CASE REPORT

Double lumen remodelling balloon: A new technique for treatment of bifurcation aneurysms

Ballon de protection à double lumière. Une nouvelle technique pour le traitement des anévrismes de la bifurcation

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Summary Bifurcation aneurysms (carotid bifurcation aneurysms, top of basilar artery aneurysms and middle cerebral artery aneurysms) are frequently treated by endovascular treatment (EVT) but their treatment is sometimes difficult singularly when the neck is wide. The ”remodelling technique” is used for the treatment of these difficult aneurysms. However, the use of this technique is more complicated in bifurcation aneurysms compared to side-wall aneurysms. It is effectively necessary to protect in the same time the aneurysm neck, the parent vessel, and also the collateral branches. We present endovascular treatment of two cases of bifurcation aneurysms using a new technique of remodelling for endovascular treatment of bifurcation aneurysms by using a double lumen balloon.

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Introduction

The endovascular approach is more and more considered as the first therapeutic option for the treatment of intracranial aneurysms [1]. Moreover, new devices such as remodelling balloons and self-expandable stents have enlarged the indications of endovascular treatment (EVT).

Bifurcation aneurysms (carotid bifurcation aneurysms, top of basilar artery aneurysms and middle cerebral artery aneurysms) are frequently treated by EVT but are sometimes technically challenging due to the complex anatomy of the bifurcation. Bifurcation aneurysms are often wide necked and/or incorporate the origin of arterial branches in the aneurysm base [2].

The ”remodelling technique” for the treatment of these difficult aneurysms was initially described by Moret et al., 1997 [3]. A temporary, inflated balloon is placed in front of
the aneurysmal neck during each coil placement to avoid inadvertent coil protrusion into the parent artery.

The remodelling technique is relatively easy to use for sidewall aneurysms like carotid siphon aneurysms. For bifurcation, the use of this technique is more complicated as it is necessary to protect in the same time the aneurysm neck, the parent vessel, and also the collateral branches. For this purpose, several options are available: peer-shaped remodelling balloons, round balloons, double balloon technique. For carotid bifurcation or top basilar aneurysms, it is also possible to place a regular remodelling balloon perpendicular to the neck by using a Pcom approach, but it’s not feasible for middle cerebral artery (MCA) aneurysms.

In our cases, we present a new technique of remodelling for endovascular treatment of bifurcation aneurysms by using a double lumen balloon.

Case 1

A 60-year-old male was presented with unruptured left MCA bifurcation aneurysm measuring nearly 10 mm in its long axis, 7 mm in its transverse axis and the neck was about 4 mm. Both parents were presented with subarachnoid hemorrhage after aneurysm rupture. According to the patient age, aneurysm size and family history of aneurysm rupture, it was decided to treat the aneurysm. Endovascular approach was chosen by a multidisciplinary team. Remodelling technique was used due to the size of aneurysm neck. After establishment of anticoagulation by introducing a bolus dose of heparin 50 IU/kg associated with peri-operative intravenous injection of 250 aspirin followed by intravenous infusion of heparin 25 IU/kg/hour, a guiding catheter (6 Fr, Envoy, Cordis Endovascular System or Shuttle, Cook, Inc.) was inserted in the left carotid siphon and a balloon double lumen remodelling ASCENT 4 × 7 mm (Micrus Endovascular Corp, San Jose, California, USA), was navigated and inflated in front of the neck permitting the deployment of coils, through the internal lumen of balloon (Fig. 1).

Case 2

A 41-year-old male was presented with ruptured basilar termination aneurysm measuring 11 mm in its long axis, 7 mm in transverse axis the neck was about 4 mm with dome to neck ratio 2.75. A balloon double lumen remodelling ASCENT 4 × 7 mm, was inflated in front of the neck which allowed us to deploy the first two coils in the aneurysm sac through the internal lumen of balloon and to make a remodelling at the neck by protecting both P1 segments. Then 12 coils were deployed in the aneurismal sac. No intraoperative complications was observed. Final angiogram showed quite satisfactory occlusion of the aneurysm sac, scale Montreal: B (Fig. 2).

Discussion

In ISAT, EVT was more effective than clipping for all aneurysms, whatever their location [4]. Management of bifurcation aneurysms remains singularly difficult when the neck is wide [3].

The remodelling technique enables aneurysms to be treated that are not suitable for treatment with coils alone, specially in wide-neck aneurysms, which are challenging from both a technical and clinical point of view [5]. According to ATENA and CLARITY analyses, the remodelling is used in all aneurysm locations, but less frequently in anterior communicating and anterior cerebral aneurysms [6,7].

