Coil Migration through a Neuroform 3 Stent during Endovascular Coiling

A Case Report

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Summary

A 43-year-old woman attended for stent assisted coiling. A Neuroform 30 x 4.5 mm stent had been successfully placed over the left periorbital aneurysm. During the coiling the first coil migrated through the crown in the stent, lodging at the MCA bifurcation. We believe that the coil herniated through the overlying stent due to the carotid siphon curvature and the open cell design. Furthermore the distal markers of the stent impeded coil extraction with a MERCI device.

Introduction

Endovascular occlusion of cerebral aneurysms is an established technique in the management of cerebral aneurysms. Techniques have evolved which enable us to treat broad-necked aneurysms including balloon remodeling¹ and stent assisted coiling.

Case Report

A 43-year-old woman presented after an incidental finding of three cerebral aneurysms on MRA. The two right carotid aneurysms were successfully coiled on two separate occasions. A left periorbital aneurysm was too broad-necked to coil unassisted and therefore a 30 mm x 4.5 mm Neuroform 3 stent (Boston Scientific/Target, Fremont, CA, USA) was placed across the aneurysm neck. The procedure was uncomplicated with the platinum struts in a satisfactory position the patient returned home well on

dual antiplatelet therapy to return in six weeks for endovascular coiling of this aneurysm.

Six weeks later angiography showed that the aneurysm was unchanged and measured 4 x 2.5 mm (Figure 1). The stent remained in its correct position and a 0.17 Courier catheter (Micrus, Sunnyvale, CA, USA) was advanced over a transcatheter wire to the aneurysm. The catheter was successfully placed in the aneurysm after a number of attempts. The initial coil was advanced (Cerecyte 2.5 x 3.3 cm Micrus, Sunnyvale, CA, USA). Despite our optimal working angle difficulty arose in ascertaining whether or not this first coil was completely inside the aneurysm or whether some of the loops protruded into the parent vessel. A low contrast DynaCT (Siemens Medical Solutions, Forchheim, Germany) although reconstructed according to the recommended protocol was unable to identify the struts of the stent. The CT did show a probable coil herniation through the stent into the carotid (Figure 2) and the coil was removed.

The microcatheter was repositioned and another coil (Hydrocoil, 2 x 4cm, MicroVention, Aliso Viejo, CA, USA) placed which had a more favourable appearance (Figure 3). This was deployed and followed by a second coil (Hydrocoil, 2 x 3cm) at the same catheter position. As the second coil neared the point of detachment the first coil herniated in its entirety into the parent vessel (Figure 4). The second coil was retracted and the herniated coil drifted toward the middle cerebral artery (MCA). Attempts were made to retrieve the coil using the MERCI device (Concentric Medical, Inc,

Figure 1 Angiogram at the working angle with a 2.5 mm periphthalmic aneurysm.

Mountain View, CA, USA). Although successful on gaining purchase on the herniated coil, on withdrawing the device it consistently failed to enter the distal end of the stent at the level of the distal markers (Figure 5).

The coil herniated further up the MCA. No more retrieval efforts were made and 4 mg Ateplase was administered locally through the microcatheter to improve the compromised flow in the MCA. The patient remained on heparin. On post operative neurological assessment the only deficit was some subtle decrease in the extensors of the right hand.

Figure 2 Axial MPR of low contrast DynaCT with placed coil visible within the carotid lumen and failure of distal stent markers to be proud to lumen wall (arrow).

Discussion

The Neuroform stent was the first self-expanding intracranial stent. It was a significant advance in the treatment of broad-necked aneurysms which providing a low profile and flexible scaffold to anchor coils in place². The latest generation stent, the Neuroform 3, has a similar open cell design to its predecessor. It has a nitinol structure made up of rows of 'crowns' each measuring 2.5 mm which are attached at three points in a 180 degree circumference.

The success of this tool has been described in small numbers of patients^{3,4}. However, there are a number of considerations to be taken into account when placing any intracranial stent including technical difficulty of accurate placement, potential migration⁵ and thrombogenicity. We perform delayed coiling to reduce the risk of stent migration and the manufacturer advocates placing the stent at least 4 mm proximal and distal to the aneurysm neck.

A primary advantage of this design of stent is its ability to conform and comply correctly with the intimal surface of tortuous vessels in which they are placed even at very acute angles. At angiography the stent proper is radiolucent with only the most peripheral platinum markers seen. In our case, when the initial coil was placed it appeared to exit the stent and compromise the vessel. We performed an on table DynaCT to resolve the issue. The visibility of the crowns was poor but the distal ends were well visualized and were seen not to conform to the wall of the vessel, which inhibited coil retrieval. The stent was placed quite distally in what appears from the image (Figure 2) to be a curved part of the vessel rather than the straight portion of the vessel which is the recommended site of distal placement. This fact may have compromised complete apposition of the stent. However, the internal carotid artery was tortuous in its entire intracranial component and the straightest portion was actually just distal to the aneurysm. Placement of the stent here would result in it being inside the minimum distance required from the aneurysm, 4 mm.

The coil sizes, initially 2.5 mm and then 2 mm may appear to be too small for an aneurysm measuring 2.5 x 4 mm. Under normal circumstances in a narrow-necked aneurysm without a stent these coils would certainly be undersized

Figure 3 2.5 x 4 cm hydrocoil placed which appeared to be in good position. The proximal and distal stent markers are also visible on this unsubtracted image.

Figure 4 The placed coil has migrated into the carotid vessel. The microcatheter remains in the aneurysm with a second coil now withdrawn to the catheter.

relative to the aneurysm. However the objective of the stent is to ensure the placed coil stays within the aneurysm and remains in that aneurysm immaterial of whether it is only 2 mm, helical or complex.

In vitro studies have addressed the apposition of stents within vasculature including carotid and coronary stents. Hsu et Al⁶ described the direct visualization of twelve Neuroform stents with macro photography after placement in eight cadaver intracranial arterial segments under replicated clinical conditions. Regardless of the potential confounding factors the study did show that the open cell design certainly does conform well to the vessel contour in which it is placed. However the ability of the stent to adapt to the shape and bridge the neck of the aneurysm is dependent on a number of factors. These include the degree of curvature of the vessel, location of the connecting strut and any potential transition in vessel diameter. They noted that in areas of increased angulation such as the carotid siphon there was a real probability that the crowns can separate excessively at the apex of the greater curvature thus increasing the intercrown area, particularly if the connecting strut is not at the orifice of that aneurysm. Similar work was performed by Ebrahimi et Al where the Neuroform 3, the Enterprise and

LEO stents were compared⁷. The authors found that the Neuroform 3 stent did show outward prolapse of crowns into an aneurysm when it was situated at the convexity of a curvature. This has also been found during a case of elective

Figure 5 The migrated coil with MERCI device distal to it lodged at the level of the distal markers.

basilar coiling in which angiographic CT was used to visualize the stent⁸. This imaging tool does allow for a superior method of viewing stents and the potential prolapse of the stent or widening of cells into the aneurysm⁹.

The open cell design of the Neuroform 3 allows distal placement in tortuous vessels. How-

ever it allows opening of the crowns particularly if the aneurysm is located at a point of curvature such as the carotid siphon. In our case this opening allowed a successfully deployed coil to be dislodged and migrate distally. Non-conformity of the distal end of the stent prevented coil retrieval.

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