Guidewire Tip Detachment during Stent-Assisted Coiling of an Intracranial Aneurysm

A Case Report

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Summary

Endovascular treatment of complex intracranial lesions often requires use of two different microcatheters or micro-guidewires. A basilar artery aneurysm was treated with microstent-assisted coiling. During the procedure a microwire severed and the distal platinum portion of the wire was left after unsuccessful attempts to retrieve it. The patient remains asymptomatic. The proximal part of the microwire was analyzed and additional experiments indicate that it may have detached by electrolytic corrosion.

Introduction

Endovascular treatment of complex intracranial lesions often requires use of two different microcatheters or micro-guidewires. A basilar artery aneurysm was treated with microstent-assisted coiling. During the procedure a microwire severed and the distal platinum portion of the wire was left after unsuccessful attempts to retrieve it. The patient remains asymptomatic. The proximal part of the microwire was analyzed and additional experiments indicate that it may have detached by electrolytic corrosion. With the recent introduction of specially designed intracranial stents some wide necked aneurysms can now be treated by combining microstents and coils¹. This often requires concurrent use of two microcatheters or guide-

wires. We report a technical complication resulting from this technique. Our hypothesis is that the security wire, through the microstent, may possibly have detached by electrolytic corrosion while in contact with the stent.

Case Report

This patient, a 60-year-old woman, presented with a subarachnoid hemorrhage and hydrocephalus. Cerebral angiography demonstrated a 10 mm saccular aneurysm originating from the right half of a non-fused (fenestrated) segment of the proximal aspect of the basilar artery (Figure 1). Surgical clipping of the aneurysm was considered an option but coiling using a microstent to remodel the wide neck at the level of the fenestration was chosen. The patient was preloaded with acetylsalicylic acid and clopidogrel bisulfate (Plavix; Bristol-Myers Squibb/Sanofi Pharmaceuticals, New York, NY). A 6-French sheath was placed in the right femoral artery and a 5-French sheath was placed in the left. Full anticoagulation with intravenous heparin (USP, Wyeth-Ayers & Co., Philadelphia, PA) was started immediately after arterial puncture. The activating clotting time (ACT) was maintained between 250-350 seconds. After diagnostic angiography had been performed, appropriate working angles were registered for microstent delivery and aneurysm coiling.

Figure 1 Three dimensional reconstructions from a rotational angiogram of the aneurysm at the level of the vertebrobasilar junction.

A preloaded 3.5 x 20-mm Neuroform Stent 2 (Boston Scientific/Target, Fremont, CA) was advanced through a 6-French Envoy guiding catheter (Cordis Neurovascular, Miami Lakes, FL) and placed in the distal portion of the right vertebral artery.

With the previously inserted microwire, numerous attempts were made to access the more distal basilar artery through the level of the fenestration and the aneurysm but this was unsuccessful. Therefore, an X-celerator™ – Exchange Hydrophilic Guidewire (Micro Therapeutics, Irvine, CA, USA) was used through a Prowler-10 microcatheter (Cordis Corporation, Miami Lakes, FL), to navigate across the neck of the aneurysm. The distal portion of this wire was placed in the proximal portion of the right posterior cerebral artery.

After removal of the microcatheter the microstent was delivered over the wire and laid across the wide neck of the aneurysm passing through the left limb of the fenestration. An uncomplicated deployment of the stent was carried out and the exchange wire was left in position as a security measure. Before deploying the microstent a two tip Prowler-10 microcatheter (Cordis Corporation, Miami Lakes, FL) was placed into the aneurysm through a 5-French Envoy guiding catheter in the left vertebral artery. Coiling of the aneurysm was therein carried out with protection of the neck

afforded by the presence of the microstent. The first coil used was a Micrus (Micrus Therapeutics, CA, USA) spherical 10-mm in diameter, followed by a Micrus spherical 8 mm. An additional eight coils were deployed into the basket, including four Micrus coils and four Guglielmi Detachable coils (GDCs) (Boston Scientific/Target, Fremont, CA). Despite this, there was inadequate packing of the lower portion of the aneurysm. It was therefore decided to place another microcatheter into the lower portion of the aneurysm, taking advantage of the microwire remaining through the microstent. The wire tip was positioned in the basilar artery, just above the level of the distal markers of the microstent. An Excelsior SL-10 microcatheter (Boston Scientific/Target, Fremont, CA) was easily maneuvered over this exchange length microwire. Slight back tension was exerted on the wire in order to bring the microcatheter around the curve at the C1-C2 level. During this maneuver it was apparent that the wire had severed and the distal platinum portion of the wire remained in the vessel, extending from the C1 level of the vertebral artery through the microstent into the mid portion of the basilar artery.

A decision was made not to attempt its removal at this stage (Figure 2). The Excelsior SL-10 microcatheter was directed into the lower portion of the aneurysm using a regular

Figure 2 A) Before the detachment of the microwire, the arrow points to the solder joint. B) After the detachment of the distal tip of the microwire. C) The final results from the stenting and coiling. Note the microwire still in place.

length Transend EX Platinum microwire 0.010 (Boston Scientific/Target, Fremont, CA) and an additional eight Micrus coils were placed with excellent packing of the residual aneurysm (Figure 2). With the aneurysm now secured, several attempts were made to retrieve the severed portion of the microwire unsuccessfully. The retained wire did not appear to be causing hemodynamic effect. Vasospasm had developed in the distal right vertebral artery and was treated with angioplasty (Figure 2B). A follow up angiogram seven days later showed complete packing of the aneurysm and the retained wire tip in the same position as before. The patient has remained asymptomatic at seven months follow-up.

