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Clinical Article

Complementary Management of Residual Intracranial Aneurysms after Endovascular or Surgical Treatment

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Objective : The purpose of this paper is to report our experiences in managing seventeen cases of residual intracranial aneurysms following surgical or endovascular treatment and discuss the incidence of residual aneurysms, the indications and technique of retreatment of residual aneurysms.

Methods : During a period of 42 months, we treated 391 aneurysms in 339 patients with microsurgical clipping or GDC embolization as a primary treatment. In 39 of them, follow-up angiography revealed residual aneurysms and seventeen of whom were retreated. There were eleven cases in ACoA, three cases in distal ICA, one, in each of MCA, ACA and basilar artery. We reviewed retrospectively the clinical notes, operation records and cerebral angiograms of seventeen patients who had been treated for residual aneurysms.

Results : Complementary treatment was performed in 8 cases by means of surgery and in 9 cases by means of GDC embolization. There were eleven females and six males with an age variation between 29 and 78 years. The mean duration of angiographic follow-up was 17.3 months. Of the seventeen cases that were treated for residual aneurysms, fourteen achieved complete occlusion. Of 17 retreated patients, fifteen patients had good recovery according to the Glasgow Outcome Scale.

Conclusion : When occlusion after endovascular or surgical treatment is incomplete, a new multidisciplinary approach should be carried out. Given our experiences, we recommend coil embolization of the choice in cases that the residual aneurysmal neck had been narrowed by previous clipping. On the other hand, if the residual aneurysm has enough space to clip but not enough to coil, we recommend the microsurgical clipping.

KEY WORDS : Intracranial aneurysm · Residual · Surgical treatment · Endovascular treatment.

Introduction

The primary goals of cerebral aneurysm treatment are to achieve complete obliteration and isolate the entire lesion from the arterial circulation. The danger of hemorrhage persists if the aneurysm is not completely excluded from the arterial circulation[4,6,7,15]. Nowadays, with the widespread use of endovascular methods as an option in the management of patients with aneurysm, the debate regarding the correct management of residual aneurysms, whether after surgical clipping or endovascular methods, has become topical. Regardless of the initial method of treatment of intracranial aneurysms, the neurosurgeon involved in the management of these patients will at some stage be faced with residual aneurysms. However the indication for selecting surgical versus endovascular treatment for patients with these residual lesions has not been established well.

In this report, we reviewed the clinical notes, operation records and cerebral angiography of seventeen patients who had been treated for residual aneurysms at our institute. The treatments of these lesions were performed using a variety of modalities.

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Materials and Methods

Protocol for aneurysm treatment

The Department of Neurosurgery in our institution has a policy with regards to the primary treatment modality used for patients with aneurysms. Both the endovascular and surgical methods are used as primary treatment. The patients admitted with aneurysm are screened by means of a computer

Table 1. Related factors to the decision for retreatment

Patient factor	Residual aneurysm factor
Age	Change in size
Symptom	Configuration
Medical co-morbidity	Location
Level of disability	
The patient's decision	

tomographic angiography and digital subtraction angiography to document the presence of intracranial aneurysms. Subsequently, the aneurysm characteristics will determine whether the patient will undergo a surgical or endovascular procedure to occlude the lesion. A decision was made after a thorough risk/benefit analysis of each method.

In surgical cases, an angiographic follow-up was performed within 14 days after clipping. In the Guglielmi detachable coil (GDC) treated cases, angiographic follow-up was performed immediately after embolization. Subsequent angiographic follow-up was scheduled at 3, 6, 12 and 18 months after treatment if the aneurysms had been incompletely occluded. These angiograms were then reviewed by a neurosurgeon and a neuroradiologist, according to the following criteria.

1. Total occlusion : 100% aneurysm occlusion
2. Near total occlusion : over 95% aneurysm occlusion
3. Incomplete occlusion : under 95% aneurysm occlusion

Selection criteria for retreatment

The decision for retreatment was made on the basis of several factors (Table 1). Patient factors included the patient's age, subarachnoid hemorrhage(SAH) as a presenting symptom, medical co-morbidities, level of disability, and the wants of the patient or patient's relatives. Aneurysm factors included size, configuration, location of the residual lesion, and unstable appearance of the remnant on serial angiographic studies. The final decision on retreatment was made by consensus of the neurosurgeon and neuroradiologist. Once an individual patient was selected for and agreed to undergo retreatment, a combined neurovascular team chose either surgical or endovascular methods for patients with these residual aneurysms.

