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Original Article

Recurrence of Previously Clipped Anterior Communicating Aneurysm: The Surgical Techniques and Strategies: A Case Series

Abstract

Background: Microsurgical aneurysm (MSA) clipping is considered as the standard therapy with the endovascular coiling. Microsurgical clipping is considered superior to endovascular in terms of the recurrence rate. The management of recurrent aneurysm following previous microsurgical clipping is challenging. The management of recurrent aneurysm following previous microsurgical clipping is challenging. This study aims to explore the management of recurrent aneurysm of the anterior communicating artery (ACoM). **Materials and Methods:** This is a case series of three elder women who had a recurrence of ACoM aneurysm after MSA clipping. All the three patients were operated with microsurgical clipping. We studied the preoperative images of the first surgery of all the patients. The detailed case-by-case analysis was performed based on preoperative, postoperative, and follow-up radiologic examinations and operative findings. **Results:** All three patients who had a recurrence after MSA clipping of ACoM aneurysm and were asymptomatic. At presentation, they were diagnosed at the postoperative imaging at follow-up. The earliest recurrence was 1 year while in one patient; the recurrence was detected 8 years after the initial MSA clipping. The cerebral aneurysms were posteriorly directed in the initial preoperative images in all the cases. **Conclusion:** This study revealed the recurrence as the residual neck or the enlargement of the aneurysm even after MSA in these cases of ACoM aneurysm. Even with the complete clipping, there can be recurrence at the clip site due to the change in hemodynamics over the time. We should follow-up the patients regularly even after microsurgical clipping.

Keywords: *Aneurysm, anterior communicating artery, management, microsurgical clipping, recurrence*

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Introduction

Microsurgical aneurysm (MSA) clipping is the conventional treatment of a cerebral aneurysm from the first description of microsurgical clipping by Dandy.[1] Even endovascular treatment is an emerging modality of the management of cerebral aneurysm; still, the surgical clipping holds better hand. The authors of the Barrow Ruptured Aneurysm Trial[2] and the Cerebral Aneurysm Rerupture After Treatment[3] studies reported the superior durability of surgical clipping to endovascular coil embolization in which the latter is associated with higher rates of recurrence and retreatment. It is rare to have the recurrence with clipping, but it is not possible to achieve complete clipping in all the cases. It is reported to have a remnant aneurysm, and its data vary from 1.6% to 42%.[4] Even with postoperative confirmation of complete obliteration, patients may be at a continued risk for recurrent aneurysms. Aneurysm recurrence may be due to radiographically unapparent or incomplete initial obliteration, clip slippage or breakage, or regrowth of the aneurysm. The efficacy of clip ligation is high, and annual recurrence rates of 0.26%–0.53% have been reported.[5] In addition, *de novo* aneurysms have been reported to occur at a rate of 0.84%–1.8% per year.[6] An objective evaluation of the long-term durability of clip ligation is one of the factors that are pertinent for justifying the use of microsurgery. There are reports of aneurysm re-growth after incomplete or complete treatment and reports of the *de novo* aneurysm. A recurrent aneurysm developed by arterial wall damage from earlier manipulation and clip edge is different from a residual aneurysm in that the former is possible even if complete

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clipping has performed. However, recurrent cerebral aneurysms were not studied yet enough. Hence, we present here three anterior communicating aneurysms which were previously treated with microsurgical clipping with complete occlusion, and these cases had a recurrence on follow-up. These cases underwent microsurgical clipping again.

Materials and Methods

This study aims to explore the management of recurrent aneurysm of the anterior communicating artery (ACoM). We have included three cases of ACoM aneurysm who had a recurrence on follow-up. All cases had posterior pointing ACoM aneurysm who had undergone pterional approach and MSA clipping. Since there were recurrences with, all the patients had to undergo reoperation. The objective of the study was to find out the outcome after the surgery. We have taken the three-dimensional computed tomography (CT) images of the patient before the previous surgery and the recurrence images on follow-up.

