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Case Report

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Surgical Clipping of Intracranial Aneurysm Regrown after Endovascular Coiling

Operative clipping after previous endovascular coiling in an aneurysm is a different problem from primary clipping procedure for neurosurgeons. With the increasing use of coil embolization, neurosurgeons will more and more face the similar situation. We report surgical clipping cases of intracranial aneurysm regrown after endovascular coiling. Three patients with a history of subarachnoid hemorrhage due to ruptured aneurysm underwent endovascular treatment (EVT) with detachable coils. The aneurysms were in the posterior communicating artery, the middle cerebral artery, and distal anterior cerebral artery (DACA). Two near-total occlusions and one partial occlusion were achieved by EVT. After several months, angiographic follow-up revealed regrowth of the aneurysm requiring surgical clipping. Here, we report three cases in which surgical clipping was more difficult than a usual clipping procedure performed several months after EVT, because of adhesion and coil bulging into the aneurysmal neck. The difficulty of the treatment of the residual aneurysm after coiling is discussed, as are the surgical complications and limitations of clipping.

KEY WORDS : Intracranial aneurysm · Endovascular treatment (EVT) · Clipping.

INTRODUCTION

The ISAT (International Subarachnoid Aneurysm Trial) in 2002[8] and 2005[9] has resulted in increasing numbers of undergoing EVT in patients with a ruptured aneurysm, as first-line treatment for aneurysm occlusion. The widespread use of this technique, even in those cases in which surgical clipping would have been possible, is largely related to the less invasive approach used for detachable coil embolization. However, complete occlusion of an aneurysm by coil embolization has been reported in only 70% of cases[2,10]. Regrowth of an aneurysm after EVT can occasionally increase the chance of re-rupture, and microsurgical clipping is needed to completely obliterate the aneurysmal sac. Here, we report our experience with these three aneurysm cases that showed regrowth after EVT and on which surgical attempts were made to obliterate the residual sac. The difficulty of the treatment of the residual aneurysm after coiling is discussed, as are the surgical complications and limitations of clipping.

CASE REPORT

Case 1

A 44-year-old female patient presented with a left DACA aneurysm rupture (Fig. 1A). The patient was in a Hunt & Hess grade II clinical state. EVT led to near-total occlusion of the aneurysm (Fig. 1B), and she was discharged without complication. On the angiographic follow-up, 11 months later, regrowth of the aneurysm was noted (Fig. 1C). Surgical clipping was performed via the interhemispheric approach, and complete neck clipping was achieved due to the presence of a sufficient aneurysmal neck for clipping (Fig. 1D). The patient was discharged without sequelae.

Case 2

A 59-year-old male patient presented two and half years ago with SAH grade II (Hunt & Hess), which was confirmed by computed tomography (CT) scan. Cerebral angiography showed an aneurysm located at the right middle cerebral artery bifurcation (Fig. 2A). Partial occlusion was obtained with EVT (Fig. 2B), and angiographic follow-up 30 months later showed progression of the residual aneurysm, especially the regrowth of the dome (Fig. 2C). During microsurgical treatment, the regrown dome of aneurysm showed too much adherence

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to the temporal lobe for us to properly dissect it with the M2 branch, and the aneurysmal wall was so thin and transparent that we could not handle it easily (Fig. 2D). In addition, the coil was bulging into the neck of the aneurysm, so we were not able to clip the aneurysmal neck accurately, lest clipping of the aneurysm result in a stenosis of the parent artery. Therefore, only the regrown dome of the aneurysm was clipped in a limited manner (Fig. 2E), moreover, one protrusion of the coil inside the regrown dome prohibited the operator from modest clipping. The patient showed good recovery, and no neurological deficits were observed after surgery.

