Experience of Y-Configured Stents for Small Basilar Tip Aneurysms

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Summary

Among posterior circulation aneurysms, basilar tip aneurysm is the most difficult to treat. Because of their deep location in front of the brainstem and their intimate relationship to perforating vessels, morbidity and mortality rates associated with direct exposure used to be daunting.

Complex intracranial aneurysms are not uncommonly encountered in cerebrovascular practice. Often their complexity can render standard treatment either impossible or exceedingly hazardous. Although endovascular therapy is an available alternative to surgical clipping, it is not without risks.

The Neuroform stent represents a significant advance in the endovascular treatment of intracranial aneurysms. The Y-configured reconstruction method of the Neuroform stent may represent a variable therapeutic option especially in the case of terminal type including bifurcation aneurysms.

We report the results of our experience in two small basilar tip aneurysms using stent-assisted coiling.

Introduction

Endovascular treatment of intracranial aneurysms has substantially improved in recent years¹. The recent publication of a multicenter randomized trial showed improved safety and

clinical outcome of patients treated with endovascular treatments compared with surgical clipping^{2,3}. Despite rapid advances in the development of endovascular devices such as new coil configurations, embolic materials and stents, small broad-necked aneurysms still pose a therapeutic challenge.

The present paper describes two patients in whom a small, acutely ruptured, broad-neck basilar tip aneurysm was treated by means of a Y-configured stent technique.

Technique

Patients were not pretreated with antiplatelet drugs (Patients were started on 75 mg of clopidogrel and 300 mg of aspirin on the same evening or the next morning if the intervention was performed in the evening or during the night). On the first day in the hospital, an aneurysm at the basilar tip aneurysm was found in cerebral angiography, and the coiling was implemented under Monitored Intravenous Anesthesia Care by using Propofol and Alfentanil. After completion of the diagnostic angiogram, patients were anticoagulated with heparin adequate to keep the activated clotting time longer than 2-2.5 times the baseline value. A 6F guide catheter was placed in the left vertebral artery.

A 3 x 20 mm and 3 x 15 mm self-expanding stent (Neuroform; Boston Scientific/Target

Figure 1 Initial noncontrast brain computed tomography (CT) scan showing subarachnoid hemorrhage in the prepontine cistern.

Therapeutics, Fremont, CA) was prepared by attaching the stent delivery catheter and stabilizer to heparinized saline flushed, and advancing the stabilizer into the delivery catheter proximal to the stent. The initial stent placed was 20 mm in length and was deployed from the left PCA into the basilar artery. The second 15 mm stent was advanced over the wire through the first stent within the basilar artery into the right PCA.

The stents were deployed over the neck of the aneurysm in a satisfactory position. After successful stent placement, coiling was performed with Guglielmi detachable coils (GDCs; Boston Scientific, Fremont, CA) through a microcatheter (Excelsior SL-10; Boston Scientific, Fremont, CA) and a microwire (Transend 14; Boston Scientific, Fremont, CA) placed in the aneurysm through the mesh of the stent. After undergoing stent placement, the patient received clopidogrel (75 mg daily) for six weeks and aspirin (300 mg daily) indefinitely, homeostasis was achieved by use of an arterial closure device and heparin was not reversed at the end of the procedure.

Case Illustration

Case 1

This 58-year-old woman was transferred from a local hospital due to symptoms of acute headache and decreased consciousness. Brain computed tomography (CT) revealed a subarachnoid hemorrhage in the prepontine cistern (figure 1). The clinical condition at presentation was equivalent to grade III of the Hunt and Hess grading scale. On the first day in the hospital, diagnostic cerebral angiography revealed a basilar tip aneurysm, measuring approximately 2 x 2 mm in size (figure 2). Due to the size, location of the aneurysm and the poor clinical status of the patient, surgical clipping were not considered feasible. Subsequently, we elected to proceed with basilar artery to posterior cerebral artery (PCA) stent placement to reconstruct the basilar artery apex.

