Balloon or Stent-assisted Coil Embolization for Acutely Ruptured Wide-necked Aneurysms

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Summary

In this paper, we report five cases with acutely ruptured wide-necked aneurysms, which were treated with coil embolization using a balloon or stent-assisted technique. Balloon-assisted coil embolization using Equinox balloon, Commodore balloon, and Hyperform balloon were performed for four patients and stent-assisted coil embolization using BX velocity for one patient. We discuss problems of coil embolization for acutely ruptured wide-necked aneurysms with a balloon or stent-assisted technique.

Introduction

A wide-necked aneurysm is difficult to treat because coils easily protrude into the parent artery during or after embolization. There are limits to occluding wide-necked aneurysms with only the standard coil embolization technique. Therefore, an adjunctive technique, such as balloon-assisted coil embolization or stent-assisted coil embolization, is necessary to avoid the coil protruding into the parent artery. However, this technique remains challenging in acutely ruptured aneurysms because of the risk of rupture during the procedure. We report five cases of acutely ruptured aneurysms treated with various types of balloon-assisted or stent-assisted technique, and discuss the periprocedural problems of these techniques.

Material and Methods

In 91 patients, who were treated with coil embolization for acutely ruptured aneurysms in our institution and branch hospitals, balloon or stent-assisted coil embolization was performed in five patients with wide-necked aneurysm.

These cases are summarized in table 1. Generally, we performed the neck remodeling technique for wide-necked aneurysms we cannot treat with standard coil embolization. Coil embolizations for acutely ruptured aneurysms were performed under general anesthesia in our institute. If we use a balloon or stent-assisted technique for acutely ruptured aneurysms, we keep the patient under anesthesia for 24 hours after embolization with anticoagulant or antiplatelet therapy and mild hypotension in our intensive care unit.

Results

Endovascular treatment was performed for all five patients with acutely ruptured wide-necked aneurysm within three days from the onset. All patients were successfully treated with no periprocedural complications such as perforation of aneurysm, thromboembolic events, and rebleeding. Anticoagulant or antiplatelet therapy was continued after embolization, but no rebleeding was encountered.

Figure 1 Balloon-assisted coil embolization with "double balloon technique". A) Preoperative angiogram shows a basilar apex wide-necked aneurysm. B) The distal part of the Equinox occlusion balloon is positioned into the the right PCA and its proximal part is positioned at the aneurysmal neck. The distal part of the Commodore occlusion balloon is placed into the left PCA and its proximal part is placed into the basilar artery. Both balloons were inflated during coil placement to avoid coil protrusion. C) Postoperative angiogram shows complete aneurysm occlusion with the patency of bilateral posterior cerebral arteries.

Case 3 (figure 1)

A 54-year-old woman was admitted to our hospital with subarachnoid haemorrhage. Cerebral angiography showed a basilar apex aneurysm and a basilar artery (BA)-left superior cerebellar artery (SCA) aneurysm at the time of admission. Coil embolization was performed for these aneurysms on the following day. Initially, the standard technique was tried for the BA aneurysm, but the coil easily protruded into the parent artery. Secondly, we treated it using a neck -remodeling technique with a Hyperform balloon. We could occlude the aneurysms completely with no complications. The patient was discharged without any new neurological deficits.

Case 4 (figure 2)

An 85-year-old woman was referred to our hospital with severe headache, and her consciousness deteriorated to semicomatous state immediately after admission. Head CT showed severe subarachnoid haemorrhage and cerebral angiography demonstrated a basilar apex aneurysm. The patient was treated with coil embolization on the following day. Because it was difficult to treat with standard coil embolization due to the wide neck, a special neck remodeling technique, so called double balloon technique, was performed using an Equinox balloon and a Commodore balloon. The aneurysm was completely obliterated with the coils,

but the patient's neurological status remained unchanged. She died due to severe pneumonia 1 month after embolization.

Case 5 (figure 3)

A 59-year-old man was admitted to our branch hospital with severe headache. Head CT showed subarachnoid haemorrhage and cerebral angiogram demonstrated a fusiform aneurysm on the lower basilar artery trunk. On the 3rd day after admission, we scheduled stent-assisted coil embolization to preserve the patency of the basilar artery. Initially, we carefully placed a BX Velocity stent across the aneurysmal neck. Secondly, we introduced a microcatheter into the aneurysmal sac through the stent strut, and then aneurysm occlusion with coils was performed. We could completely occlude the aneurysm, and the patient was discharged with no neurological deficit.

Discussion

The neck remodeling technique, which was reported by Moret et Al. as balloon-assisted coil embolization, has become one of the most popular adjunctive techniques for treating wide-necked aneurysms^{1,4,6}.

