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Case Report

A Case of Microguidewire and Neuroform Atlas Stent Entanglement Resulting in Extraction Difficulty

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Objective: The trans-cell technique in stent-assisted coil embolization is a common treatment method for intracranial aneurysm. However, despite the frequency of its use, reports discussing its complications and their management are few. We describe a case of stent and microguidewire entanglement, which could not be removed, during treatment using the trans-cell technique. We discuss the mechanism of the entanglement and its management.

Case Presentation: A woman in her 40s was found to have an unruptured cerebral aneurysm with a maximum diameter of 5.9 mm located in the paraclinodal anterior process of the left internal carotid artery during a close examination of a headache. The aneurysm had an irregular shape and wide neck. Stent-assisted coil embolization was planned. Initially, the coil was embolized using a jailing technique, but the microcatheter was pushed out of the aneurysm during embolization. Thus, we attempted to switch to a trans-cell technique. However, during the process, the stent and microguidewire became entangled and could not be removed. Finally, when the stent slipped off, the entanglement was resolved and the microguidewire was retrieved. Fortunately, the patient was discharged home without postoperative complications.

Conclusion: Once a stent and a microguidewire become entangled, safely releasing them is difficult. Thus, it is important to avoid this scenario from occurring.

Keywords trans-cell technique, Neuroform Atlas stent, microguidewire, entanglement

Introduction

Endovascular treatment of cerebral aneurysms has made remarkable progress, with stent-assisted coil embolization now being commonly used and new devices being developed one after another. However, reports describing the techniques and complications of these methods are scarce despite the frequency of their use.[1–3)]

In this paper, we describe a case of stent and microguidewire entanglement, which could not be removed, during treatment with the trans-cell technique. We discussed the mechanism of the entanglement and its management. Informed consent was obtained from the patient for the publication of this case report.

Case Presentation

A woman in her 40s who was found to have an unruptured cerebral aneurysm with a maximum diameter of 5.9 mm located in the paraclinoid anterior process of the left internal carotid artery during a thorough examination of a headache. The aneurysm had an irregular shape and wide neck of 5.4 mm in size. Stent-assisted coil embolization was planned (**Fig. 1**).

Under general anesthesia, a 6-Fr sheathless guiding catheter (FUBUKI; Asahi Intecc Medical, Aichi, Japan) was placed into the left internal carotid artery (ICA). We used a combination of a distal access catheter (Tactics; Technocrat Corporation, Aichi, Japan), microcatheter (Headway 17; Terumo Medical Corporation, Tokyo, Japan), and microguidewire (Synchro SELECT Soft 0.014 inch; Stryker, Fremont, CA, USA).

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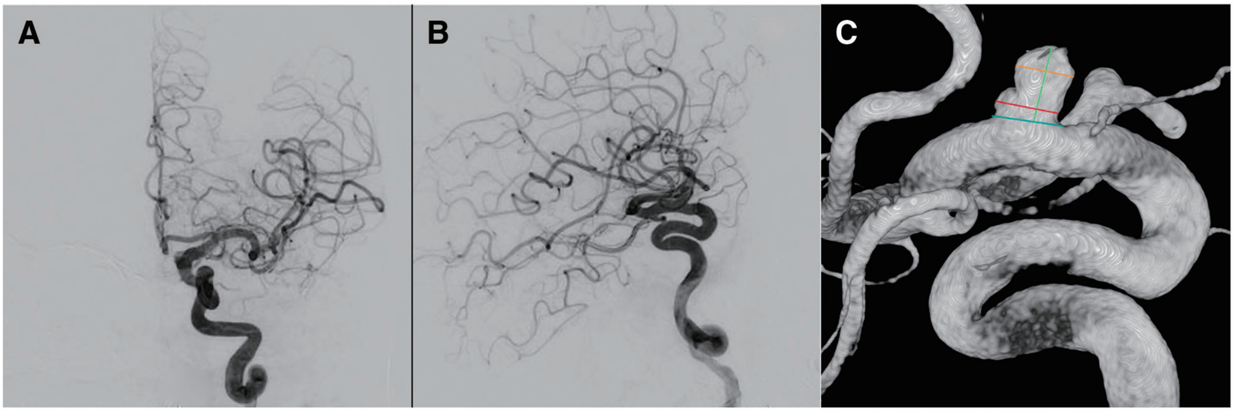

