

Trans-cell Approach through Closed-cell Stent for Middle Meningeal Artery Embolization in Recurrent Chronic Subdural Hematoma

Shogo DOFUKU,¹ Masayuki SATO,¹ Daisuke SATO,¹ Seiji KURIBARA,¹
Shotaro OGAWA,¹ Seiei TORAZAWA,¹ and Takahiro OTA¹

¹Department of Neurosurgery, Tokyo Metropolitan Tama Medical Center, Fuchu, Tokyo, Japan

Abstract

We report a case of recurrent chronic subdural hematoma (CSDH) treated using the trans-cell approach through a closed-cell stent for middle meningeal artery embolization (MMAE). A 77-year-old man with acute ischemic stroke due to anterior circulation tandem occlusion was treated with intracranial thrombectomy and carotid artery stenting using a closed-cell stent 5 years ago. He experienced head trauma after a fall, which then developed into a CSDH. Burr hole surgery was performed twice, followed by MMAE considering the high possibility of recurrence due to antiplatelet therapy and brain atrophy after ischemic stroke. A distal access catheter was inserted into the external carotid artery through the closed-cell stent, and a microcatheter was navigated in the middle meningeal artery. The anterior and posterior convexity branches were embolized with 16.7% N-butyl cyanoacrylate. The postoperative course was favorable, and CT at 3-month follow-up showed a decrease in the hematoma. Even after the placement of the closed-cell stent, endovascular treatment of the external carotid artery is possible and can be a therapeutic option using the trans-cell approach.

Keywords: trans-cell approach, Carotid Wallstent, middle meningeal artery embolization

Introduction

The trans-cell approach is sometimes applied in the stent-assisted coil embolization of intracranial aneurysms, which involves inserting a microcatheter into an intracranial aneurysm through a stent covering the aneurysm neck.^{1,2)} However, there are no reports of cases treated with the trans-cell approach using an intermediate catheter after carotid artery stenting with a closed-cell stent. We report a case of recurrent chronic subdural hematoma (CSDH) treated using the trans-cell approach through a closed-cell stent for middle meningeal artery embolization (MMAE).

Case Report

A 77-year-old man with an acute ischemic stroke due to anterior circulation tandem occlusion was

treated with intracranial thrombectomy and carotid artery stenting using a closed-cell stent 5 years ago. Carotid Wallstent (Boston Scientific, Santa Clara, CA, USA), measuring 10 × 31 mm, was placed. Neurological deficit markedly improved, and the patient was discharged with dual antiplatelet therapy with a modified Rankin Scale score of 1 on day 90 after onset. Thus, dual antiplatelet therapy was continued by a family doctor.

The patient presented with headache and gait disturbance 1 month after head trauma caused by a fall. CT demonstrated right CSDH (maximum hematoma width, 35 mm), and a burr hole surgery was performed. His clinical symptoms improved after surgery, and he was switched to single antiplatelet therapy. However, 3 months later, he complained of gait disturbance, and CT showed recurrence of CSDH (maximum hematoma width, 32 mm) (Fig. 1). Therefore, we performed a burr hole surgery again. Considering the high possibility of recurrence due to antiplatelet therapy and brain atrophy after ischemic stroke, we decided to perform MMAE 2 weeks after the second surgery. We planned

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Fig. 1 CT showing recurrence of right subdural hematoma.

MMAE using N-butyl cyanoacrylate, which was approved by the ethical committee (approval number 3-59; August 3, 2021). Written informed consent

was obtained from the participant and legal representative of the patient.

Endovascular procedure

Under local anesthesia, a 5-Fr FUBUKI guiding sheath (Asahi Intecc, Aichi, Japan) was inserted into the right femoral artery and guided into the right common carotid artery. Heparin (3000 units) was intravenously injected for systemic heparinization. Common carotid angiography revealed patency of the external carotid artery through the Carotid Wallstent. We attempted the trans-cell approach through the Carotid Wallstent using a 3.4-Fr TACTICS (Technocrat, Aichi, Japan) as a distal access catheter, which was advanced over a radifocus 0.035-inch guidewire (Terumo, Tustin, CA, USA). The TACTICS was guided into the Carotid Wallstent, and the radifocus and TACTICS were inserted into the external carotid artery through the Carotid Wallstent (Fig. 2A). A DeFrictor (Medico's Hirata, Osaka, Japan), which was advanced over a CHIKAI X10 (Asahi Intecc) guidewire, was navigated in the MMA, and MMA angiography through the microcatheter was performed to detect the absence of anastomosis with the ophthalmic artery and to select target branches (Fig. 2B). Anterior and posterior convexity branches were embolized with 16.7% N-butyl cyanoacrylate, and MMA angiography demonstrated decreased flow into the MMA branches (Fig. 2C). The postoperative course was favorable, and the