Patients population

Between January 2000 and June 2003, 339 patients with one or more intracranial aneurysms were treated at our institution, with a total of 391 treated aneurysms. 241 patients with 282 aneurysms underwent microsurgical clipping as the primary therapy while 98 patients with 109 aneurysms underwent endovascular embolization with GDC as the primary therapy. Forty three aneurysms of 28 patients among 241 microsurgically treated patients were excluded in this study because of lack of postoperative angiographic findings. Angiographic follow-up was performed on a total of 348 aneurysms.

In our GDC group, total occlusion was obtained in 95 aneurysms (87.2%), near total occlusion in 4 aneurysms (3.7%), and incomplete occlusion in 10 aneurysms (9.1%) among total 109 aneurysms. Five aneurysm remnants out of the fourteen not totally occluded aneurysms appeared stable and safe, although presented with near total or incomplete occlusion. Follow-up angiography of these stable lesions demonstrated that two developed spontaneous obliteration, three remained unchanged (mean follow-up period, 22.5months). In nine cases of residual aneurysms, however, additional treatment was thought to be necessary, either due to progression of residual lesions or unsafe occlusion of the aneurysm. There were four cases in anterior communicating artery(ACoA), three cases in distal internal carotid artery(ICA), and one, in each of anterior cerebral artery(ACA) and basilar artery.

In our surgical cases, total occlusion was obtained in 214 aneurysms (89.5%), near total occlusion with small residual neck in 16 aneurysms (6.7%), and incomplete occlusion in 9 aneurysms (3.8%). The principal causes of partial occlusion were a wide aneurysm neck, a hidden lobulus of the multilobulated aneurysm, an intraoperative rupture, the parent artery or perforators around the neck, and the clip slippage. The results of follow-up angiography of the near total occlusion group demonstrated that two aneurysm remnants had developed spontaneous occlusion (Fig. 1), three had a decrease in residual neck, while the others remained unchanged (mean follow-up period, 18.3months). Therefore, further treatment was not considered for these stable

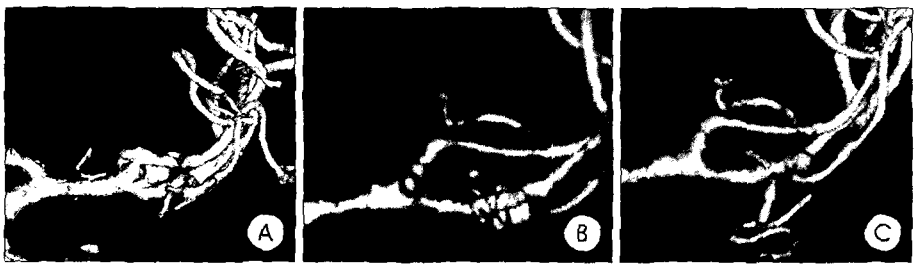

Fig. 1. A 63-year-old woman with acute subarachnoid hemorrhage of Hunt and Hess scale II. A : Left internal carotid 3D angiogram demonstrating an 3.8mm sized bilobulated aneurysm at the left middle cerebral artery bifurcation site. B : Seven days after primary clipping, left internal carotid 3D angiogram shows incomplete obliteration with residual neck. C : Six months after discharge, follow-up left internal carotid 3D angiogram displaying spontaneous near complete occlusion.

residual lesions. On the other hand, in all cases of the incomplete occlusion group, the residual aneurysm was large enough to allow further rupture and additional treatment was thought to be necessary. But one patient treated primarily with incomplete clipping of a large fusiform middle cerebral artery(MCA) aneurysm was observed under follow-up, because reclipping or coiling was likely to be associated with a high morbidity. The other eight cases underwent further treatment. The location of the residual aneurysms included ACoA in 7 cases and MCA in one case.