Fig. 1 Preoperative DSA view. (**A** and **B**) Overall images and ICA are found to be tortuous for the patient's age. (**C**) 3D rotation angiography showed an aneurysm with an irregular shape and wide neck type. ICA: internal carotid artery

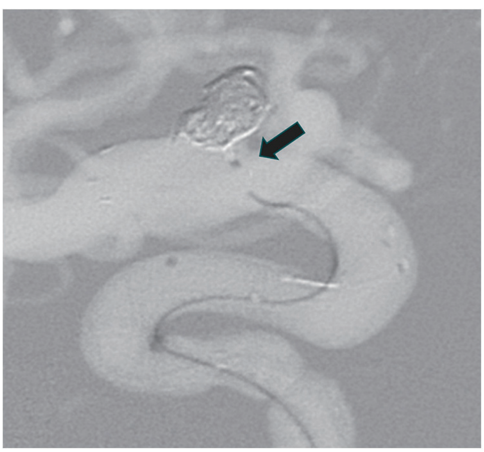

Fig. 2 Intraoperative DSA image. The microcatheter (arrow) was pushed out of the aneurysm.

The Headway was guided into the aneurysm. From the microcatheter (SL-10; Stryker) guided distally, the stent (Neuroform Atlas 4.5 mm × 21 mm; Stryker) was fully deployed from slightly more proximal than the posterior communicating artery. The 1st coil (Target XL 360 Soft 5 mm × 15 cm; Stryker) was filled from the Headway and a good frame was created. The Headway was unintentionally pushed out of the aneurysm when the second coil (Kaneka i-ED Coil SilkySoft 2 mm × 3 cm; Kaneka Medix, Osaka, Japan) had finished filling (**Fig. 2**).

We attempted to guide the Headway into the aneurysm again using the trans-cell technique; however, it was challenging. Attempts were made repeatedly for approximately 60 min, but the microcatheter could not be guided into the aneurysm.

Suddenly, we could no longer pull or push the Synchro (**Video 1**). We realized that it had entangled with the stent (**Fig. 3**).

We attempted to manipulate the tangled section using a balloon, but it was unsuccessful. Next, we attempted to pull the Synchro into the SL-10 and Tactics, but it was also unsuccessful. Finally, to carefully pull the Synchro, we grasped the area around the entangled Synchro using a 2-mm Goose Neck Snares (Medtronic, Minneapolis, MN, USA) (**Fig. 4A**). As a result, Atlas slipped off. During this process, the entanglement between the Synchro SELECT and Atlas stent was resolved, allowing the retrieval of Synchro (**Fig. 4B**). The Atlas stent remained in place near the proximal part of the ICA, and no further retrieval was done. A new Neuroform Atlas was placed on the neck of the aneurysm, and the procedure was terminated (**Fig. 4C**). Fortunately, postoperative computed tomography showed no signs of bleeding, and the MRI performed the following showed only minor ischemic changes. The patient was asymptomatic and discharged home.

Follow-up DSA at 1 year confirmed the absence of aneurysm. The slipped stent was deformed, and its exact shape is unknown, but the positioning of the markers does not appear to have changed (**Fig. 5**).

Experiment

A stent (Neuroform Atlas 4.5 mm 21 mm, Stryker) was implanted into a clear artificial vessel and guided using a combination of SL-10 and microguidewire (**Fig. 6**). Each microguidewire was shaped with a J-curved tip. We determined whether or not the entanglement of the microguidewire and stent could be reproduced. When the wire was pulled, if the stent moved with the wire, the stent and wire were considered entangled. The following three types of microguidewires were used: Synchro SELECT Soft (0.014 inch; Stryker), ASAHI CHIKAI