Results

All the three patients who had a recurrence after MSA clipping of ACoM aneurysm and were asymptomatic at presentation. They were diagnosed during the regular follow-up. The earliest uptake of recurrence was in 1 year and one patient we could find recurrence in 8 years after MSA clipping. One patient had other *de novo* aneurysms, and all aneurysms were treated in this setting by MSA clipping. In two patients, the standard interhemispheric approach was used, and complete occlusion was verified from the dual image video angiography (DIVA). One patient, we used pterional approach and MSA clipping because there were aneurysms in the middle cerebral artery (MCA) and anterior cerebral artery (ACA). We performed MSA clipping of all the aneurysms in this patient, and complete clipping was confirmed by DIVA [Table 1].

Illustrated case: 1

A 62-year-old female patient who had undergone an aneurysm clipping operation 1 year ago presented with regular follow-up. CT angiography done revealed an aneurysm right beside the previously clipped ACoM aneurysm [Figure 1]. She underwent bicoronal incision and interhemispheric approach. A recurrent aneurysm was completely clipped by the curved clip. According to the radiographs, the aneurysm was incompletely clipped during the previous surgery. Operative findings noted that an aneurysm had recurrence right beside the previously clipped aneurysm [Figure 2]. In conclusion, this recurrent aneurysm was caused by the incomplete clipping during the previous surgery.

Illustrated case: 2

This is another case of the ACoM aneurysm, which was operated 4 years ago. Complete clipping was achieved. The patient was on follow-up. After 4 years on regular follow-up, we could see the recurrence of an aneurysm [Figure 3]. The patient was asymptomatic, but the aneurysm was seen around the previous clip. We counseled the patient regarding the risk of rupture and cause subarachnoid hemorrhage (SAH). We performed the interhemispheric approach, and aneurysm clipping was done [Figure 4]. We did not remove the previous clip as it was occluding the neck partially and there was adhesion. The patient outcome was good with no complications.

Illustrated case: 3

Seventy years' right-handed female has been operated for ACoM aneurysm 8 years ago. Aneurysm was of size 7.4 mm × 3.2 mm. The patient had undergone right pterional craniotomy and MSA clipping. She was on regular follow-up as she had aneurysms of the MCA and the ACA. There was a recurrence of the aneurysm of the ACoM and was kept in surveillance. Her other aneurysms of the right MCA and right ACA size were increasing. The patient was asymptomatic. The patient was explained about the fate of these aneurysms. The patient underwent right pterional craniotomy and MSA clipping of the ACoM and other aneurysms with complete occlusion evidenced on DIVA [Figure 5]. Pterional craniotomy was taken into consideration because the patient had other *de novo* aneurysms such as right MCA aneurysm (M1) and the right ACA aneurysm (A1) so we clipped all three aneurysms from this corridor [Figure 6].

Discussion

We know that microsurgical clipping of a cerebral aneurysm is superior to endovascular coiling in regard to occlusion rates and rebleeding risk, but microsurgical clipping of aneurysms still carries a risk for recurrence.[7] According to Feurberg *et al.*, an incomplete clipping rate varies from 1.6 to 14.[8] We can divide a recurrent aneurysm into two types: one which is developed after incomplete clipping and the other one which is developed eccentrically in relation to the clip. The rebleeding rate of aneurysms with residual necks has been reported to be about 3.5%–28%,[9] and aneurysm regrowth has been reported to occur in 3.5%–15%.[10] According to Ebina *et al.*, the recurrent aneurysm can be developed by arterial wall

Table 1: Cases of incomplete clipping or regrowing aneurysm

Case	Age/Sex	Interval to Recurrence	Approach Used in Second Surgery	Cause of Recurrence	Outcome
1	62 Y/F	1 Year	Interhemispheric	Incomplete Clipping	Good
2	73 Y/F	4 Years	Interhemispheric	Fragility of Vessel wall	Good
3	70 Y/F	8 Years	Pterional	Incomplete Clipping	Good