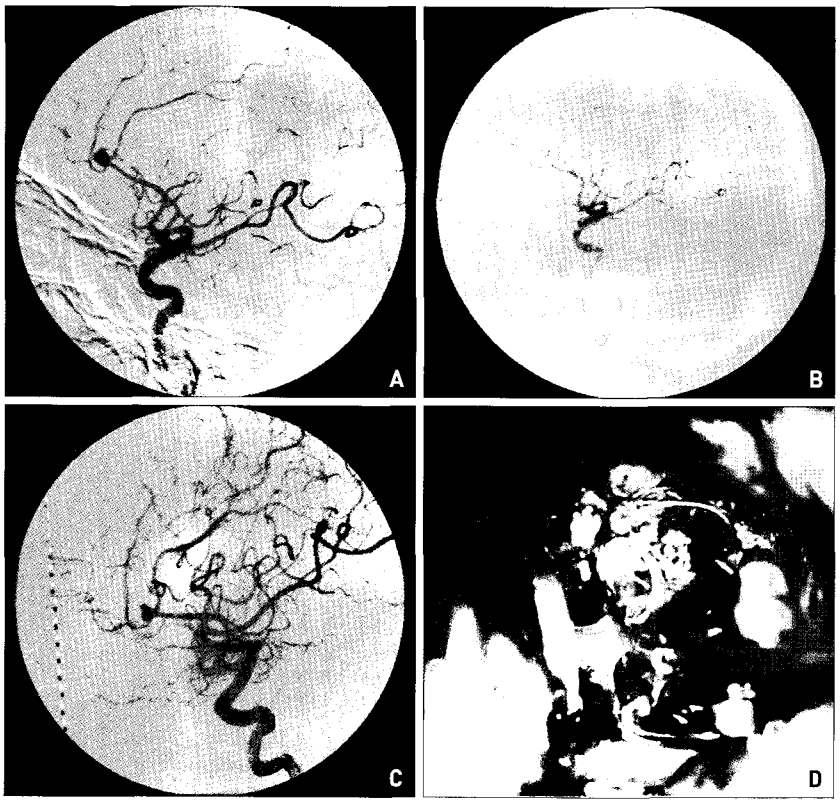

Fig. 1. A : Initial digital angiography showing a ruptured distal anterior cerebral artery (DACA) aneurysm. B : Near-total occlusion of a DACA aneurysm. C : Follow-up angiography showing coil compaction after 11 months. D : Surgical aneurysmal neck clipping via the interhemispheric approach.

Case 3

A 51-year-old male patient was admitted after grade I subarachnoid hemorrhage, which was evaluated a grade III after bleeding occurred again in the emergency room. Brain CT confirmed a subarachnoid hemorrhage associated with intraventricular hemorrhage in the left trigon area. Cerebral angiography showed a left posterior communicating artery (P-comA)