Following placement of the stents, the aneurysm was embolized with one ultra-soft coil (GDC-10; 2 mm x 2 cm) (figure 3A, B). After the procedure, the patient was taken to the intensive care unit (ICU). She was maintained on oral antiplatelet agents for six weeks and heparinization for three days. The patient was discharged from the hospital without any neurological defects on the 18th day of hospitalization. Follow-up angiography six months after treatment revealed complete occlusion of the aneurysm (figure 4).

Case 2

A 55-year-old female presented with severe headache. On brain CT, subarachnoid hemorrhage in the basal cistern was identified. We performed catheter angiography of the vertebral artery in the standard fashion. Cerebral angiography revealed a small basilar tip aneurysm measuring approximately 3 x 3 mm in size (figure 5). The aneurysm was embolized with three platinum coils (GDC-10; 3 mm x 4 cm, 2.5 mm x 3 cm, 2 mm x 3 cm).

Although the neck of the aneurysm was covered with the stent, abrupt protrusion of the first coil could not be prevented (figure 6A-C). In this case, aneurysm dome and neck size were both 3 mm and unfavorable orientation of the stent struts across the neck may result in insufficient support for small coils. The patient was maintained on oral antiplatelet agents for six weeks and heparinization for three days. The patient is doing well clinically, without any deficits.

Discussion

The treatment of intracranial aneurysms with endovascular coils has become an important and well known alternative to microsurgical clip placement^{1,2,3}. Detachable coils are established as a safe and effective treatment option for many intracranial aneurysm patients^{2,3}. Although this treatment does not represent a useful option for the treatment of certain types of complicated aneurysms, broad-based aneurysms are still complicated to embolize because of the risk of coil migration or coil protrusion into the parent vessel⁴.

A large percentage of such aneurysms were amenable to coiling after the introduction of the balloon-assisted coiling technique⁴ and of three-dimensional coils. Balloon-assisted coiling is used to protect the parent artery lumen during coil delivery within the aneurysm^{4,5,6}. However, this technique may fail to retain coils in aneurysms with relatively large necks. Moreover, it is associated with a higher rate of thromboembolic events because of occlusion of the parent artery⁷. Cross et Al⁸ reported on the use of Neuroform stent deployment for the treatment of basilar tip aneurysms via a posterior communicating artery (PcomA) route. However, this technique cannot be used when the PcomA is very small in size or when its geometry is too tortuous to allow catheterization via this route.

Complete obliteration of the aneurysm from the circulation is the obvious goal of both clipping and coiling. In various endovascular series,

Figure 2 Frontal view of the left vertebral angiogram showing the small aneurysm at the basilar artery bifurcation before stent-assisted coiling.

complete aneurysms occlusion rates between 21% and 84% when using detachable coils have been reported^{9,10,11,12}, the relatively broad range being explained by differences in aneurysm size and morphological composition. For example Pierot et Al¹¹, reported a 73.5% rate of total occlusions and Raymond et Al¹² reported a 42% rate of total occlusions in a series of basilar apex aneurysms.

In analyzing factors that might influence the long-term stability of the angiographic result, Fernandez Zubillaga et Al¹³, found a positive correlation between angiographic results and

Figure 3 A) Frontal view of the left vertebral angiogram showing the small aneurysm at the basilar artery bifurcation after stent assisted coiling. B) Immediately posttreatment, frontal view unsubtracted left vertebral angiography demonstrating an optimal stents position and no residual filling in aneurysm.

Figure 4 Follow-up angiography six months after treatment revealed complete occlusion of the aneurysm.

aneurysm neck size. They observed that narrow-necked aneurysms could be obliterated completely in 85% of cases, whereas in wide-neck aneurysms complete occlusion was accomplished in only 15%.

The Neuroform stent, a Nitinol self-expanding stent delivered through a microcatheter, offers several substantial advantages over the preexisting balloon expandable coronary stents primarily related to the increased flexibility of the stent and delivery system, which allows safe navigation and deployment. The stent itself is

Figure 5 Frontal view of the left vertebral angiogram showing the small aneurysm at the basilar artery bifurcation before stent-assisted coiling.