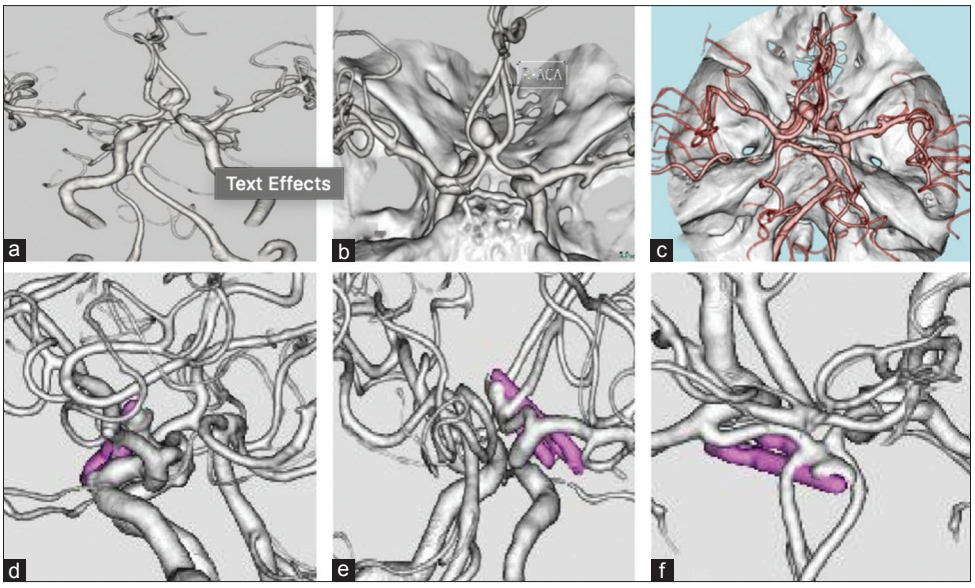

Figure 1: Computed tomography angiography with three-dimensional reconstruction images. (a-c) Computed tomography angiography with three-dimensional reconstruction images when aneurysm was diagnosed at the first time 1 year ago. (d-f) Computed tomography angiography with three dimensional reconstruction post aneurysm clipping on follow-up which we can see the recurrence of the aneurysm

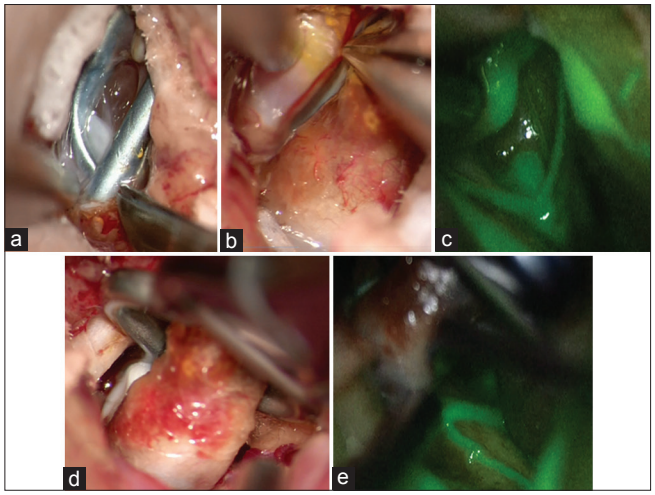

Figure 2: Intraoperative pictures of the microsurgical aneurysm clipping of the recurrent anterior communicating artery aneurysm. (a and b) Intraoperative pictures showing the previous clip and the recurrence of the aneurysm. (c) Dual image video angiography before clipping the aneurysm, and we can see filling in the previously clipped anterior communicating artery aneurysm. (d and e) Intraoperative pictures of microsurgical aneurysm clipping of the recurrent aneurysm and confirmation of the complete occlusion with dual image video angiography

