Late Recurrence of Subarachnoid Hemorrhage Due to Regrowth of Aneurysm After Neck Clipping Surgery
—Four Case Reports—

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Abstract

Late recurrence of subarachnoid hemorrhage (SAH) due to regrowth of aneurysm after neck clipping surgery occurred in four patients. Two patients underwent surgical treatment, and two patients received endovascular treatment. Endovascular treatment was successful in one case, but emergent surgery was necessary for the other case because of possible pseudoaneurysm formation. Postoperative course of all patients was excellent. Late recurrence of SAH can occur even after complete clipping, and further treatment should be considered.

Key words: late recurrence of subarachnoid hemorrhage, regrowth of cerebral aneurysm, surgery, endovascular treatment

Introduction

Neck clipping surgery is a well-established treatment for subarachnoid hemorrhage (SAH) caused by aneurysm rupture, but carries a low but significant risk of recurrent hemorrhage. Recurrent hemorrhage can be classified into early recurrence and late recurrence.22) Early rebleeding mainly results from inadequate clipping, whereas late rebleeding originates from an associated but unruptured aneurysm which was not treated together with the ruptured aneurysm at the initial hemorrhage, de novo aneurysm, and regrowth of the initially treated aneurysm. Regrowth of the previously clipped aneurysm has been reported in cases of residual neck and even completely obliterated aneurysm2–4,6,13,18) and may manifest as hemorrhage or compressive neurological deficit.

Treatment for regrowth of a previously clipped aneurysm is one of the most difficult procedures in aneurysm surgery. A recent classification based on technical difficulty in reoperations for aneurysms considered that late reoperation is more challenging than early reoperation.8) However, recent technical developments in endovascular treatment now enable intravascular embolization of aneurysms by Guglielmi detachable coil (GDC) placement.1,7,8,16,17,20,21)

We describe our recent experience with four patients with late recurrence of SAH due to regrowth of a previously clipped aneurysm who were treated by both surgical and endovascular procedures.

Case Reports

Four patients with late recurrence of SAH due to regrowth of an aneurysm after neck clipping surgery underwent either surgical or endovascular treatment in our institution (Table 1). Their clinical records were reviewed for age, sex, radiological findings, surgical procedures, and other general clinical data. The clinical conditions of the patients on admission were classified according to the Hunt and Hess grade,10) and clinical outcome was determined at 3 months according to the Glasgow Outcome Scale.12)

Case 1: A 61-year-old woman was admitted to our hospital under a diagnosis of SAH. She had suffered SAH due to rupture of an anterior communicating artery (ACoA) aneurysm 8 years before, which was
Table 1 Summary of cases

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Site of aneurysm</th>
<th>First admission</th>
<th>Second admission</th>
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<tr>
<td></td>
<td>Grade</td>
<td>Age/Sex</td>
<td>Operative route</td>
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<tr>
<td>1</td>
<td>ACoA</td>
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<td>2</td>
<td>BA tip</td>
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<td>4</td>
<td>lt ICA-PCoA</td>
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On admission, DSA demonstrated regrowth of the aneurysm (Fig. 2C). The aneurysm was clipped via the left pterional approach with a fenestrated clip. Postoperative course was excellent and DSA showed a small residual neck (Fig. 2D). She was discharged without further treatment.

**Case 3**: A 71-year-old female presented with headache. Computed tomography (CT) revealed SAH in the left sylvian fissure. She had undergone successful clipping surgery for two middle cerebral artery aneurysms 12 years before (Fig. 3A). She refused postoperative angiography and returned to normal life.

On admission, DSA revealed regrowth of an aneurysm between the clips. Endovascular treatment was selected because of her age and the risk of wide dissection along a similar route in the sylvian fissure to obtain enough space to observe the aneurysm between the two clips. Coil placement in the dome of the aneurysm instead of complete obliteration was planned because of the wide base. Two weeks later, endovascular treatment was performed. After several trials, the dome of the aneurysm was occluded with six GDC-10 coils (Fig. 3B, C).

Postoperatively she suffered no rebleeding from treated by complete clipping via the right pterional approach (angiography not available) and returned to normal life.

On admission, digital subtraction angiography (DSA) demonstrated regrowth of the ACoA aneurysm posterior to the clip (Fig. 1A). She underwent clipping surgery via the interhemispheric approach on the next day to obtain better exposure of the neck of the aneurysm. The aneurysm was clipped with sharp dissection of the tightly adhered tissue near the aneurysm which had not been wrapped at the initial operation. The previous clip was not removed.

Postoperative DSA showed a small residual neck of the aneurysm (Fig. 1B). Her condition deteriorated with symptomatic vasospasm and normal pressure hydrocephalus after the surgery, but recovered soon after placing a ventriculoperitoneal shunt. She was discharged with moderate disability.

**Case 2**: A 64-year-old woman presented for elective surgical treatment for regrowth of a basilar tip aneurysm that had bled 3 months before. She had suffered SAH 15 years before from the basilar tip aneurysm which was surgically treated via the right pterional approach in our hospital (Fig. 2A, B). She was discharged and returned to normal life.

