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Original Article

A Novel Technique for Stent-Assisted Coil Embolization of Intracranial Aneurysms: The Wireless Trans-Cell Approach

Abstract

Background: When inserting coils under stent deployment, a jailed microcatheter technique is typically applied as a first line approach. However, the trans cell approach might be required to achieve satisfactory complete occlusion. The trans cell approach occasionally ends in failure because the catheter cannot safely follow a proceeding guidewire into the aneurysm. Here, we report the new wireless trans cell approach (WTA), which allows feasible and safe catheter navigation through the stent strut into the aneurysm, without a proceeding guidewire. **Methods:** A straight tip microcatheter was used, and the tip was shaped as a very small bend of approximately 45°. The side aspect of the catheter tip exhibited a right angled edge, while the front aspect showed a round curve in the advancing direction. We compared the 45° microcatheter with a straight tip microcatheter using a silicon vascular model and then applied the WTA in a case of an unruptured basilar apex aneurysm. **Results:** Catheter navigation through the stent strut was smoother with the WTA than the conventional wire assisted approach. Our case of a basilar apex aneurysm was successfully treated with the dual catheter technique, which involved a jailed catheter and navigation using the WTA. After stent deployment from the right posterior cerebral artery to the basilar artery through the 45° microcatheter, the WTA was applied using the same catheter. No stress was detected during catheter navigation through the stent strut into the aneurysm. **Conclusions:** The WTA is associated with smoother catheter navigation compared with the conventional wire assisted approach in cases of a terminal type aneurysm.

Keywords: *Coil embolization, endovascular treatment, intracranial aneurysms, stent*

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Introduction

Endovascular coiling is one of the primary treatments of intracranial aneurysms. At present, coiling is performed even for very wide-necked aneurysms with stent deployment. When inserting coils under stent deployment, a jailed microcatheter technique is generally applied at a first line.[1-3] However, a trans-cell approach is required when the jailed catheter unexpectedly escapes out of the aneurysm before completion or when additional coil embolization is planned for retreatment after stent-assisted coiling. The trans-cell approach occasionally ends in failure because the catheter cannot safely follow the proceeding guidewire into the aneurysm. Moreover, sudden jumping-in of the microcatheter to release the accumulated pushing force through the stent strut into the aneurysm is very dangerous. This might cause a catastrophic subarachnoid hemorrhage owing to aneurysmal perforation involving the catheter. Here, we report a new technique, which is called the wireless trans-cell approach (WTA). This technique allows feasible and safe catheter navigation through the stent strut into the aneurysm without a proceeding guidewire. We herein discuss the utility of our method.

Materials and Methods

In this study, we used the SL-10 straight microcatheter (Stryker Neurovascular, Kalamazoo, MI, USA) and Neuroform Atlas stent (Stryker Neurovascular). The microcatheter tip had a very small bend of approximately 45°. The microcatheter tip was manually bent using an inner mandrel, and it was heated with a hot air gun (BOSCH, Gerlingen, Germany) [Figure 1]. The microcatheter tip was set at 3 cm from the nozzle of the hot air gun, which had a temperature of 130°C for 30 s. We noted that the front view showed a round curve while the lateral

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view showed a right angle in the catheter's advancing direction [Figure 2]. In a terminal-type aneurysm, we thought that a straight-tip catheter would not easily pass the stent strut even using a guidewire because the straight tip has a flat plain surface [Figure 3], whereas a 45° catheter would easily pass the stent strut because the tip has a column edge and not a plain surface. We evaluated the difference between the straight tip and 45° microcatheter using a silicon vascular model (*in vitro* experiments) and then applied the WTA to a case of an unruptured basilar apex aneurysm.

Results

The results of *in vitro* experiments are presented in Figure 4a-d. When we attempted to navigate the straight-tip microcatheter using a proceeding guidewire through the stent strut into the aneurysm, the catheter was excluded by the stent in almost all attempts. The stent occasionally showed deformation and deviation. On the other hand, the WTA was smoother than the conventional wire-assisted approach with regard to catheter navigation through the stent strut. The 45° microcatheter could be easily passed through any window of the stent [Figure 4b-d].