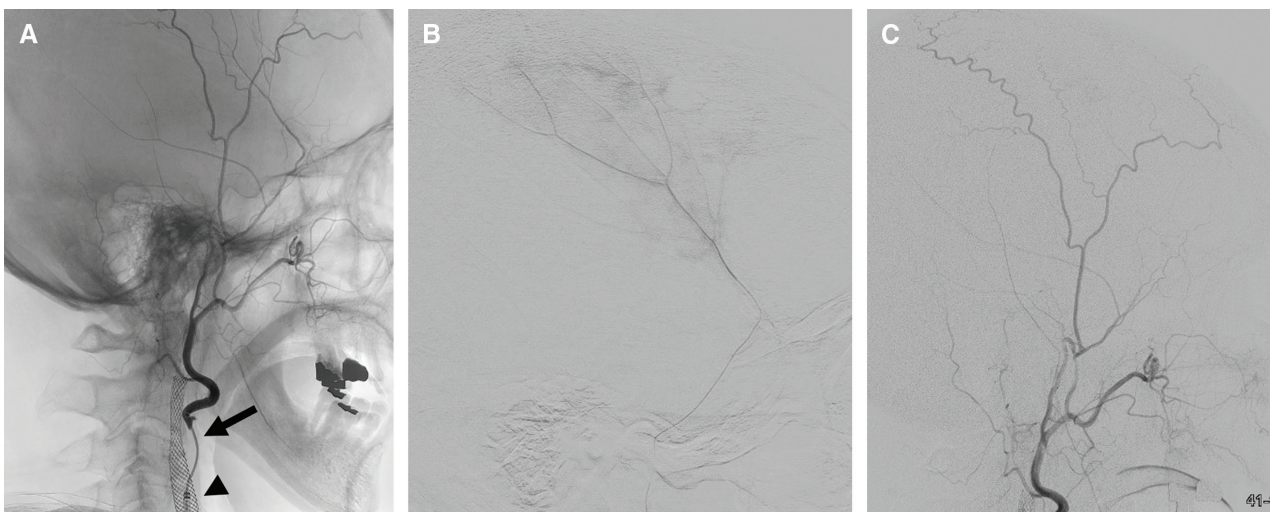


Fig. 2 (A) Angiography (lateral view) demonstrating TACTICS (black arrow) inserted into the external carotid artery through the Carotid Wallstent (arrowhead: tip of 5Fr guiding sheath). (B) MMA angiography demonstrating an irregular wispy appearance of the anterior branch. (C) Post-embolization angiography demonstrating decreased flow into the MMA branches. MMA: middle meningeal artery.

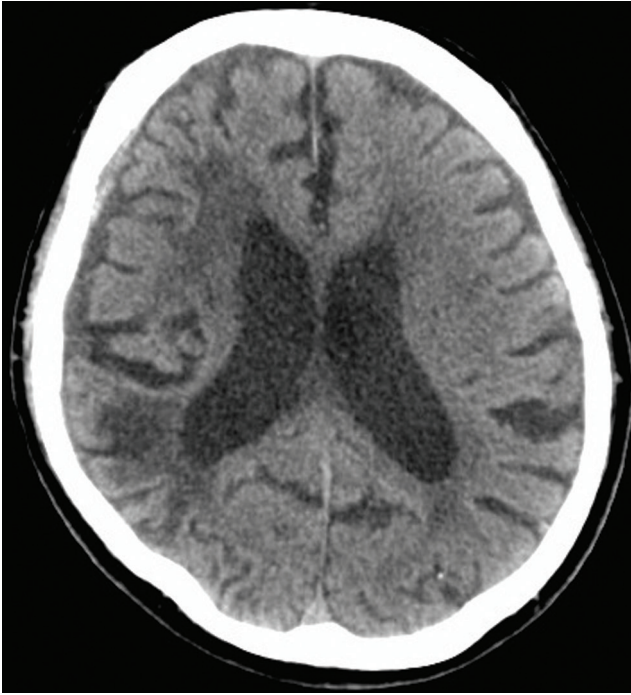


Fig. 3 CT 3 months post-embolization showing resolution of right subdural hematoma.

patient was discharged on postoperative day 1. CT at the 3-month follow-up showed an improvement of the hematoma (Fig. 3).