damage from earlier manipulation and applied clip edge.[11] David *et al*. reported a 0.52% annual regrowth rate for completely clipped aneurysms and a 1.8% annual rate of *de novo* aneurysm formation.[12] Regarding the cause of the recurrence of a previously clipped aneurysm, the first and the main cause is incomplete clipping. The complete clipping is the ultimate goal of treatment, but complete occlusion of an aneurysm by a clip is always possible but may not be achieved in some cases. Thereby, the experiences and the operator's microsurgical techniques and skills are the most important issues; moreover, supplemental methods are required to confirm the completeness of the clipping and to reduce mistakes on surgical decisions during surgery. A real-time visualization of the intracranial vasculature such as a video angiography with indocyanine green or fluorescein can also be greatly helpful for complete clipping.[12] We use the DIVA to confirm complete clipping. Another cause for the recurrence can be explained with the fragility of vessel wall near the clip site. Sustained hemodynamic change over the years after clipping can increase the fragility of the vessel wall at clip edge, and eventually, aneurysm could recur. These findings indicate that even if the clipping is perfect, recurrent aneurysm still can occur. Papadopoulos *et al*. found that reported multiple open/close cycle and sustained opening on the clip applier weaken the grip strength of clips. If the operator sustained maximal opening for as little as 10 min, the closing force decreased by 20%–25%. In addition, repetitive opening and closing such as scissoring action caused weakness further by 12%.[13] Repeated sterilization might also weaken the clipping power. Some clips which are infrequently used undergo sterilization many times. The less frequent the usage of the clip, the higher the possibility of this process. Then, the clip power weakened by this process leads to an incomplete clipping or clip slippage. Therefore, to preserve the grip strength of clips, the operators should keep these in mind during surgery. Always the risk factors contributing to the recurrence can be divided as aneurysm-related factors, clip-related factors, surgical technique-related factors, and others. Among all the risk factors, the location of an aneurysm plays a key role as a risk factor for the recurrence. It is an ACoM aneurysm which has the maximum recurrence rate.[14] Tsutsumi *et al*. identified the presence of multiple aneurysms at initial presentation and residual aneurysm after clip ligation

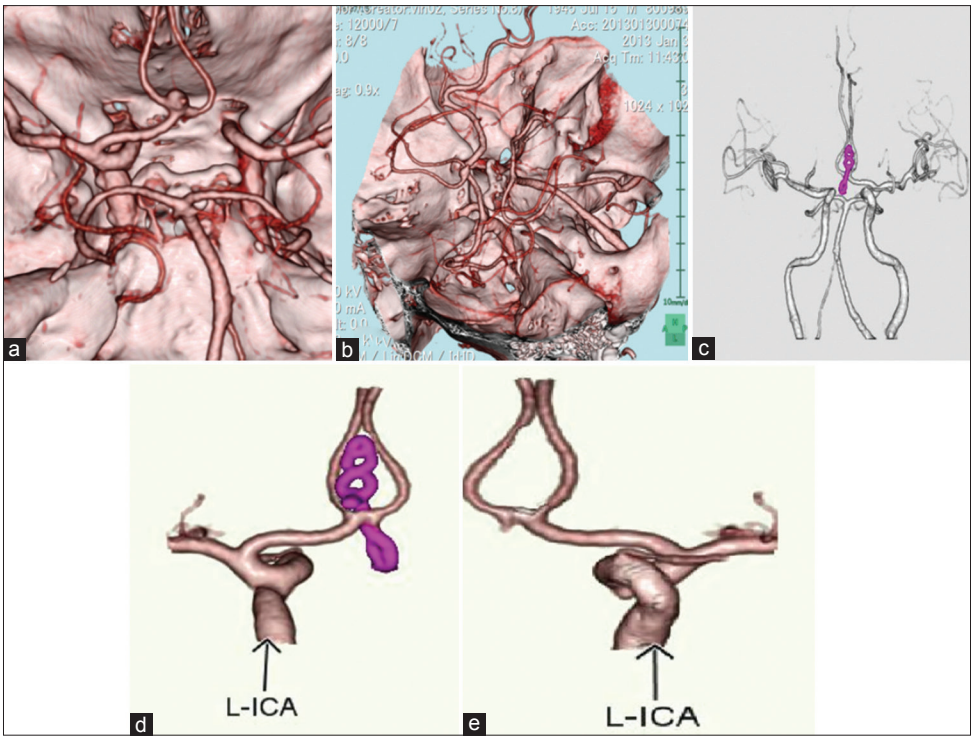

Figure 3: Computed tomography angiography with three-dimensional reconstruction images. (a and b) Computed tomography angiography with three-dimensional reconstruction images when aneurysm was diagnosed at the first time 4 years ago. (c-e) Computed tomography angiography with three dimensional reconstruction, post aneurysm clipping on follow-up which we can see the recurrence of the aneurysm