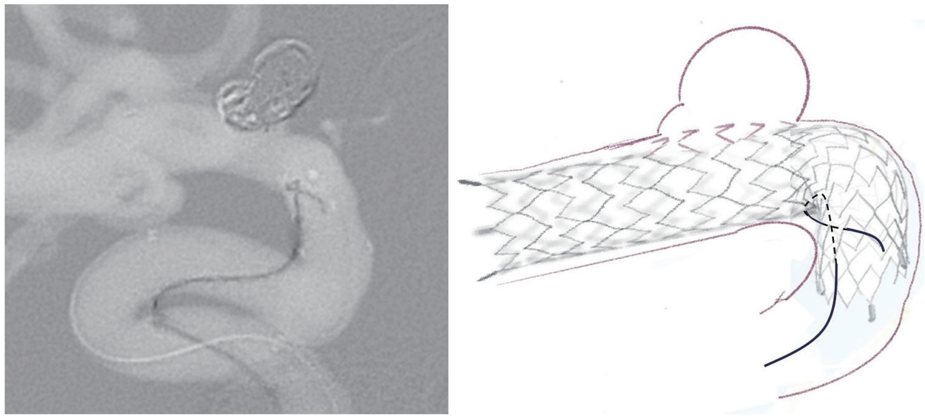

Fig. 3 Intraoperative DSA image showing the microguidewire being entangled with the stent and stuck.

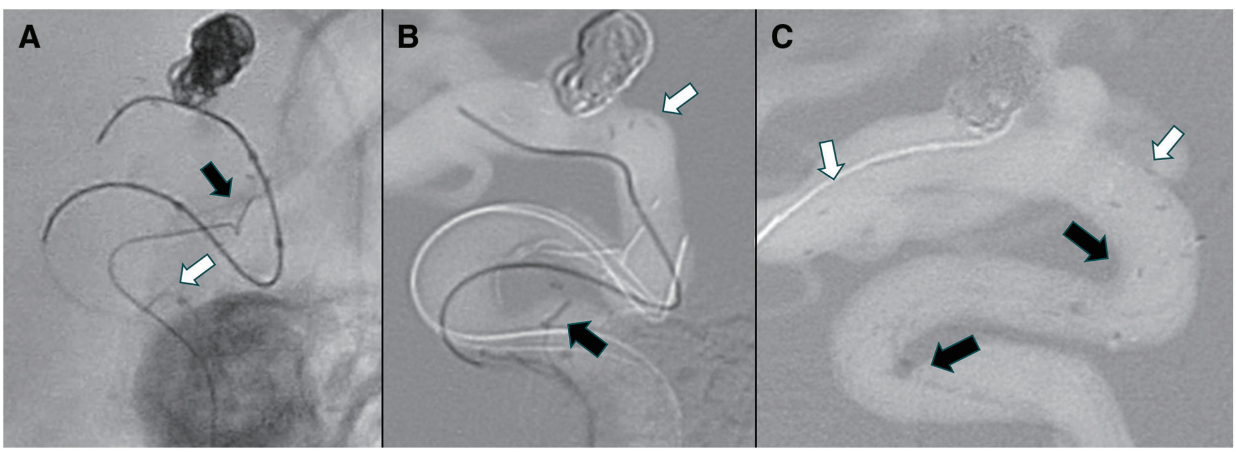

Fig. 4 Intraoperative DSA image. (**A**) Image of a 2-mm gooseneck snare (white arrow) being guided along a tangled microguidewire (black arrow). (**B**) Image of a microguidewire (black arrow) being pulled by a gooseneck snare and a stent (white arrow) in the process of sliding down. (**C**) A stent (black arrows) that has slipped down and a newly placed stent (white arrows).