Discussion

We report a case treated using the trans-cell approach, which involves inserting an intermediate catheter into the external carotid artery through a closed-cell stent for MMAE in recurrent CSDH. To the best of our knowledge, this technique has not been previously reported.

The types of stents that can be placed in the carotid artery are mainly classified as open-cell and closed-cell stents.³⁾ Carotid Wallstent (Boston Scientific, Santa Clara) is a closed-cell and self-expandable stent. It has a small free cell area of 1.08 mm² to avoid plaque prolapse. On the other hand, the size of the stent cells can alter depending on the diameter of the indwelling vessel. In a previous study, when the 8-mm and 10-mm diameter Carotid Wallstent were deployed in a 6-mm inner-diameter tube, its cell area was stretched to 3.2 mm² and 4.4 mm², respectively, and the mean diagonal length was 1.87 ± 0.03 mm \times 1.72 ± 0.03 mm and 2.68 ± 0.07 mm \times 1.65 ± 0.03 mm.⁴⁾ We decided that it was appropriate to pass the TACTICS (Technorat Corporation) as a distal access catheter through the Carotid Wallstent, considering the size. It was considered

that passing the TACTICS once through the stent reduced the risk of multiple stent passages of the microcatheter for distal embolization and instability of distal embolization, although there was a risk of stent breakage and migration. The TACTICS is a novel large-bore microcatheter with a 3.2-Fr (1.07 mm) distal outer diameter that was designed with kink resistance and better luminal retention.⁵⁾ We confirmed its passability in that the TACTICS could be inserted into the Carotid Wallstent. It has a 0.035-inch inner diameter and can be passed through a flow-directed microcatheter inside, such as DeFrictor (Medico's Hirata) and Marathon (Medtronic, Minneapolis, MN, USA), and is often used as a distal access catheter to stabilize microcatheters for coiling. There have been no reports on the use of the trans-cell approach, which involves inserting an intermediate catheter through a closed-cell stent. First, the TACTICS over the radifocus was placed in the stent, and we attempted to pass the radifocus through the stent. With the support of the TACTICS, the wire could be easily passed through the stent, and TACTICS could also be easily guided into the stent over the wire. Although there were concerns about the risk of thrombosis and stent breakage, there were no complications. Therefore, long-term follow-up is required.

CSDH is now a common disease, especially in the elderly, and the incidence of CSDH has been predicted to increase further. MMAE has emerged as a potential treatment for CSDH,^{6,7)} and numerous studies have shown its efficacy in decreasing the rate of recurrence of CSDH after burr hole surgery.⁷⁻¹⁰⁾ In a previous study, 4 of the 89 patients (4%) in the MMAE group required burr hole surgery for CSDH recurrence, significantly less than the 24 of the 174 patients (14%) in the control group ($P = 0.02$, odds ratio: 95% confidence interval 0.28: 0.07–0.86).⁹⁾ Exponential increases in utilization of MMAE for CSDH treatment in recent years in USA.¹¹⁾ In Japan, the number of carotid artery angioplasty with stenting (CAS) procedures exceeds that of carotid endarterectomy procedures.¹²⁾ Patients often take antiplatelet drugs after CAS, which is considered to be a risk factor for CSDH. As the number of cases requiring MMAE after CAS is expected to increase, this study provides a therapeutic option for treating such patients.

This report had limitation. It is a single case, and thus the possibility to insert the closed-cell stent (Carotid Wallstent) using the distal access catheter (TACTICS) could not be guaranteed in other patients. Although this technique cannot establish in a single case, we believe that this represents one option for patients requiring endovascular treatment of the external carotid artery

after CAS. More cases should be gathered to examine the usefulness of this technique.

Our case was treated using the trans-cell approach through a closed-cell stent for MMAE in recurrent CSDH. Even after the placement of the closed-cell stent, endovascular treatment of the external carotid artery is possible and can be an option using the trans-cell approach.

Conflicts of Interest Disclosure

There are no competing interests to declare.

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Corresponding author: Shogo Dofuku, MD, PhD
 Department of Neurosurgery, Tokyo Metropolitan
 Tama Medical Center, 2-8-29 Musashidai, Fuchu,
 Tokyo 183-8524, Japan.
e-mail: s.dofuku@gmail.com