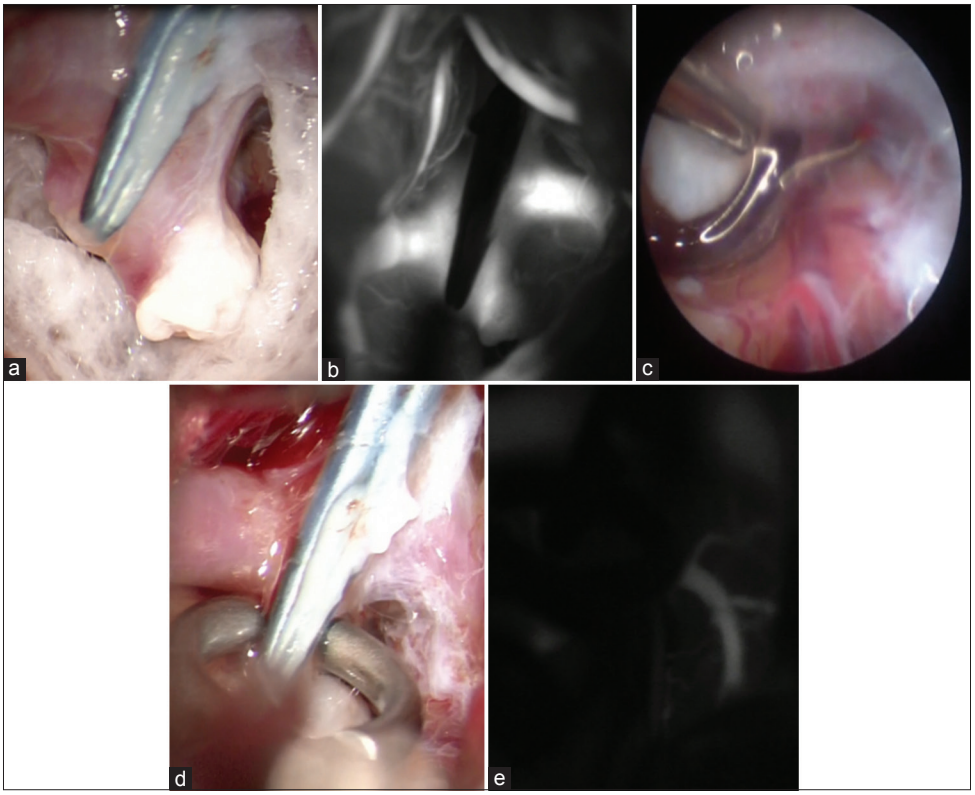

Figure 4: Intraoperative pictures of the microsurgical aneurysm clipping of the recurrent anterior communicating artery aneurysm. (a) Intraoperative pictures showing the previously applied clip. (b) Indocyanine green fluoroscopy before clipping the aneurysm and we can see filling in the previously clipped anterior communicating artery aneurysm. (c) Endoscopic view of the recurrent anterior communicating artery aneurysm. (d and e) Intraoperative pictures of microsurgical aneurysm clipping of a recurrent aneurysm and confirmation of the complete occlusion with indocyanine green