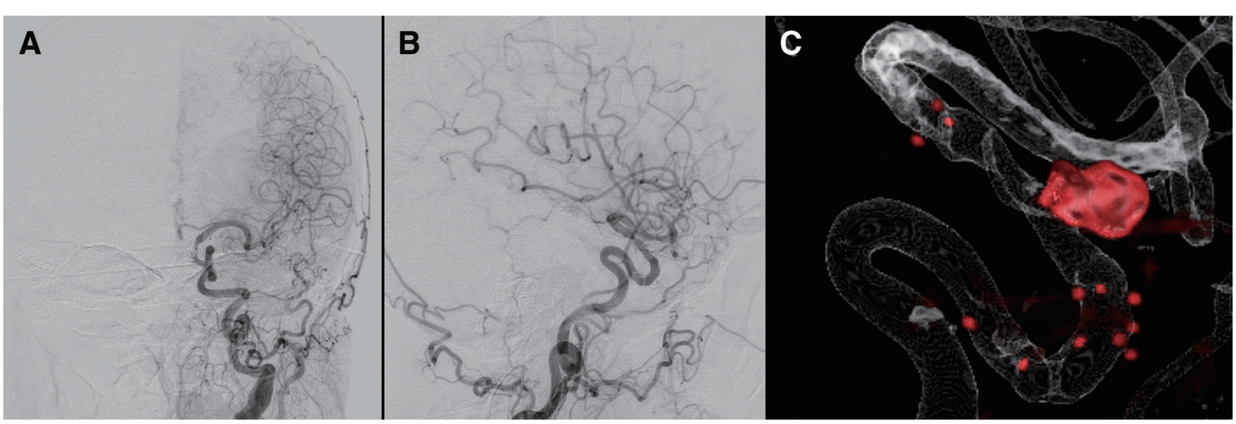

Fig. 5 Follow-up DSA image at 1 year. (**A** and **B**) Complete obliteration of the aneurysm is maintained. (**C**) The stent that slipped off appears to be deformed.

(0.014 inch; Asahi Intecc), and TENROU S (0.014 inch; Kaneka Medix).

When Synchro was used as the microguidewire, the microguidewire was passed through the stent from inside to outside to inside. When the guidewire was twisted, it easily tangled. The entanglement was released only when the guidewire could be twisted in the correct direction or when the guidewire was pulled to the outside of the

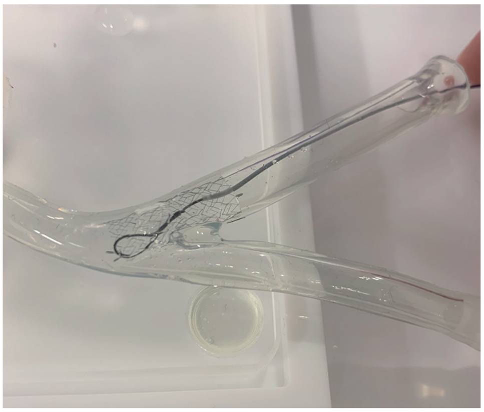

Fig. 6 Image of the experiment. The stent was implanted into a clear artificial vessel, and a combination of SL-10 and microguidewire was used to guide the wire into the stent. This system was used to examine whether the stent and microguidewire will entangle.

artificial vessel (**Video 2**). Subsequently, the guidewire was guided into the gap between the stent and vessel wall. When the wire was twisted after passing from outside to inside to outside of the stent, they became entangled. However, it was challenging to reproduce this wire running.

When CHIKAI was used as the microguidewire, the wire was twisted after passing from inside to outside to inside of the stent, resulting in entanglement, as observed in the case of the Synchro. However, it was somewhat difficult to run the CHIKAI in this route, and this process could only be performed twice in 5 min.

When TENROU was used as the microguidewire, the process was performed for 5 min, although we could not make it run in the same direction and entanglement was not observed.

Discussion

The Neuroform Atlas stent and Synchro SELECT can become entangled and cannot be removed. There are few safe management strategies for such a case; thus, efforts should be made to avoid this scenario.

Stent-assisted coiling (SAC) with the Neuroform Atlas stent is commonly used to treat wide neck cerebral aneurysms.[1–3] Although SAC with the jailing technique is generally applied as the first-line strategy, Neuroform Atlas SAC with the trans-cell technique is often performed because the Neuroform Atlas is an open-cell stent with a larger individual cell size as compared to closed-cell stents.

Some reports have described how to perform the trans-cell technique safely,[4–6] but their complications are rarely reported.[7–9] In case of the Neuroform Atlas stent and Synchro SELECT entanglement, causing difficulty in removal, severe complications may occur.

In the trans-cell technique, the first step is to ensure that the microguidewire is guided into the true lumen of the stent. It is important to guide the J curve microguidewire into the stent, as described elsewhere.[4] However, as in our case, if the J-shaped microguidewire is rotated in the stent, it may become entangled with the stent. Therefore, after guiding the catheter into the stent, it is considered important to change the microguidewire's shape to allow facilitate its insertion.

The Synchro SELECT guidewire is advantageous in terms of good tip shape retention and torque transmission. As demonstrated in the present case, when the J shape Synchro SELECT guidewire was rotated in the stent, it may entangle the struts of the stent. The mechanism of this entanglement was thought to be caused by the microguidewire passing from inside the stent, then outside, and back inside. Furthermore, in our case, when the stent and microguidewire became entangled, the attempt to pull the Synchro into the catheter may have reinforced the entanglement.