The neck-remodeling technique prevents the coil from protruding into the parent artery, and keeps microcatheter position stable in the aneurysm. The neck-remodeling technique en-

Figure 2 Balloon-assisted coil embolization with a Hyperform occlusion balloon. A) Preoperative angiogram shows a basilar apex wide-neck aneurysm with a bleb and a small BA-SCA bifurcation aneurysm. B) The Hyperform balloon is placed into the BA bifurcation. The distal part of the inflated balloon is bulging into the aneurysmal neck and the left PCA, and its proximal part is positioned in the basilar artery. C) Postoperative angiogram shows total occlusion of the both aneurysms with patency of bilateral posterior cerebral arteries.

abled treatment of wide-necked aneurysms, and reduced the size of aneurysm remnant after coil embolization, consequently improving the embolization ratio with dense coil packing. More recently, other new devices have been developed for treating wide-necked aneurysms, such as more compliant balloon, intracranial

stent system, and neck-bridge device^{2,3,5,8}. These devices have enabled us to treat wide-necked aneurysms with not only balloon-assisted coil embolization but also stent-assisted coil embolization.

In Japan, a low-compliant balloon, such as Equinox (MTI; Micro Therapeutics Irvine),

Table 1 Clinical characteristics of 5 patients.

Case	age/sex	lesion	H&K	timing	technique	device	ER(%)	complication, outcome
1	80/F	rt. IC-PC	grade 4	day 1	balloon assist	Equinox	25.5	none, SD
2	79/F	rt. IC-PC	grade 2	day 2	balloon assist	Equinox	24.1	lt. haemiparesis (embolism)
3	54/ F	BA tip BA-lt. SCA	grade 2	day 2	balloon assist	Hyperform	33.5	none, GR
4	85/F	BA tip	grade 4	day 2	balloon assist	Equinox, Commodore (double balloon technique)	31	none, SD
5	59 /M	BA trunk	grade 3	day 3	stent assist	BX VELOCITY	23.3	none, GR

BA; basilar artery, IC; internal carotid artery, PC; posterior communicating artery
SCA; superior cerebellar artery
ER; embolization ratio, SD; severe disability, GR; good recovery

Figure 3 Stent-assisted coil embolization. A) Preoperative angiogram shows a lower basilar trunk wide-necked aneurysm. B) A coronary stent, BX Velocity, is placed across the orifice of the aneurysmal neck. C) A microcatheter was positioned into the aneurysm through the stent strut and coils were packed uniformly. D) Angiogram after embolization shows complete occlusion of the aneurysm with patency of the basilar artery.

Copernic (Balt) and Sentry (Boston Scientific), has been used mainly for treating wide-necked sidewall aneurysms with a simple balloon-assisted technique. If we use these balloons for treating bifurcation aneurysms such as basilar apex or middle cerebral artery bifurcation, we

often have difficulty remodeling the neck of the aneurysm. Recently, a new, more compliant balloon, Hyperform (MTI), has become available for treating complex bifurcation aneurysms two in Japan. This balloon is so supple that it can adapt its cylindrical shape to the

anatomy of the surrounding vessels. Consequently, we can easily treat complex bifurcation aneurysms such as basilar artery bifurcation and middle cerebral artery bifurcation with a simple balloon-assisted technique.

Recent publications have reported that the Neuroform stent (Boston Scientific) has been used for treating wide-necked aneurysms with stent-assisted coil embolization^{3,7}. Stents are easy to handle, but it is uncertain whether the perforating artery can preserve its patency or not after stent placement. The Neck-bridge device, Trispan (Boston Scientific), has also been proposed to treat complex aneurysms, but this device is sometimes difficult to deploy adequately⁸. In Japan, we cannot use the above-mentioned devices such as Neuroform stent, Trispan. We can only use a coronary stent for stent-assisted coil embolization at present.

Balloon or stent-assisted coil embolization has some problems as follows. When we apply unexpected pressure to the aneurysm wall during coil placement, the risk of perforating the aneurysm increases. The risk of thromboembolic complication is also considered to increase with these techniques, because temporary occlusion of the parent artery is inevitable and

balloon or stent inflation in the vessel causes injury to the arterial wall. Therefore, sufficient anticoagulant or antiplatelet therapy is necessary during and after the procedure.

These problems are more important and troublesome if we treat acutely ruptured aneurysms. When we treat acutely ruptured aneurysms with a balloon or stent-assisted technique, we keep in mind that; 1) the aneurysm should be embolized as tightly as possible to avoid rebleeding, 2) the patient should be managed under anesthesia for 24 hours after the procedure, and continue to receive sufficient anticoagulant or antiplatelet therapy immediately after embolization.

We think that the balloon or stent-assisted technique for acutely ruptured aneurysms does not enhance the risk of rebleeding during and after coil embolization, if the procedure is performed by experts.

Conclusions

The balloon or stent-assisted coil embolization is useful and almost risk-free for treating acutely ruptured wide-necked aneurysms if performed by experts.

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