Representative case

A 69-year-old female was admitted for endovascular treatment of a basilar apex aneurysm [Figure 5]. The maximum dome size was 6.9 mm. She received dual antiplatelet therapy for 2 weeks before treatment, and then, coil embolization was performed using the stent-assisted technique. Under general anesthesia, a 6-Fr guiding catheter was placed at the right vertebral artery via the transfemoral approach. First, an SL-10 straight microcatheter, with the tip shaped at 45° just below the first marker for the WTA, was navigated into the right posterior cerebral artery. Then, a Headway 17

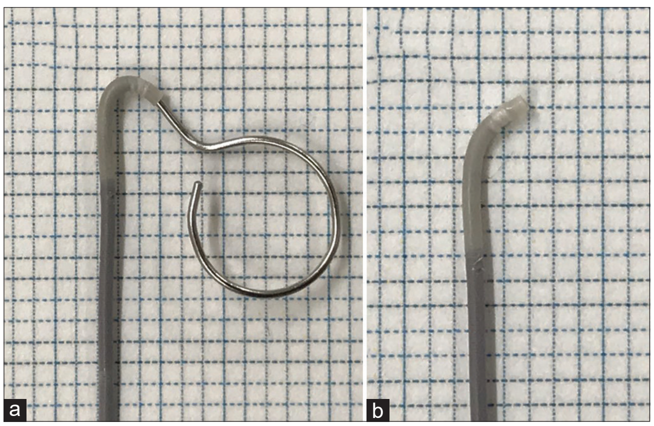

Figure 1: (a) Photograph of a manually bent straight microcatheter with a shaping mandrel attached to the microcatheter. (b) Photograph of the microcatheter tip after heating over a hot air gun. A very small 45° tip is obtained

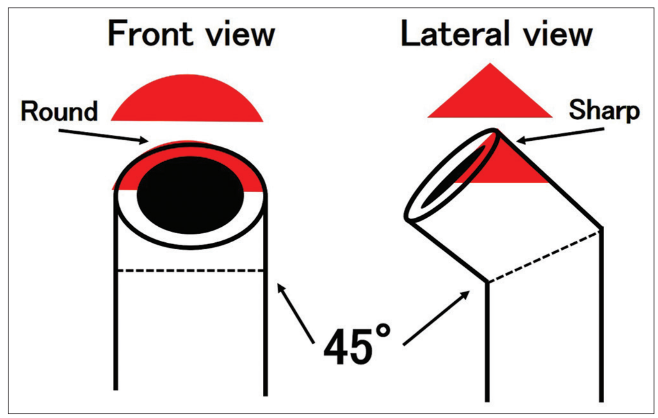

Figure 2: Schematic drawing of the very small 45° tip. The front view showing a round curved tip, and the lateral view showing a rectal-angled edge in the catheter's advancing direction

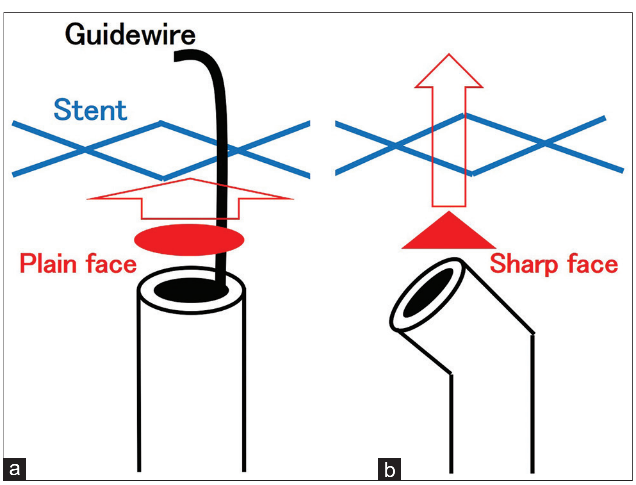

Figure 3: Schematic drawings of the conventional wire-assisted approach (a) and the wireless trans-cell approach (b). The plain surface of the straight catheter pushes the stent strut into the aneurysm, even when using a guidewire, whereas the very small 45° tip pushes aside the stent structure gently

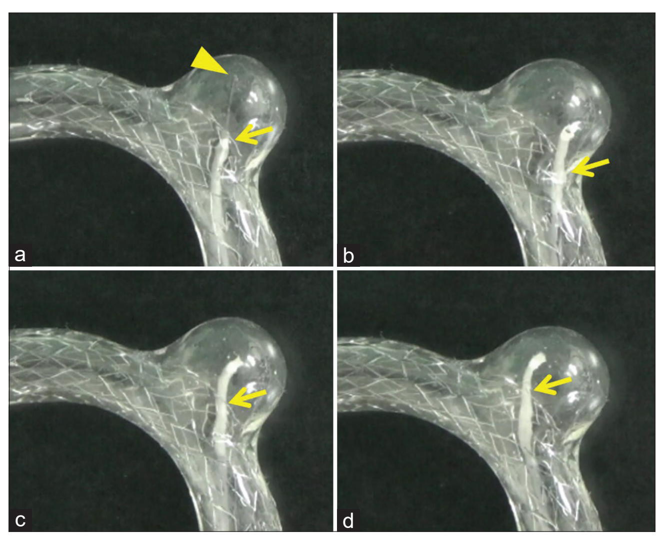

Figure 4: Photograph of *in vitro* experiments. (a) When using a straight microcatheter (arrow) with a guidewire (arrowhead), the catheter cannot pass the stent strut. (b-d) When using the wireless trans-cell approach, the catheter tip (arrows) can pass each stent strut smoothly

