectomy, a 9-Fr Super ARROW-Flex® and balloon-guiding catheter (BGC) were navigated to the occluded CCA. B: The long-sheath introducer-assisted revascularization technique is shown. First, the BGC was inflated, and aspiration from the BGC was performed. The BGC was then removed when it became obstructed by the clot. This procedure was performed through a 9-Fr Super ARROW-Flex® until the clot volume decreased enough to enable its retrieval by a stent retriever and/or aspiration catheter. C: After reduction of the clot volume by aspiration from the BGC, mechanical thrombectomy was performed.

medical history. Her family noted eye conjugate deviation, right hemiparesis, and aphasia at home and called emergency services. She was transferred to our hospital approximately 30 minutes after the onset. Her National Institutes of Health Stroke Scale (NIHSS) score was 24. Ultrasonography (US) of the carotid artery performed at the time of admission detected a giant clot at the common carotid artery (CCA) and internal carotid artery (ICA), and stagnant blood flow at the CCA was noted on color Doppler imaging on US (not shown in figure). We directly transferred the patient to the angiosuite because of the very short duration from the onset to admission, severe neurological deficit, and unavailability of computed tomography (CT) and magnetic resonance imaging (MRI) scan rooms in addition to the availability of the angiosuite at the time of admission.

After confirming the absence of large ischemic lesion, parenchymal edema, and intracranial hemorrhaging on cone-beam CT (Fig. 2A), we started MT 35 minutes after admission. Under local anesthesia, we inserted a 5-Fr sheath into the right femoral artery and exchanged it for a 7-Fr sheath. Next, we exchanged the 7-Fr sheath for a Super ARROW-Flex® 9 Fr/80 cm [Inner diameter (ID): 9-Fr, Teleflex, Morrisville, USA] and navigated it to the left CCA using a Branchor 9-Fr/100 cm (Asahi Intecc, Seto, Japan), 6-Fr Berenstein-type inner catheter and a 0.035-inch/180 cm guidewire as a coaxial system.

We considered navigation of the long-sheath introducer and BGC relatively easy after guidance with a 0.035-inch guidewire to the CCA (Fig. 2B). Before the procedure, we suspected that this patient might have tandem lesion, indicating the presence of clot at the CCA and terminus of the ICA or MCA. Furthermore, we suspected it might be difficult to retrieve a distal clot at the terminus of the ICA or MCA before reopening the ICA orifice, as we confirmed the presence of a giant clot at the CCA and ICA by US. Furthermore, the usage of a 9-Fr long-sheath introducer for repeated MT might shorten the procedure time.

We first approached the clot at the CCA and ICA orifice. DSA showed left CCA occlusion by a giant clot at the CCA (Fig. 2C), for which we performed manual aspiration from the BGC under inflation of the attached balloon (Fig. 2D). We removed the BGC through the long-sheath introducer because it became obstructed by the clot. This operation, indicating aspiration from the BGC, was repeated a few times, and a large clot was retrieved during each pass. However, the ICA occlusion persisted (Fig. 2E).

To revascularize the occluded ICA, we guided the BGC to the ICA and advanced a AXS Catalyst 6 (Stryker, Kalamazoo, USA) to its C2 segment using a Trevo Trak 21 microcatheter (Stryker) and a CHIKAI Black soft tip (Asahi Intecc). After navigating the Trevo Trak 21 microcatheter distal to the site of occlusion (Fig. 2F), we deployed the SR (Embotrap® II; Cerenovus, Johnson and Johnson, New Brunswick, USA). Furthermore, the AXS Catalyst 6 was ad-