These seventeen cases of retreated aneurysms were assessed in detail according to the location, configuration, type and result of primary treatment as noted in the clinical or operation records as well as on follow-up cerebral angiography. Patients demographic data, specifically age, sex, presenting symptoms, presenting grade of SAH were also documented as assessed according to the Glasgow Coma Scale(GCS) and finally the outcome, as assessed by the Glasgow Outcome Scale(GOS).

Results

Seventeen patients were treated for residual aneurysm (Table 2). There were eleven females and six males with an age variation between 29 and 78 years. The mean duration of angiographic follow-up was 17.3 months. Of the seventeen cases that were treated for residual aneurysms, fourteen achieved complete occlusion. Two patients had stable residual aneurysms which still required further surveillance or management. In one case, the poor condition of the patient did not allow us to repeat cerebral angiography. Fifteen patients had good recovery according to the Glasgow Outcome Scale. Three patients initially presented as poor GCS rebled after primary endovascular treatment. Among them, one patient died after retreatment, the other patient was left severely disabled, and another patient had good recovery.

Clipping after Coiling

Five patients underwent surgical clipping procedure for residual aneurysms after coiling as primary treatment (Fig. 2). Successful clipping of the residual aneurysm neck was possible in all cases. In general, although some adhesions were found around the aneurysms during surgery, dissection was not unduly difficult. We did not remove any coil, neither the coils impacted inside the sac of the aneurysm nor the ones bulging at its neck. Three patients experienced hemorrhage in the interval between primary coiling and second treatment, and despite early clipping after recurrent hemorrhage, one patient died after retreatment, the other patient was left severely disabled, and another patient had good recovery. Angiographic follow-up was performed in the 4 surviving patients and total occlusion of the residual aneurysm was demonstrated in all 4 cases.

Coiling after Coiling

Four patients underwent further coiling to treat their aneurysm remnants. Three of these patients had a distal ICA

Table 2. Complementary management of partially occluded aneurysms in seventeen patients

No	Age /Sex	Initial presentation	Location	Initial configuration	Initial size(mm)	Initial treatment	FUA	Re-treatment	Tx interval	Last FUA	Final GOS
1	43/F	SAH, II*	ACA	Multilobulated	4	Coiling	Incomplete	Clipping	14 days	Complete	5
2	33/F	SAH, V*	ACoA	Saccular	8	Coiling	Enlarging remnant	Clipping	19 days	Complete	5
3*	45/F	SAH, IV*	ACoA	Multilobulated	10	Coiling	Incomplete	Clipping	2 hours	Complete	4
4*	43/M	SAH, V*	ACoA	Multilobulated	7	Coiling	Incomplete	Clipping	20 days	Complete	3
5*	66/F	SAH, IV*	ACoA	Multilobulated	7	Coiling	Incomplete	Clipping	4 days	-	1
6	29/M	SAH, II*	ICA	Saccular	9	Coiling	Enlarging remnant	Coiling	10 mo	Complete	5
7	68/F	Headache	ICA	Multilobulated	23	Coiling	Incomplete	Coiling	10 mo	Stable residual	5
8	78/M	Headache	ICA	Multilobulated	18	Coiling	Incomplete	Coiling	6 mo	Stable residual	5
9	32/F	SAH, II*	BA	Saccular	18	Coiling	Incomplete	Coiling	7 days	Complete	5
10	57/M	SAH, II*	ACoA	Multilobulated	10	Clipping	Incomplete	Clipping	6 days	Complete	5
11	61/F	SAH, II*	ACoA	Multilobulated	10	Clipping	Incomplete	Clipping	16 days	Complete	4
12	63/M	SAH, II*	ACoA	Multilobulated	3	Clipping	Incomplete	Clipping	14 days	Complete	5
13	42/M	SAH, I*	ACoA	Multilobulated	8	Clipping	Enlarging remnant	Coiling	15 days	Complete	5
14	65/F	SAH, II*	ACoA	Multilobulated	8	Clipping	Enlarging remnant	Coiling	2 mo	Complete	4
15	68/F	SAH, II*	ACoA	Multilobulated	10	Clipping	Enlarging remnant	Coiling	12 days	Complete	5
16	64/F	SAH, IV*	ACoA	Multilobulated	7	Clipping	Incomplete	Coiling	12 days	Complete	4
17	48/F	SAH, I*	MCA	Biboulated	9	Clipping	Incomplete	Coiling	17 days	Complete	5