In sidewall aneurysms, the balloon is simply placed in the parent vessel in front of the aneurysm neck. For bifurcation aneurysms, the situation is more complex as it is necessary to protect completely the neck to avoid coil protrusion. In this situation several options are possible:

- to put the balloon in the parent vessel and one bifurcation artery and to inflate it sufficiently to cover completely the neck. Some balloons are specifically designed for this purpose with a pear-shape when inflated but with pear-shaped balloons it is not always possible to protect the neck and collateral branches completely;
- to put two balloons in front of the aneurysmal neck. For example, for a basilar tip aneurysm, one balloon is placed in the basilar artery and in one posterior cerebral

Figure 1  A. Sequences of EVT of MCA bifurcation aneurysm. Cerebral angiogram of the left ICA (3 D reconstruction) showing left MCA bifurcation aneurysm measuring 10 mm in its long axis, 7 mm in its transverse axis and the neck was about 4 mm. B. Inflated double lumen balloon in front of the neck permitting the deployment of coils, through the internal lumen of balloon (black arrow). C. Cerebral angiography showed quite satisfactory occlusion of the aneurysm sac, scale Montreal: B. D. Left ICA DSA, oblique view, non-injected, non-subtracted image showing the coil mesh. Notice three markers; distal two marker bands for optimal placement of balloon (black arrows) and one proximal marker band 3 cm from the distal end, which allows delivery of coils (white arrow).
Double lumen remodelling balloon: A new technique for aneurysm treatment

Figure 2  A. Sequences of EVT of top of basilar artery aneurysms. Cerebral angiogram of the vertebrobasilar artery (A-P view) showing basilar termination aneurysm measuring 11 mm in its long axis, 7 mm in transverse axis the neck was about 4 mm. B. Left vertebral DSA, oblique view, non-injected, non subtracted image showing the coil mesh. C. Cerebral angiography showed quite satisfactory occlusion of the aneurysm sac, scale Montreal: B.

artery and another one on the other side. Double balloon technique need to have three devices in the bifurcation:
• to put a round balloon sticked on a microcatheter in front the aneurismal neck. With round balloons, navigation has to be done without guidewire and stability of the balloon is sometimes difficult to obtain. As this type are no more available, this technique can no more be used;
• to use a double lumen microcatheter remodelling balloon.

ASCENT Occlusion Balloon Catheters (Micrus Endovascular Corp, San Jose, California, USA) set a new device for neurovascular balloon performance. It is compatible with .014″ or smaller guidewires, the ASCENT balloons feature a coaxial, dual-lumen design to provide stability, deliverability, conformability, and visibility.

This coaxial dual-lumen design provides a central inner guidewire lumen compatible with .014 or smaller guidewires, it is .017 inch in diameter, and a parallel outer lumen for contrast allowing balloon inflation and deflation regardless the position of guidewires.

The ASCENT balloon (Micrus Endovascular Corp, San Jose, California, USA) has three markers; distal fully integrated two marker bands for optimal placement of balloon and one proximal marker band 3 cm from the distal end, which allows delivery of coils. The balloon is delivered in front of the neck with the microguidewire inside the neck. The guidewire is removed followed by deposition of the coils in the aneurismal sac through the central inner guidewire lumen.

The advantage of this new technique rather than classical hyper compliant balloon or double balloon technique is that with this new double lumen balloon, we can protect the neck and collateral branches without using many devices in the bifurcation and avoid the anatomical changes which occur after deflation of balloon. Also by using this technique, we can avoid associated risk of combined anti-platelets therapy which occurs during treatment of such bifurcation aneurysms using the stent/balloon or the double stent technique [8]. This balloon can only be used in aneurysms larger than 6 mm because the distal end of the balloon resting inside the aneurisimal sac is 3 mm in length.

The “remodelling technique” can lead to some reported complications like aneurism or vessel rupture, vasospasm, thromboembolic events and coil migration or coil protrusion into the parent vessel. The two most frequent complications of the endovascular treatment of intracranial aneurysms are thromboembolic events and intraoperative rupture [9—11]. No complications was reported in our cases.

Our cases confirmed that bifurcation aneurysms can be treated with an endovascular approach using remodelling technique with a double lumen balloon.

Conclusion

Use of a double lumen balloon is a satisfactory alternative to treat bifurcation aneurysms with the remodelling technique.

Conflict of interest statement

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

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