‘open-cell’ with two or three fusion points between stent elements. The cell size between elements ranges from 2.0 to 2.7 Fr in the sheath. The open cell design makes the self-expandable stent system highly flexible but is large enough to allow protrusion and migration of coils in the curvature segment^{14,15}.

Stent-assisted coiling provides important technical and theoretical advantages^{14,15}. By providing secure and durable protection of the parent vessel, a broad-neck aneurysm theoretically could be more completely packed with coils with less risk of rupturing, coil migration and parent artery obstruction. The stents may produce flow redirection and disruption of the aneurysm inflow and outflow zones resulting in hemodynamic uncoupling of the parent vessel-aneurysm complex. This hemodynamic advantage may help to reduce coil compaction in the region of the inflow zone and prevent subsequent growth of the aneurysm.

The application of an endovascular stent as an adjunctive technique to coil embolization has evolved quickly in recent years^{14,15}. These reports on the unconventional use of the Neuroform stent have provided intelligent technical solutions to difficult endovascular cases.

Henkes et Al¹⁶ successfully deployed two stents in a “kissing” configuration to treat a fusiform aneurysm of the upper basilar trunk, whereas Thorell et Al¹⁷ and Perez-Arjona et Al¹⁸ reported on a Y-configuration deployment of two stents applied in the treatment of a broad-neck basilar tip aneurysm.

However, this might be of limited use in small size acutely ruptured, broad-neck aneurysms. Although small aneurysms are frequently encountered, the endovascular treatment of these lesions can be technically demanding¹⁹. Small size is a challenge for aneurysm catheterization, risk of dome perforation by the microcatheter that loads and springs forward, and difficulty placing multiple coils¹⁹. In many cases with small aneurysms, it is often not possible to place more than a single coil. Therefore, approximate coil selection is very important.

Although we only treated two cases, we experienced no periprocedural thromboembolic events with no pretreatment of our patients with antiplatelets in ruptured aneurysms. Some authors report that the premedication of antiplatelet drugs is strongly recommended to prevent the thromboembolic events enhanced by stent positioning^{14,15}. However, in the case of

Figure 6 A) Frontal view of the left vertebral angiogram showing the small aneurysm at the basilar artery bifurcation after first coil detachment under stent deployment. B) Immediately posttreatment, frontal view of the left vertebral angiogram showing no residual filling and bilateral posterior cerebral artery (PCA) are patent. C) Immediately posttreatment, frontal view unsubtracted left vertebral angiography demonstrating an optimal stents position and no residual filling in aneurysm but coil loop prolapse into the left PCA.

ruptured aneurysms, the procedures should be performed as early as possible; the recommended premedications of antiplatelet drug for two or three days in most cases could not be used. Katsaridis et al²⁰ reported a series of 44 patients treated with stent-assisted coiling for ruptured intracranial aneurysms who were not pretreated with oral antiplatelet agents. Satisfactory aneurysm occlusion was achieved in 94.4% of their cases, whereas there was no aneurysm bleeding and no aneurysm recanalization or thromboembolic events were reported. More clinical data with long-term follow-up are needed to help establish the role of stent-assisted coiling for ruptured broad neck aneurysm and pretreatment with antiplatelet therapy.

The Y-configured stent method may represent a variable therapeutic option, especially in the treatment of small, acutely ruptured aneurysms, in which direct coiling is not considered feasible or believed to be too dangerous. But we think that this method should bear in mind that the risk of coil protrusion through the

stent would be higher if the first coil size is less than 3 mm.

Conclusions

The Neuroform stent is a useful device for the treatment of aneurysms that may not otherwise be amenable to surgical or traditional endovascular treatment strategies. This technique represents a viable treatment option for patients with broad-neck basilar tip aneurysms. But the long-term efficacy of this challenge is unknown, and further long-term follow-up review is necessary.

We believe the size of the aneurysm and the first coil play a major role, and recommend always keeping in mind the possible untoward coil protrusion in this technique.

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