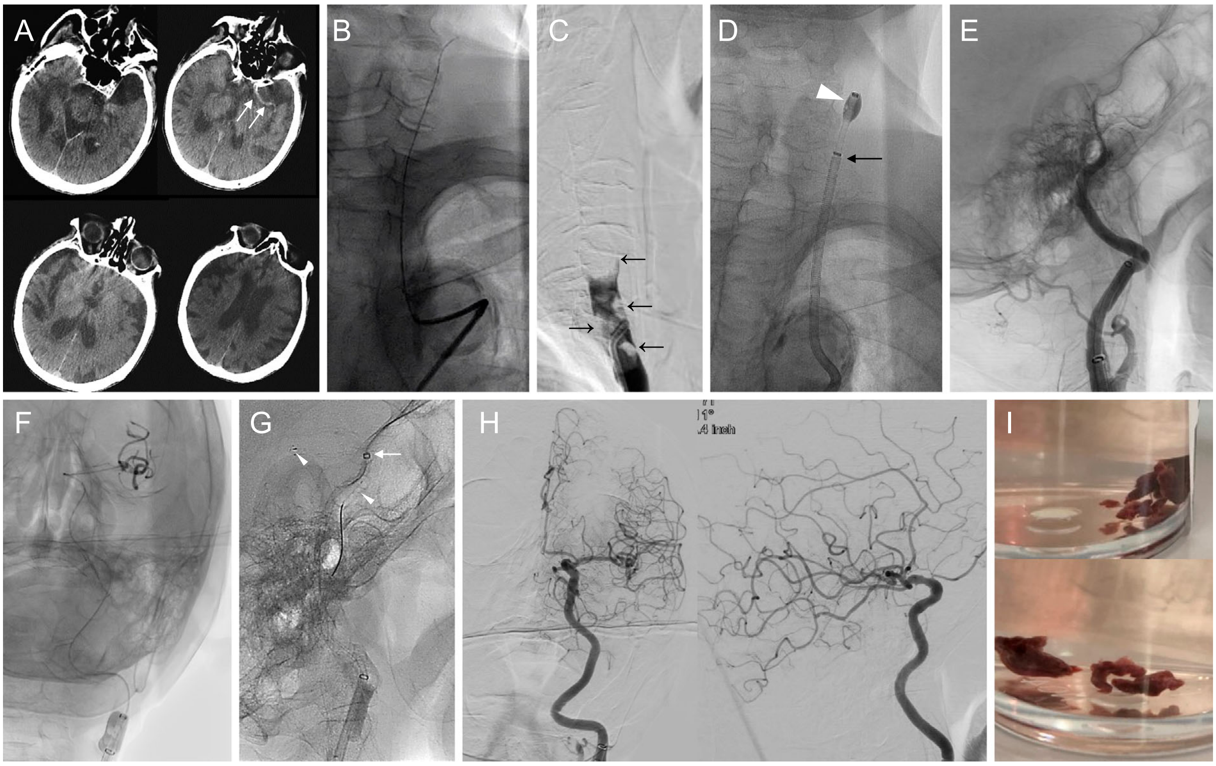

Figure 2. **A: Cone-beam CT shows no intracranial hemorrhaging. B: Anteroposterior view shows configuration of the aortic arch and common carotid artery. Tortuousness of aortic arch is not too severe to navigate a long-sheath introducer. C: A lateral view of digital subtraction angiography (DSA) of the left common carotid artery (CCA) showing occlusion due to a large clot (black arrows). D: A Super ARROW-Flex® (black arrow) and 9-Fr balloon guiding catheter (BGC; white arrowhead) were navigated to the left CCA. E: After repeated aspiration from the BGC, the CCA occlusion persisted only at the distal portion of the internal carotid artery. F: After guidance of the microcatheter distal to the occluded site, selective DSA from the microcatheter revealed a patent left middle cerebral artery. G: The stent retriever was deployed at the occluded site (white arrowheads), and the aspiration catheter was guided proximal to the clot (white arrow). H: Anteroposterior and lateral views of DSA showing complete recanalization after mechanical thrombectomy. I: Piecemeal clot retrieved by aspiration from the BGC.**

vanced just proximal to the clot after the SR deployment (Fig. 2G). We removed the SR and AXS Catalyst 6 together under BGC inflation. DSA showed complete recanalization 65 minutes after groin puncture (Fig. 2H). Giant clots were retrieved as multiple fragments after MT (Fig. 2I).

The patient's NIHSS score improved to 10 after MT, and atrial fibrillation was detected during hospitalization as a cause of the ischemic stroke. She was transferred to another hospital for rehabilitation with a direct oral anticoagulant.

Discussion

We occasionally perform MT for CCA or ICA orifice occlusion due to giant cardiogenic thrombi. Several previous reports demonstrated successful revascularization for LVO due to a giant clot using direct aspiration from BGC, several passes by SR under distal protection, the parallel SR deployment technique, and direct carotid exposure (2-9). Although direct exposure for CCA occlusion was reported to be effective, it might be more invasive and requires much more time than endovascular treatment alone.