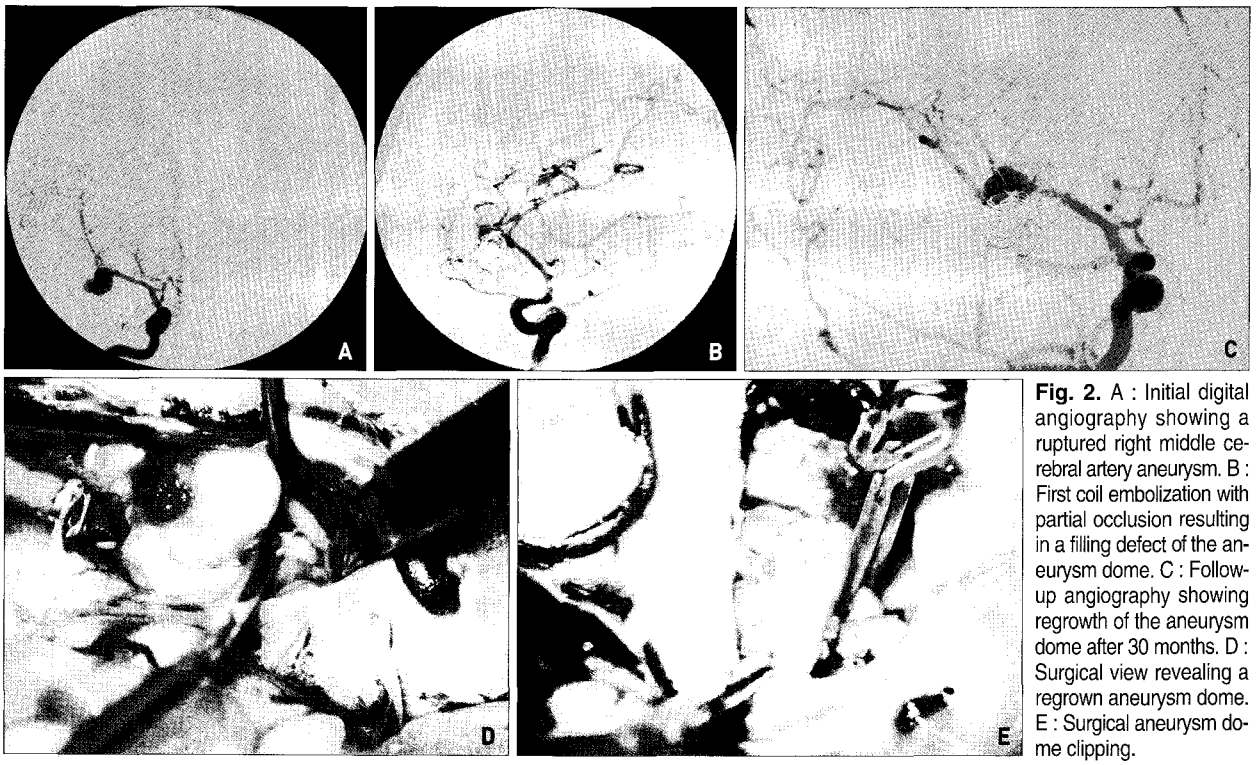

Fig. 2. A : Initial digital angiography showing a ruptured right middle cerebral artery aneurysm. B : First coil embolization with partial occlusion resulting in a filling defect of the aneurysm dome. C : Follow-up angiography showing regrowth of the aneurysm dome after 30 months. D : Surgical view revealing a regrown aneurysm dome. E : Surgical aneurysm dome clipping.