* : Hunt & Hess Grade, **: Rebleeding between primary treatment and second treatment. FUA : Follow-up Angiography, GOS : Glasgow Outcome Scale

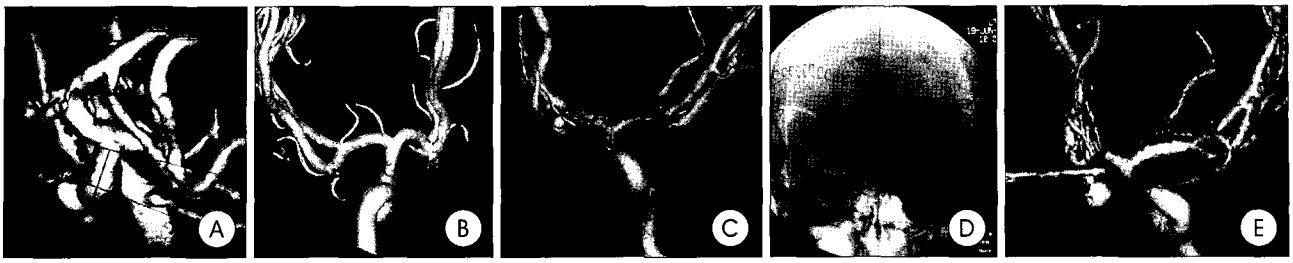

Fig. 2. Case 2. A 33-year-old woman presented with an acute headache and subsequent deterioration into coma with subarachnoid hemorrhage. A : Left internal carotid 3D angiogram demonstrating an 8mm sized aneurysm at the anterior communicating artery. B : Left internal carotid 3D angiogram obtained immediately after incomplete endovascular treatment with Guglielmi detachable coils. C : Fifteen days after endovascular treatment, follow-up left internal carotid 3D angiogram displaying slight progression of residual aneurysm. D and E : Postoperative angiogram obtained seven days after complementary surgical treatment showing complete clipping of the residual aneurysm.

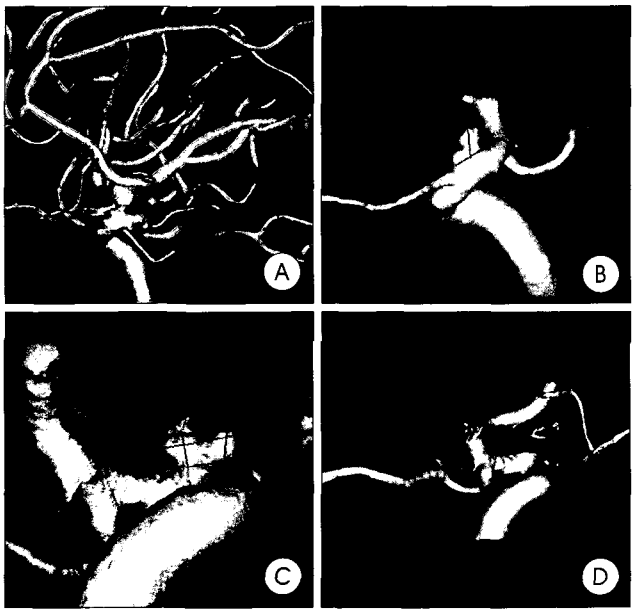

Fig. 3. Case 6. A 29-year-old man presented with acute subarachnoid hemorrhage of Hunt and Hess scale II. A : Right internal carotid 3D angiogram lateral view reveals a 9-mm maximum diameter saccular aneurysm of the right distal internal carotid artery. B : Right internal carotid 3D angiogram obtained immediately after endovascular treatment by Guglielmi detachable coils demonstrating incomplete occlusion of the aneurysm. C : Eight months after endovascular treatment, follow-up right lateral carotid angiography showing progression of residual lesion. D : Control angiogram of the right internal carotid artery obtained after further endovascular treatment with two Guglielmi detachable coils, showing complete occlusion of the residual aneurysm.