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Fig. 2  Case 2.  A: Lateral left panangiogram taken 15 years previously showing a basilar tip aneurysm. B: Postoperative lateral left vertebral angiogram showing complete obliteration of the aneurysm with two clips. C: Anteroposterior left vertebral angiogram on admission showing regrowth of the basilar tip aneurysm. D: Postoperative anteroposterior left vertebral angiogram showing disappearance of the aneurysm dome with a small residual neck.

the aneurysm. Follow-up DSA showed slight coil compaction but she was discharged without further treatment.

Case 4: A 44-year-old female presented with severe headache. CT revealed diffuse SAH. She had suffered SAH due to rupture of a left internal carotid artery (ICA)-posterior communicating artery (PCoA) aneurysm 14 years before and underwent clipping surgery in another hospital (data not available). She lead a normal life thereafter.

On admission, she was alert with no neurological deficit. DSA revealed regrowth of the left ICA-PCoA aneurysm (Fig. 4A, B). The aneurysm was treatable by either endovascular or surgical approaches because the neck was not wide and the lesion was not complicated. Endovascular treatment was planned, but 2 weeks after the hemorrhage, left third cranial nerve paresis appeared and DSA revealed enlargement of the aneurysm posteriorly (Fig. 4C), suggesting a rapid formation of a pseudoaneurysm, which would imply high risk with coil placement. After informed consent was obtained, she underwent emergent clipping surgery. Larger exposure at the frontal base side during craniotomy exposed the carotid cistern with dissection of only the proximal portion of the sylvian fissure. The previous clip was removed with sharp dissection and the aneurysm was clipped successfully. A very small ICA-anterior choroidal artery aneurysm was also clipped.

Postoperative DSA revealed disappearance of both aneurysms (Fig. 4D). The third cranial nerve paresis gradually disappeared and she was discharged with no neurological deficit.

Discussion

Surgical clipping continues to be the gold standard for the treatment of intracranial aneurysms. However, good results are not uniformly achieved despite highly standardized strategies and occasionally technical failures mandate further treatment. A large series of cases of failed aneurysm surgery described detailed technical failures in aneurysm surgery, and concluded that reoperation should be considered if first surgery fails to obliterate aneurysms. However, most neurosurgeons would consider reoperation difficult. Reoperative management of intracranial aneurysms can be classified into three major grades of increasing complexity.

Late reoperation poses greater problems because of the scarification which occurs during the long delay between surgical procedures. The approach should be carefully selected depending on the planned exposure of the neck of the aneurysm and the risk of dissection along a similar route to the previous operation or a different route if possible. All our cases required late reoperation. In Case 4, the second approach was similar to that of the initial surgery, but only the proximal portion of the left sylvian fissure was dissected to reduce the injury of the brain with maximal exposure of the cranial base at craniotomy. Sharp dissection was necessary to avoid damage to the brain and the previous clip was removed to ensure complete obliteration of the aneurysm. In contrast, a different approach was selected in Case 1 with an ACoA aneurysm and Case 2 with a basilar tip aneurysm. Using a different approach can avoid the dissection of the previous adhesive route. On the other hand, further damage to
the brain should be avoided and the previous clip cannot be removed which could result in a neck remnant as seen in Cases 1 and 2.

GDC treatment is most effective in small aneurysms with small necks, but not in wide-necked or large or giant aneurysms, although balloon-assisted coil placement for wide-based aneurysms is possible. GDC placement has been used to treat incompletely clipped aneurysms, and narrowing of the neck at the initial surgery may enable GDC coil placement in the remnant aneurysm. GDC placement for regrowth of cerebral aneurysms after clipping may be useful, but the indications for endovascular treatment must be carefully assessed. The pattern of regrowth must vary in individuals because of changes in the hemodynamic stress after the initial clipping surgery, which would result in aneurysms with atypical shapes. Histological study of a recurrent aneurysm after initial neck clipping indicated that local fragility of the arterial wall adjacent to the aneurysm was the cause of formation of a new aneurysm. The pseudoaneurysm in Case 4 may have resulted from such local fragility and required an emergent operation.

Complete obliteration of the aneurysm neck depends on the individual anatomical situation and the expertise of the surgeon, so incomplete clipping to preserve the normal arterial structure is inevitable in some cases. Apparently adequate clipping at the intraoperative stage should always be monitored for evidence of residual neck at both the intra- and postoperative stages. Assessments of the risk of aneurysm regrowth suggest that such cases are not very rare. We doubt that late recurrent hemorrhage due to aneurysm regrowth after neck clipping surgery can be classed as a neurosurgical failure. Late rebleeding as well as early rebleeding can deteriorate the patient’s condition, which implies that the initial surgery had some technical failure, but a long and useful period of life without rebleeding after the initial surgery also implies successful treat-
ment.

The present cases suggest two important conclusions. First, the initial treatment should aim at complete obliteration of the ruptured aneurysm to avoid regrowth. Postoperative angiography to evaluate any residual neck is important as well. Second, late recurrent hemorrhage due to regrowth of aneurysm is a likely phenomenon even if complete obliteration of aneurysm is achieved, and further treatment including both reoperation and endovascular treatment should be considered. Further experience may reveal which treatment is the method of choice.

References

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