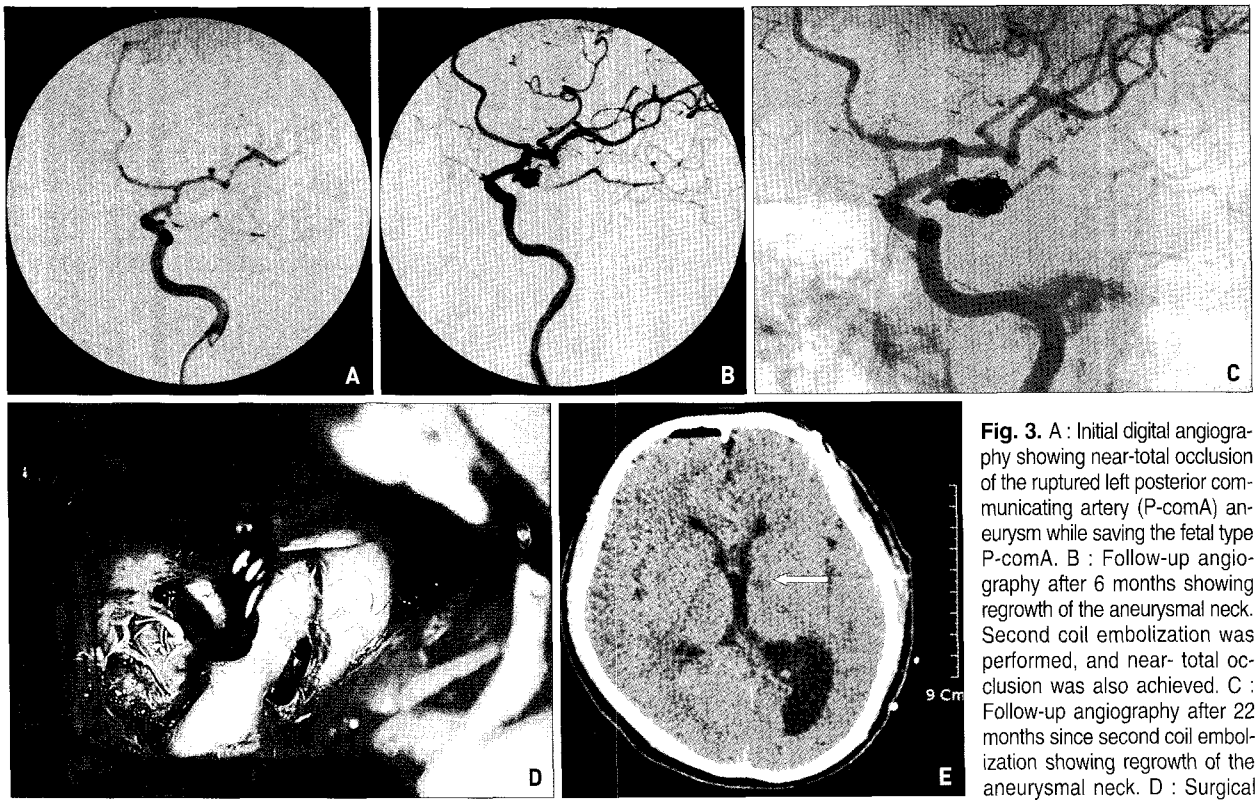

Fig. 3. A : Initial digital angiography showing near-total occlusion of the ruptured left posterior communicating artery (P-comA) aneurysm while saving the fetal type P-comA. B : Follow-up angiography after 6 months showing regrowth of the aneurysmal neck. Second coil embolization was performed, and near- total occlusion was also achieved. C : Follow-up angiography after 22 months since second coil embolization showing regrowth of the aneurysmal neck. D : Surgical view revealing direct aneurysmal neck clipping while saving the P-comA. E : Postoperative one day computed tomography scan showing focal low density area (arrow) in the genu of the internal capsule, which suggests injury of the anterior thalamoperforating artery.

aneurysm and a fetal type P-comA. EVT was performed first, but a near- total occlusion of the aneurysm re- mained due to the fetal type P-comA (Fig. 3A). Angiographic follow-up 6 months later showed progression of the residual neck of the aneurysm (Fig. 3B). Second coil embolization was performed and resulted in near-total occlusion, saving the P-comA. However, angiographic follow-up 22 months after the second embolization revealed regrowth of the aneurysm due to coil compaction (Fig. 3C). Surgery was performed with optimal clipping of the residual aneurysm, saving the P-comA and the anterior choroidal artery (A-ChoA) (Fig. 3D).

The partial coiled status around the neck of the aneurysm facilitated accurate clipping, but the severe adhesion of the aneurysm to the temporal lobe inhibited sharp dissection around the aneurysmal neck and the A-ChoA. Strangely, the patient did not wake up until three days after the surgery, and the brain CT at postoperative one day showed a small, low density area around the anterior thalamus and anterior limb of the internal capsule (Fig. 3E). In the microsurgical field, we could not find perforating arteries of the P-comA because manipulation of the dome of the aneurysm was difficult due to severe adhesion to the temporal lobe. Finally, an anterior thalamoperforating artery injury was suspected. The patient recovered well, but mild weakness of the right lower extremity (Grade IV+) has persisted.