In endovascular procedures for patients such as the present case, blocking of the BGC by a giant clot during the procedure is often seen (2-7). We must remove the BGC and re-navigate the catheter to the target vessels to continue MT. This situation might cause difficulty, leading to a longer time to treat LVO due to a giant clot, although a shorter procedure time in patients with LVO has reportedly improved outcomes (10).

Our method, named the L-SHARE technique, might be effective for managing giant clots and have several advantages over previous reports (2-9). First, the L-SHARE technique might facilitate repeated aspiration from the BGC through a long-sheath introducer, even if the BGC is obstructed by a clot and removed from the body. Second, it might aid in performing DSA after blocked BGC removal, as the long-sheath introducer is located at the CCA. Third, a stiff guidewire can be advanced to the CCA through a long-sheath introducer before its removal, when the long-sheath introducer becomes obstructed by a giant clot. After guidance with a stiff guidewire, the long-sheath introducer can be removed re-guided through the stiff guidewire after rinsing.

The time from the onset to reperfusion is one of the strongest predictors of the outcome in patients with LVO (10). Recently, the direct transfer to angiosuite (DTAS) protocol for patients suspected of having LVO based on a scoring system of acute stroke code, such as the Rapid Arterial oCclusion Evaluation (RACE) scale, was reported to be useful for shortening the time from admission to revascularization and improving the outcome (11, 12) However, Pfaff et al. reported that there was no significant difference in the door-to-reperfusion time between the DTAS group and the conventional workflow group (13, 14). These results suggest that the reduction in in-hospital delays depends on the capability and availability of the angiosuite at the time of admission and the feasibility of a floor plan for treating Acute Ischemic Stroke patients.

Based on previously reported findings (11, 12), we also skip performing conventional CT and MRI in order to reduce the time from admission to groin puncture when patients with a high NIHSS (>10) and within 6 hours from the onset are admitted while the CT or MRI rooms are occupied. Therefore, in the present case, we skipped MRI and CT because the patient met the conditions described above. This protocol was approved by the local ethics committee.

We did not administer recombinant-tissue plasminogen activator (rt-PA) before MT. We skipped this prescription for several reasons. First, previously reported studies comparing rt-PA skip and bridging therapy showed a low trend toward intracranial hemorrhaging in the rt-PA skip therapy group (15). Second, we did not adequately evaluate the patient by MRI and/or conventional CT before treatment. Third, we worried that long-sheath introducer usage might cause vessel wall injury to the femoral artery and hemorrhaging after its removal. Finally, we concerned that we should refrain from using antiplatelet drugs under administration of rt-PA if atherosclerotic lesion was confirmed at target vessel during procedure.

Of note, the use of a long-sheath introducer has some limitations. First, in patients with a tortuous aortic arch, such as a type 3 aortic arch or bovine arch, navigation of the long-sheath introducer might be difficult, as alternative methods of navigating the guiding catheter, such as a NEURO EBU 8 Fr/83 cm (Gadelius Medical, Sagamihara, Japan), cannot be used after switching to a long-sheath introducer. In cases that should undergo MT using a NEURO EBU, the length of the NEURO EBU 8 Fr/83 cm is not sufficient to advance to the CCA through a long-sheath introducer of 80 cm. If there is concern about the difficulty of guiding catheter navigation, a NEURO EBU should be used through an 8- or 9-Fr sheath inserted into the femoral artery before switching to a long-sheath introducer for this reason. The evaluation of the approach from the aortic arch to the target vessels by magnetic resonance angiography (MRA) or CT angiography (CTA) or performance of control angiography before exchange from a short- to a long-sheath introducer might be needed before MT to assess whether or not a long-sheath introducer can be used. When difficulty navigating a guiding catheter to the CCA is encountered despite applying these various approaches after insertion of a long-sheath introducer, contralateral groin puncture or switching from a long-sheath introducer to a 9- or 10-Fr short-sheath introducer as a new route for navigating the BGC to the target vessel might be needed, for the reasons described above.