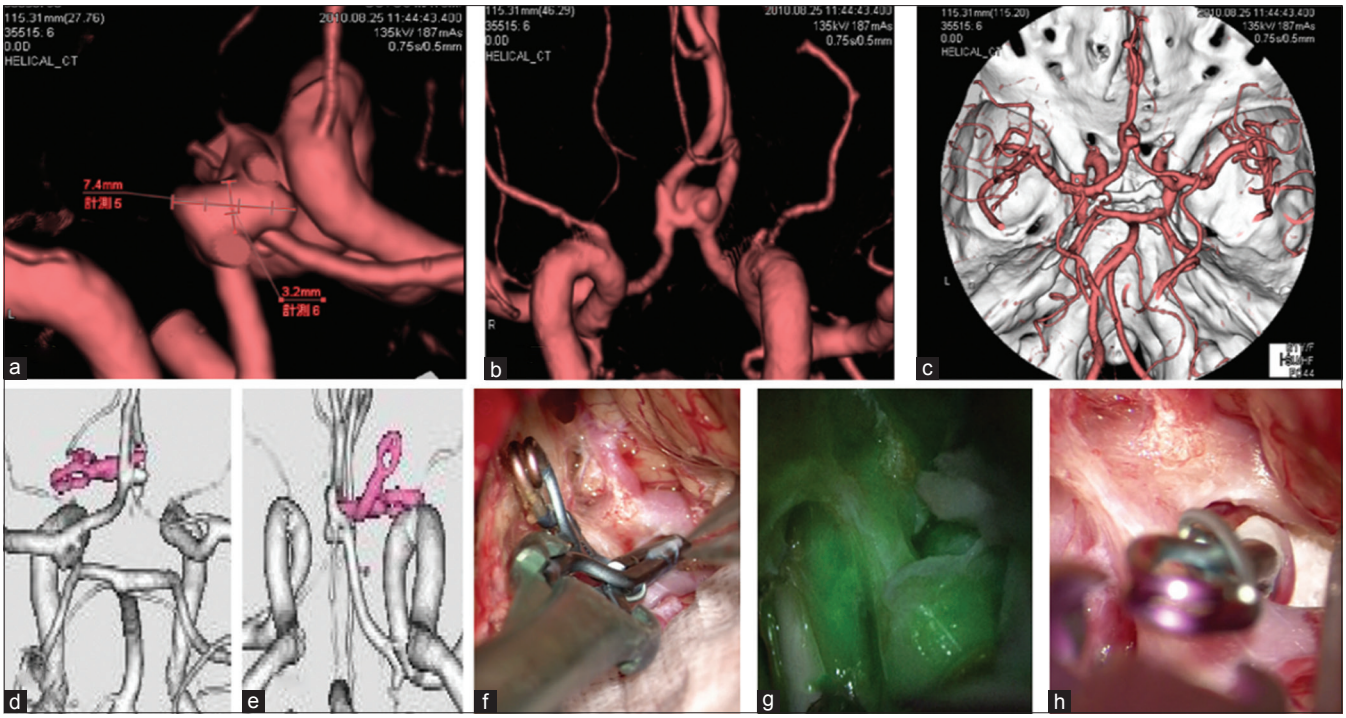

Figure 5: Computed tomography angiography with three-dimensional reconstruction images and intraoperative pictures. (a-c) Computed tomography angiography with three-dimensional Reconstruction Images when aneurysm was diagnosed at the first time 8 years ago. (d and e) Computed tomography angiography with three-dimensional reconstruction post aneurysm clipping on a follow-up which we can see the recurrence of the aneurysm. (f) Intraoperative pictures of the aneurysm with the previous clip. (g) Dual image video angiography after removal of the previous clip. (h) Microsurgical aneurysm clipping of the anterior communicating artery aneurysm