DISCUSSION

The technical development of endovascular coil embolization in the treatment of cerebral aneurysm continues to progress, and its range of treatment is rapidly broadening[11]. Besides, the recent publication of the 1-year outcome of the ISAT shows that independent survival is superior in patients who have undergone coiling compared to those who have undergone neurosurgical clipping[8,9]. However, incomplete treatment of intracranial aneurysm after EVT occurrs frequently. In the literature, the rate of partial occlusion after coiling is estimated to be between 24.8%[6] and 44%[2]. The portion of patients who require surgery after primary coiling has been reported as 2-12%[1,3,4,7,13]. For example, Gurian[4] reported 21 surgical cases requiring surgery after primary coiling out of 196 coiled patients (11%), this value varied for other investigators, i.e. Civit et al.[1] 8 out of 118 (7%), Veznedaroglu et al.[13] 18 out of 927 (2%), Conrad[3] 7 out of 59 (12%), and Minh[7] 7 out of 54 (13%).

From a technical point of view for surgery, several authors

insist that this procedure involves same difficulties as those of primary clipping, but others disagree. Civit et al.[1] reported same difficulties in the dissection of aneurysm and clipping of the aneurysmal neck, but, Veznedaroglu et al.[13] and Minh et al.[7] emphasized more difficulties in the dissection and in avoiding perforator injury, and illustrated the importance of intraoperative angiography. Minh et al.[7] reported that, with partially coiled aneurysms, clipping can be accomplished without technical difficulties, but, when the packing of the aneurysm with coils is near-total, difficulties may arise during surgery. Conrad et al.[3] found that the protrusion of the coils inside the aneurysmal neck could increase the risk of stenosis of the parent vessel in clipping, so he used ligation of the neck with coagulation of the sac. In addition, other authors[1,4,5,12] have described the removal of coils prior to definitive clipping, but, others[3,7] agree that the removal of the coil is very dangerous, especially in cases where a long time has passed since coiling.

In our case, complete neck clipping was performed in two cases due to the sufficient remnant neck of the aneurysm, and in one case, only clipping of the aneurysm dome was possible due to a protruding coil mass. However, injury of the anterior thalamoperforating artery occurred in one case because of the difficult manipulation of the dome of the aneurysm due to severe adhesion to the temporal lobe. In the microsurgical field, removal of the coil was thought to be very dangerous because coils were adhered tightly to the translucent membrane of the sac, and such a procedure would carry the risk of lacerating the aneurysm. Minh et al.[7] reported the need to use an encircling Sundt clip when the aneurysm is sheared off at the neck in the clipping procedure, emphasizing that under the circumstances, the aneurysm could not be repaired with conventional clips. No Sundt clip was used in our cases, but we agree with Minh on that point. We imagine that "the tension around the aneurysmal neck" caused by an unmoved coil mass severely adhered to brain parenchyme is so great that the laceration of the neck of the aneurysm has the potential to take place. In general, the longer the time between coiling and surgery, the more severe is the adhesion between the coil mass and brain parenchyme.

Veznedaroglu et al.[13] reported the importance of a sufficient neck and emphasized that the height of the aneurysmal remnant must be at least twice that of the neck. We afree such opinion, and is evidenced by complete clipping in our two cases due to the existence of a sufficient neck. If a sufficient neck is not guaranteed, it is better to wait until a sufficient neck due to coil compaction is insured rather than performing direct clipping. However, in case 2, the preparation of a sufficient aneurysmal neck was expected to be nearly impossible at any point, which made complete neck clipping virtually impossible, the second-best surgical strategy was thought to be the clipping of the dome.

CONCLUSION

Here, we report three cases of aneurysm clipping after EVT. Surgical clipping of intracranial aneurysm after EVT has different surgical issues compared with those involved with an uncoiled aneurysm. In such cases, additional difficulties must be considered, including dissection of aneurysm due to severe adhesion between the coil mass and brain parenchyme, handling of the dome of the aneurysm, the risk of perforating artery injury, stenosis of the parent artery, laceration of the aneurysmal neck, etc.

The sufficient neck is thought to be the most important factor of a successful surgery. If a sufficient neck is not guaranteed, adequate direct neck clipping is impossible, and the second-best surgical strategy should be considered prior to performing surgery.

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