Coil-Induced Perforation of Recently Ruptured Cerebral Aneurysm during Embolization

Causes and Avoidance

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Summary

Most coil-induced aneurysmal ruptures during endovascular treatment occur in small, recently ruptured aneurysms, and after placement of at least one coil. In cases where the distal part of the microcatheter cannot move back due to its straightness and tightness, the last coil deployed may advance towards the aneurysmal wall through intercircles of deposited coils. To solve this problem, after complete occlusion of the sac is obtained, the microcatheter is slightly withdrawn until the tip of the catheter is placed in the neck, and then the neck is occluded with the appropriate coil.

Introduction

Endovascular embolization with GDCs has been accepted as the treatment of choice for patients with cerebral aneurysm¹⁻³. Data from 13 studies in the literature revealed that the incidence of procedure-related aneurysmal rupture during endovascular therapy is 2.5%⁴.

Our purpose is to present a case of aneurysmal rupture during treatment with GDCs after tight packing of coils and to discuss the cause and how to avoid rupture.

Case Report

A 52-year-old woman presented with subarachnoid haemorrhage that had occurred five days previously. Left vertebral arteriography detected a small aneurysm at the beginning of the PICA. It was measured as 6 x 8 mm by 3D spiral CT angiography. Its body measured 6 x 6 mm. The neck of the aneurysm was small ($r = 3$ mm) (figure 1A). The patient was referred for endovascular therapy. On the night before treatment, a second bleeding occurred and the patient became comatose.

The aneurysm was selectively catheterized by using a rapid-transit microcatheter (Cordis). The tip of the catheter was placed in the proximal third of the aneurysmal cavity. The basket was formed with the initial coil (GDC-10, 6/15) sized to match the aneurysm cavity (Fig 1B). Then three more coils (GDC-10, 3/8, 3/3, 2/8) were placed in the center of the basket created by the first coil without any problem. Tight packing in the dome of the aneurysm was achieved but the neck was still patent. We introduced another coil (GDC-10, soft SR 2/4) to fill the neck. Although the tip of the microcatheter was close to the neck, the coil did not remain at the neck, but perforated the lateral

wall of the aneurysmal sac and partially protruded. Left vertebral arteriogram showed extravasation of contrast agent (figure 1C). Then, coil deployment was continued. The proximal part of the coil was placed in the aneurysmal sac, whereas the distal part of the coil was left out of the sac. Control angiogram obtained after detachment of the coil did not reveal any extravasation of contrast agent (figure 1D). We then withdrew the microcatheter slightly as the tip of the catheter was positioned in the neck of the aneurysm (figure 1D) and a last coil (GDC-10, soft SR 2/4) was placed in the neck without any problem. The final angiogram showed complete occlusion of the aneurysm and no extravasation (figure 1E). Hydrocephalus was depicted on CT scan five days after the procedure and ventriculostomy was performed.

Discussion

Intraoperative aneurysm rupture, coil migration, vasospasm and embolic accident are the feared complications of endovascular therapy. There are several reports on procedure-related aneurysm perforation during endovascular treatment⁴⁻⁹. The reported incidence of aneurysm perforation in the literature is 2-4.4%. It usually occurs due to guidewires, microcatheters, coils or increasing pressure resulting from contrast agent injection^{2,4-8}. Re-rupture of aneurysm may occur with the first coil^{7,8}. However, most of the ruptures occur during deployment of the subsequent coils after placement of at least one coil^{4,5,10}. The presence of flow in the aneurysm facilitates its growth and thus there is fear of re-growth and rebleeding in incompletely obliterated aneurysms. That is why additional coil/s are needed to obtain dense packing or to obliterate the neck of the aneurysm. Hayakawa et Al reported a 17% recanalization rate in small aneurysms with small necks and 42% in small aneurysms with wide necks after incomplete coiling (with neck remnant)¹¹. The reported rates of re-growth and rebleeding of an aneurysm with neck remnant were 14.7% and 7.9%, respectively¹². However, to occlude the neck of an aneurysm, excessive packing with coils may result in its rupture. Ringer and Hopkins stated that procedure-related perforation of aneurysms could be avoided by forming a basket or shell with three-dimensional coils sized to match the aneurysm

Figure 2 A) In the presence of an angle on the tip of the catheter, the force of deploying a coil against the deposited coils makes the catheter move backward so that the last coil circles in the neck. B) If the catheter is straight and tight, its movement backward is not possible. The delivering coil advances towards the aneurysmal wall as a result of forces produced by the deposited coils and their pusher.

dome⁵. However, in our case in spite of forming basket with the first coil (figure 1B), and placement of the following coils in the center of the basket, the last coil outpouched the aneurysm. We supposed that the causes of aneurysm rupture with the last coil were aneurysmal wall fragility due to recent and repeated rupture just before endovascular treatment and tightness and straightness of the distal part of the microcatheter (figure 1D).

When the tip of the microcatheter advances straight into the aneurysm instead of in a curve due to the anatomic configuration of the aneurysm in relation to the parent artery and it is placed in the middle of an aneurysm, the last coil desired to fill the neck may advance through intercircles of deposited coils to the aneurysm wall and so perforate the wall. Absence of a curve on the distal part of the unshaped microcatheter impedes the backward movement of the catheter tip while deploying the coil (figures 2A,B). This condition prevents deployment of the last coil in the neck and this coil that cannot find a free space among the de-

posited coils advances towards the wall of the aneurysm and perforates it. Vinuela et al advised deferring packing of the aneurysmal neck in the presence of the risk of rupture². To us, this problem is easily solved if after complete occlusion of the sac is obtained, the microcatheter is slightly withdrawn back until the tip of the catheter is placed in the neck as we did in our case. Then, the appropriate coil is deployed to occlude the neck, thereby completely occluding the aneurysm without the possibility of the coil applying force to the aneurysmal wall.

Conclusions

After tight packing of the coils in the sac of the aneurysm with presence of flow in the neck is obtained in cases where the distal part of the microcatheter is advancing straight, its tip should be withdrawn into the neck to avoid perforation of the aneurysm, and then the additional coil/s can be placed in the neck without any problem.

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