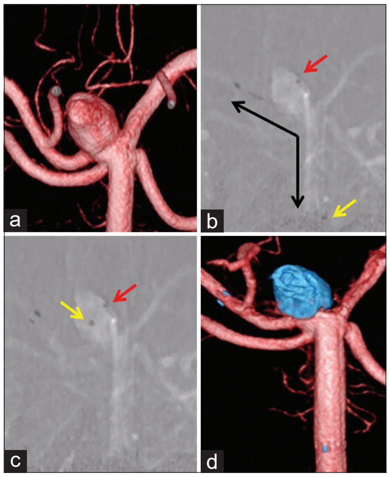

Figure 5: (a) Preoperative three-dimensional angiography. (b) An intraoperative road-mapping image. The red arrow indicates a jailing microcatheter. The yellow arrow indicates a very small 45° catheter, which had been released the stent. The black arrows indicate the area of the deployed stent. (c) An intraoperative road-mapping image. The red arrow indicates the previously navigated catheter. The yellow arrow indicates a very small 45° catheter. (d) Postoperative three-dimensional angiography

preshaped 45° microcatheter (Terumo, Tokyo, Japan) was navigated into the aneurysm as a jailed catheter. Thereafter, a Neuroform Atlas stent (3.0 mm × 21 mm) was deployed from the posterior cerebral artery to the basilar artery. Then, the stent-delivered SL-10 microcatheter was advanced into the stent lumen and was passed through the stent strut into the aneurysm, without a guidewire. The catheter tip smoothly went through the stent. After inserting two coils via the jailed catheter, the jailed catheter unintentionally escaped from the aneurysm. Therefore, additional coils were inserted via the trans-celled catheter. The aneurysm was sufficiently embolized using a total of six detachable coils. A magnetic resonance diffusion image acquired on the postoperative day 1 showed only one small high-intensity spot. The patient was discharged on the postoperative day 4 without any complication. Aneurysm recurrence was not noted during 4 months of follow-up.

Discussion

We found that a very small 45°-tip catheter could be more easily passed through the stent mesh when compared with a straight-tip catheter using a proceeding guidewire in terminal-type intracranial aneurysms. As the tip of the 45° catheter has a column edge, it pushes aside the stent structure gently. On the other hand, the straight-tip catheter has a tip with a plain surface, and this plain surface pushes the stent strut into the aneurysm even when using a guidewire. Furthermore, the excessive pushing force might cause stent migration or aneurysmal perforation owing to the jumping-in phenomenon of the catheter. Thus, physicians prefer the jailing approach to the trans-cell approach, and the jailing approach is generally applied at a first line.[1-3]

Although the jailing approach is favorable, it has some problems. First, the movement of the catheter tip is restricted by the stent itself. Thus, the deployed coils are likely to be eccentric. The limited movement of the catheter indicates more stress at the aneurysmal wall during coil insertion. Second, when the catheter unexpectedly escapes out of the aneurysm, repositioning is difficult. In particular, in case of a shallow aneurysm, the jailing catheter can easily escape during coil insertion and even just after only the stent deployment. Third, the deployed stent does not fit against the vessel wall until the catheter is retrieved. Stent apposition during coil insertion might be a risk factor of periprocedural thromboembolism. These problems can be overcome with our safe WTA.

When a microcatheter is navigated using the WTA, it is mandatory to obtain the stent true lumen with a guidewire. In the present case, the 45°-tip catheter could be advanced using the stent-delivery wire. If this approach fails, a pigtail-shaped microguidewire can be used to guide the catheter through the stent flare. We agree with the utility of the modified pigtail-shaped microguidewire for secure maneuvers, as reported previously.[4-6] The modified pigtail wire is used only to enter the stent flare. Once the catheter has entered the stent true lumen, the wire is withdrawn into the catheter for the WTA.

In this study, we evaluated the WTA using only the SL-10 microcatheter. We considered that the SL-10 with nontapering tip was more adequate for the WTA than other microcatheters with tapered tip, such as Headway 17 microcatheter and XT-17 microcatheter (Stryker Neurovascular). However, in some cases, the Headway 17 microcatheters could be navigated through the stent strut without any resistance using the WTA.

In the present study, we have evaluated the efficacy of the WTA for the terminal-type aneurysms. However, we believe that the WTA is also useful for the lateral-type aneurysms. In addition, it is important to determine whether the primary 45° curve created forward or backward against the secondary curve is better. According to our preliminary experiments, both shapes could be passed through the stent. Studies involving larger numbers of experiments and cases are necessary to confirm our findings and further assess the efficacy of the WTA.

Conclusions

We presented our new technique called the WTA. The WTA is associated with easy and smooth catheter navigation when compared with the conventional wire-assisted approach in cases of terminal-type aneurysm.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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