Analysis and Additional Experiments

After this incident we contacted three manufacturers (MTI, Boston Scientific and Micrus) to find out whether they were aware of any similar occurrence. None of the manufacturers had observed or had similar incident reported. The companies conducted various experiments after this incident. Data from these experiments that we think is of relevance to this report are presented.

Exposure of a Guidewire to Current

The severed microwire was sent to the manufacturer for analysis. The following analysis

Figure 3 Proximal site of the test micro-guidewire after electrolytic detachment at the level of the solder joint between the platinum tip and the pushing component of the wire (A) and the actual micro-guidewire used in our case showing a similar "failure signature" (B) which is different from a torque or fatigue injury.

Figure 4 A) Appearance of the solder joint of a Transend 300 Floppy micro-guidewire. Dimensions of the guidewire were measured; core wire is approximately the same diameter as the coil wire around it. B) Appearance of the micro-guidewire after the detachment of the first coil (detachment time = 143 seconds). On the left half is the solder joint shown on the right edge of A. C) After detachment of the second coil (total detachment time = 235 seconds). Similar section of the device is shown. On the left half, the inner wire has become loose (arrow).

was done in the MTI laboratory. A new X-cel-erator 10 exchange guidewire was directly connected to a detachment system control unit (anode). The distal guidewire tip and a cathode were placed in a beaker of saline. Visible damage to the wire was noted by 60 seconds of exposure to current. The device fractured after a total of 500 seconds exposure to current. Figure 3 compares the proximal site of this wire to the proximal site of the guidewire used in the actual case. This type of “failure signature” is very similar to the catheter micro-guidewire used in our case and indicates that electrolytic corrosion may have been involved. According to the engineers consulted, a “failure signature” cause by torquing or fatigue injury would have a different appearance.

Indirect Exposure of Current through Guidewire

A Transend 300 Floppy micro-guidewire (Boston Scientific/Target, Fremont, CA) was placed in contact with series of coils immersed

in saline. The proximal end of the coil delivery pushing wire was connected to a detachment system control unit (anode) and current was delivered until the coil detached. Visible damage to the micro-guidewire’s core wire was noted after a single detachment of 143 seconds duration. Repeated detachments resulted in additional electrolysis of the core wire and solder joints (Figure 4).

Other Experiments

In a series of experiments conducted by Boston Scientific/Target various types of GDCs were attached to a Neuroform stent. In each experiment two coils were attached to the stent were, one which was not connected to the detachment control unit (passive) and another which was connected and then detached (active). During detachment of older generation GDCs (GDC-3) detachment of the passive coil occurred. With the newer 10 generation of GDCs no such incident occurred with a total of seven active coils being detached. Micrus Corporation performed a series of experiments in an anatomical glass model. They could not measure current in the detachment medium during detachment of their own coils.

Hypothesis

We hypothesize that the distal platinum portion of the security microwire was in contact with the deployed stent. As coils were being detached within the aneurysm, current was transmitted to the stent and proximally in the microwire to the solder point to cause it to break.

Discussion

Neuroform microstent was the first stent to be approved for use in the intracranial circulation¹. With its more frequent use some acute or delayed complications have been described²⁻⁴. Technical complications include difficulty or inability in deploying the stent, stent displacement, inadvertent stent deployment, coil stretching and thromboembolic complications^{5,6}. Our experience with this technique has had overall good results, with a small complication rate⁷. We present a previously unreported complication that occurred during microstent-assisted coiling of an aneurysm of the basilar artery. The exact mechanism of the wire de-

tachment is not clear. Analysis of the proximal fracture site indicates that it may have occurred by electrolytic corrosion as the failure signature at the tip of the retrieved guidewire was similar to the signature of the same type of wire where electrolysis was induced by connecting the wire and activating it through a detachment control unit. Such passive detachment also occurred in the experiment with older generation GDCs of which 11 have much less diameter and are designed to detach. Newer generation of GDC coils (SynerG) are insulated electrically from the pusher/delivery wire and thus should not conduct current through the coils to the microstent according to the manufacturer.

During detachment of Micrus coils no current could be measured in the detachment medium. However, during detachment of Micrus coils the detachment box will supply a set amount of power for five seconds, regardless of when the coil detaches. Therefore, some of the energy used in the detachment cycle could potentially be transferred on to the coil mass should it be in contact with the detachment zone. A shorter time of detachment, such as seen in Micrus Therapeutics coils, most likely implicates a higher current applied to the coils during detachment.

During complex endovascular procedures interventional neuroradiologists often use multiple products from different companies to facilitate the procedure and with more complex procedures the rate of complications most likely increases. Individual companies thoroughly test their own products for compatibility but do not routinely test their products in combination with products from other companies. This can lead to potential problems as illustrated in this

case report and it is difficult to analyze when two different products with distinct mechanisms for coil detachment are used. During set up for detachment of coils, the microwire in the opposite system can be accidentally connected to the detachment control unit leading to detachment of its platinum portion distally. In our case we know this did not occur because we always cover the microcatheters and wires that are not in use in the opposite side. We would recommend a set up such as this whenever dual systems are being used.

Conclusions

With more complex neuroendovascular procedures, new unforeseen technical complications are likely to occur. We describe a case of microwire platinum tip detachment during microstent-assisted coiling of an intracranial aneurysm. Although experiments performed by the different manufactures did not reveal the exact mechanism of the wire detachment, the analysis of the proximal fracture site of the detached microwire suggests that it may have been caused by electrolytic corrosion. This has resulted in a change in our practice where we now do not leave guidewires within the microstent during sent-assisted coiling after the stent has been delivered.

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