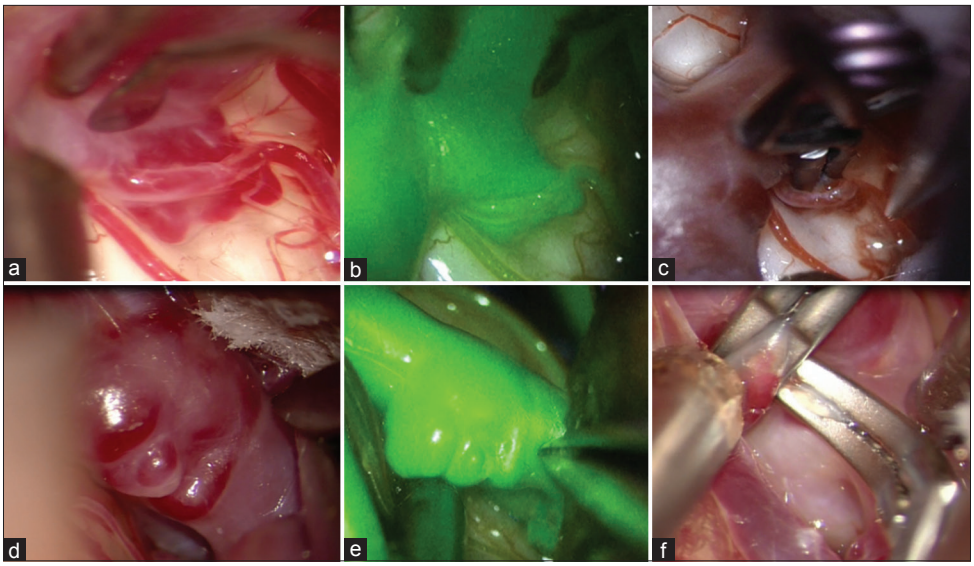

Figure 6: Intraoperative pictures of the microsurgical aneurysm clipping of the right middle cerebral artery and right anterior cerebral artery aneurysm. (a) Intraoperative picture of the right anterior cerebral artery (A1) segment aneurysm. (b) Dual image video angiography before clipping the aneurysm. (c) Microsurgical aneurysm clipping of the aneurysm. (d) Intraoperative picture of right middle cerebral artery (M1) segment aneurysm. (e) Dual image video angiography before clipping the aneurysm. (f) Microsurgical aneurysm clipping of the aneurysm

as important risk factors for recurrence.[5] Although postoperative angiography is not routinely performed, it should be done whenever incomplete clipping is doubted in operation or difficult cases. In various studies, it was found that the majority of SAH with the previously clipped aneurysm was seen even after 9 years. Hence, this tells us that good surveillance is required and for a long time even after a completely clipped aneurysm. There is always two schools of thought regarding the management of recurrent aneurysms. Feuerberg *et al.*[15] reported that there is no need for the reoperation as the risk of a residual aneurysm in some cases is very low. Sato and Suzuki[16] even

reported spontaneous obliteration of recurrent aneurysms. However, Drake and Allcock have a different thought, and they were focusing on reoperation to minimize the risk. Lin *et al*.[17] suggested that the risk of 1–2 mm sized a small aneurysm is the same as that for a large residual aneurysm. Aggressive treatment is necessary if the aneurysm shape has changed or enlarged. Reoperation for a residual aneurysm is a difficult approach and requires a more meticulous surgical technique than the initial operation. The direct reoperation is often challenging due to scar adhesions to the surrounding tissue as a result of the previous operation. The hurdles for the second operation remain the adhesion which will be present from the first surgery. This makes the anatomy obscure and difficult. A wide exposure and fine dissection of an aneurysm are also essential. Good proximal control and complete neck dissection are essential when we are operating on the recurrence of an aneurysm. It is always advised to remove the previous clip as the old clip can hinder in the complete clipping. Giannotta and Litofsky[18,19] reported that the removal of the previously applied clip is always required to completely secure an aneurysm. However, due to severe adhesion and difficulty in securing the parent artery, it is not always possible to do so. Delicate and careful dissection is most important here. There were multiple other aneurysms in these patients, so when we performed the surgery for the recurrence of an aneurysm, and we performed MSA clipping of the other aneurysms too at the same setting.

Conclusion

We recommend that aggressive treatment must be considered due to the fact that a residual or a recurrent aneurysm may cause fatal SAH. If an aneurysm is detected on postoperative angiography, careful consideration should be given for treatment strategies and follow-up. Although the clipping is perfect without any slippage, the recurrence of an aneurysm can occur due to a hemodynamic change over the years at the clip site. When a residual or a recurrent aneurysm is found, careful evaluation and appropriate planning are required. Endovascular treatment can be a good alternative treatment. All patients who underwent surgical clipping of a cerebral aneurysm need to be followed up by imaging for a long period.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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