aneurysm and the other had a basilar artery aneurysm. One patient achieved complete occlusion of a distal ICA aneurysm as confirmed by follow-up angiography (Fig. 3). The other two distal ICA aneurysms are currently under surveillance after the repeat coiling procedure resulted in a stable residual. Regular follow-up angiography was planned for these patients and should further enlargement of the residual occur, surgery will be considered. The last patient treated primarily with incomplete coil embolization of a large midbasilar aneurysm, demonstrated insecurity of the residual on follow-up angiography and performed further coiling. Late follow-up angiography demonstrated complete occlusion of the aneurysm.

Clipping after Clipping

Three patients underwent a second surgical procedure to secure a residual aneurysm after primary clipping (Fig. 4). All patients had a multilobulated ACoA aneurysm on initial angiographic study and postoperative follow-up angiography confirmed the presence of a residual lobulus. A complementary surgical procedure was then performed. During the second microsurgical procedure, we attempted the temporary clipping of parent artery and removal of previous clips was possible in all cases. Premature rupture of the residual aneurysm occurred in two patients during operation but, easily controlled by permanent clipping. All of these residual aneurysms were completely obliterated after reclipping.

Coiling after Clipping

Five patients with aneurysm remnants after surgical clipping were treated with endovascular embolization using GDC. The aneurysms were located in ACoA in four patients and in MCA in one patient (Fig. 5). Four of these patients demonst-rated progressive enlargement of their aneurysm remnants (mean follow-up period, 24 days). In the remaining patient, a large remnant was identified on postoperative angiography, which prompted further treatment. In all of these patients, the residual aneurysm neck had been narrowed by previous clipping, and therefore endovascular management was chosen as the method of retreatment, with a latency period of 12 to 61 days from the initial therapy. Overall, excellent angiographic results were achieved in all five patients.

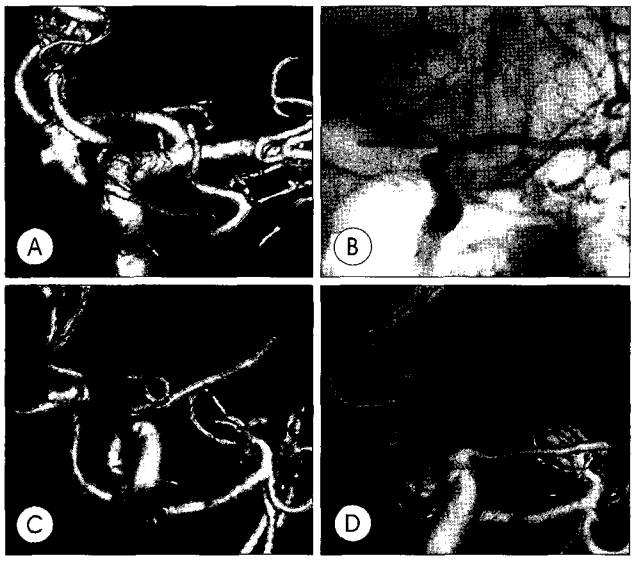

Fig. 4. Case 10. A 57-year-old man presented with acute subarachnoid hemorrhage of Hunt and Hess scale II. A : Left internal carotid 3D angiogram demonstrating a 10-mm sized multilobulated aneurysm of the anterior communicating artery. B and C : On postoperative left internal carotid 2D digital subtraction angiogram a residual aneurysm is ambiguous but 3D image displayed a small residual aneurysm just proximal to the clip. D : Follow-up angiogram obtained after reclipping. Note the complete obliteration of the residual aneurysm.