Second, the obstructed BGC must be removed without protection. This may cause distal migration of the clot. In fact, ICA occlusion remained after several aspirations from the BGC in the present case. Distal migration should be considered during aspiration or removal of the BGC. However, we speculated that tandem occlusion existed before MT because a hyperdense lesion on cone-beam CT was detected at the ICA terminus, and the patient had severe neurological deficit, indicating poor collaterals, such as terminus ICA occlusion. Third, we should consider whether or not the distance between the CCA orifice and the clot is sufficient to navigate a long-sheath introducer, as advancement of a guidewire, inner catheter, BGC, and/or long-sheath introducer might cause fragmentation of the clot. In the future, further testing of the long-sheath introducer might be needed to confirm its efficacy and safety. Furthermore, the long-sheath introducer has a ledge between the dilator and catheter, which hampers insertion into the femoral artery. Therefore, we first inserted a 5-Fr short sheath, and we replaced the 5-Fr sheath by a 7-Fr short sheath. Finally, we exchange to a 9-Fr long-sheath introducer from the 7-Fr short sheath for dilation of the hole at the femoral artery in order to safely introduce the 9-Fr long-sheath introducer. This procedure might require extra time relative to conventional procedures.

Conclusion

The L-SHARE technique might be useful for recanalizing ICA or CCA occlusion due to a large clot. In this technique, repeated aspiration from the BGC can be performed easily and thereby shorten the procedure time.

The authors state that they have no Conflict of Interest (COI).

References

1. Goyal M, Menon BK, van Zwam WH, et al. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. Lancet **387**: 1723-1731, 2016.

2. Park JW, Lee DH, Choi CG, et al. Various endovascular approaches to the management of free floating carotid thrombi: a technical report. J Neurointerv Surg **4**: 336-338, 2012.

3. Imai K, Mori T, Izumoto H, et al. Clot removal therapy by aspiration and extraction for acute embolic carotid occlusion. AJNR Am J Neuroradiol **27**: 1521-1527, 2006.

4. Xu GF, Suh DC, Choi CG, et al. Aspiration thrombectomy of acute complete carotid bulb occlusion. J Vasc Interv Radiol **16**:

539-542, 2005.
5. Giragani S, Balani A, Agrawal V. Stentriever thrombectomy with distal protection device for carotid free floating thrombus: a technical case report. J Neurointerv Surg **9**: e33, 2017.
6. Carr K, Tew D, Becerra L, et al. Endovascular aspiration of a symptomatic free-floating common carotid artery thrombus. Neuroradiology **60**: 1103-1107, 2018.
7. Hino T, Sato M, Hayakawa M, et al. A case of acute embolic occlusion of the common carotid artery in which a giant thrombus was retrieved using the parallel stent retriever technique. J Neuroendovasc Ther **16**: 87-92, 2022.
8. Lin CM, Chang CH, Chen SW, et al. Direct neck exposure for rescue endovascular mechanical thrombectomy in a patient with acute common carotid occlusion concurrent with type A aortic dissection. World Neurosurg **28**: S1878-8750(19)30179-30182, 2019.
9. Cord BJ, Kodali S, Strander S, et al. Direct carotid puncture for mechanical thrombectomy in acute ischemic stroke patients with prohibitive vascular access. J Neurosurg **14**: 1-11, 2020.
10. Bruno CA, Meyers PM. Endovascular procedures versus intravenous thrombolysis in stroke patients with tandem occlusion of the anterior circulation. J Vasc Interv Radiol **25**: 1170-1171, 2014.
11. Mendez B, Requena M, Aires A, et al. Direct transfer to angiosuite to reduce workflow times and increase favorable clinical outcome. Stroke **49**: 2723-2727, 2018.
12. Requena M, Olivé-Gadea M, Muchada M, et al. Direct to angiography suite without stopping for computed tomography imaging for patients with acute stroke: a randomized clinical trial. JAMA Neurol **78**: 1099-1107, 2021.
13. Pfaff JAR, Schönenberger S, Herweh C, et al. Direct transfer to angio-suite versus computed tomography-transit in patients receiving mechanical thrombectomy: a randomized trial. Stroke **51**: 2630-2638, 2020.
14. Pfaff JAR, Bendszus M, Möhlenbruch MA. Response by Pfaff et al. to letter regarding Article, "direct transfer to angio-suite versus computed tomography-transit in patients receiving mechanical thrombectomy: a randomized trial". Stroke **52**: e28, 2021.
15. Suzuki K, Matsumaru Y, Takeuchi M, et al. SKIP study investigators effect of mechanical thrombectomy without vs with intravenous thrombolysis on functional outcome among patients with acute ischemic stroke: The SKIP randomized clinical trial. JAMA **325**: 244-253, 2021.

Intern Med 62: 909-913, 2023