If the Atlas stent and the microguidewire become entangled, untangling them is difficult. Often, the cause of entanglement is a twist after the wire has traveled abnormally. Therefore, twisting in the appropriate direction may remove the entanglement before it becomes stronger by using other procedures. In our case, the stent slipped off when attempting to untangle the Atlas stent and the microguidewire by grasping the microguidewire with a gooseneck snare and performing pushing and pulling movements. Fortunately, the microguidewire was retrieved without damaging the artery, possibly due to the thick arterial wall in the area. However, in more distal areas where the arterial wall is thinner, traction on the Atlas stent carries a relatively high risk of arterial injury. A distal artery can be reached by craniotomy, which may be the safest approach. Alternatively, the microguidewire could be cut directly at the cervical artery and left in the artery. In any case, there is no safe, minimally invasive solution; thus, it is important to avoid the entanglement of the Atlas stent and microguidewire.

We think that trying the Transcell technique for a long time was one of the factors that caused this complication. Considering that the treatment was for an unruptured intracranial aneurysm, we think giving up additional coil placement was an option when considering safety and concerns about possible complications.

It is hoped that the present report would be of some use to similar cases.

Conclusion

The microguidewire shaped into a J curve can become entangled with the Neuroform Atlas stent. Often, the cause of entanglement is a twist after the wire has traveled abnormally. When twisting in the appropriate direction does not solve the problem, there are few safe, minimally invasive solutions. It is extremely important to prevent this complication from occurring.

Supplementary Files

Video 1: Intraoperative video

During the process of filling the aneurysm with coil, the microcatheter went outside the aneurysm; thus, we tried to guide it back into the aneurysm using the trans-cell technique. This video shows the scene after about 60 minutes of repeated trial and error. While manipulating the wire, suddenly we were not able to move the wire. When we tried to move the wire, the marker on the stent moved significantly, and we realized that the wire and stent had become entangled.

Video 2: Experimental video

We used a device in which an Atlas stent was implanted into the artificial vessel. We attempted to reproduce the entanglement phenomenon between the microguidewire and Atlas stent. Once entangled, they could not be released except by twisting the microguidewire in the correct direction.

Disclosure Statement

The authors declare that they have no conflicts of interest.

References

1) Chalouhi N, Jabbour P, Singhal S, et al. Stent-assisted coiling of intracranial aneurysms: predictors of complications, recanalization, and outcome in 508 cases. *Stroke* 2013; 44: 1348–1353.
2) Kwon O, Chung J. Outcomes of stent-assisted coiling using the Neuroform Atlas stent in unruptured wide-necked intracranial aneurysms. *J Korean Neurosurg Soc* 2021; 64: 23–29.
3) Shirakawa M, Yoshimura S, Uchida K, et al. Coil embolization for cerebral aneurysms using a semi-jailing technique and open-cell stent. *World Neurosurg* 2019; 125: e16–e21.
4) Cho YD, Rhim JK, Yoo DH, et al. Microguidewire looping to traverse stented parent arteries of intracranial aneurysms. *J Korean Neurosurg Soc* 2017; 60: 262–268.
5) Dofuku S, Sato M, Sato D, et al. Trans-cell approach through closed-cell stent for middle meningeal artery embolization in recurrent chronic subdural hematoma. *NMC Case Rep J* 2021; 8: 847–850.
6) Ohshima T, Kawaguchi R, Maejima R, et al. A novel technique for stent-assisted coil embolization of intracranial aneurysms: the wireless trans-cell approach. *Asian J Neurosurg* 2019; 14: 1122–1125.
7) Hanaoka Y, Koyama JI, Yamazaki D, et al. Passability and impassability of microcatheters through the Neuroform Atlas stent during the trans-cell approach: an experimental evaluation. *World Neurosurg* 2020; 141: e474–e483.
8) Saal-Zapata G, Durand W, Ghodke BV, et al. Endovascular strategies for stroke management after subacute in-stent thrombosis. *J Clin Neurosci* 2020; 81: 18–20.
9) Shim YS, Park SK, Chung J. Preliminary experience of stent salvage using Neuroform Atlas stent for procedure-related complication during coil embolization of intracranial aneurysms. *Clin Neurol Neurosurg* 2020; 190: 105654.