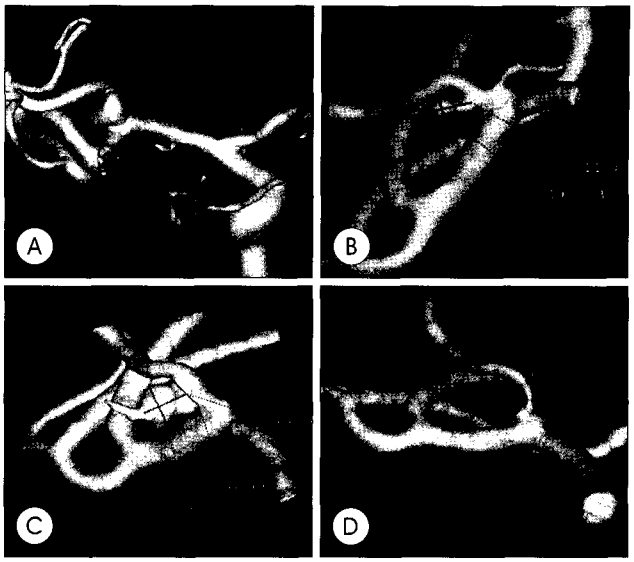

Fig. 5. Case 17. A 48-year-old woman presented with an acute subarachnoid hemorrhage. A : Right internal carotid 3D angiogram demonstrating a 9mm sized aneurysm at the right middle cerebral artery bifurcation. B : Right internal carotid 3D angiogram obtained seven days after microsurgical treatment displaying incomplete occlusion of aneurysm. C : Fifteen days after primary treatment, follow-up right internal carotid 3D demonstrating further growth of the residual aneurysm. D : Postembolization 3D angiogram demonstrating complete occlusion of the residual aneurysm.

Discussion

The natural course of an individual aneurysm remnant after either clip application or endovascular therapy is not entirely clear. In a large microsurgical treatment series, postoperative angiography demonstrated residual aneurysms in 1.6% to 14% of cases[8,17,22,24].

A recent clinical data review of six series of clipped aneurysms which were checked by early postoperative angiography revealed that out of a total of 1397 patients, 82 aneurysms (5.2%) demonstrated residual lesions[27]. These remnants are sometimes recognized or suspected in the operating room but cannot be treated because of limitations imposed by the configuration or location of the aneurysm. In other cases, however, residual aneurysmal filling is unexpectedly identified on immediate or delayed postoperative angiography after a presumably successful clipping.

Contemporary management of intracranial aneurysms includes both surgical approaches as well as the more recent endovascular techniques. The advantages and disadvantages of either option are currently under debate both in the literature as well as at local and international conferences. No matter what modality is used though, residual aneurysms will result and need to be managed appropriately.

Remnants after clipping or coiling

The issue of postoperative aneurysm rest is not a new one. There is reasonable evidence, however, to support the assumption that aneurysm may continue to pose a risk for SAH[4,6,7,15]. To quantitate this risk, Feuerberg et al.[7] analyzed postoperative angiography in their series of 715 patients. Postoperative angiography revealed 28 residual aneurysms in 27 patients (3.8% of cases). These patients were followed without further treatment. They calculated the risk of hemorrhage in this group of patients to be 0.79% per year during an observation period that ranged from 4 to 13 years. According to their result, they suggested that reoperation should be performed, at least in young patients.

In an insightful study, Lin et al.[15] further refined the understanding of the risk associated with aneurysm remnants by demonstrating that the risk was not limited to large remnants but also applied to neck remnants as small as 1 to 2 mm. Their study analyzed 19 patients who had presented with regrowth of aneurysmal sacs from residual necks after clipping. Sixteen patients in that study had 1 to 2mm postoperative remnants after initial clipping. Fourteen patients in the Lin et al.[15] study had SAH at their second presentation. The average time to second presentation with SAH in their study was 9 years

(range, 3~24 years). They observed that the patients in this series were relatively young with 14 of the cases being younger than 40 years at their first presentation. They postulated that younger patients are at a higher risk of developing larger aneurysms from tiny remnants. On the other hand, Sato and Suzuki[23] reported that there are good chances of spontaneous obliteration of the aneurysm remnants and the risk of a recurrent rupture is low. However, the follow-up time in their study was short (longest follow-up, 33months).

Subtotal or incomplete occlusion of intracranial aneurysm after endovascular treatment is frequent[3,14,16,19,22]. Reports have similarly documented the potential for aneurysm remnants to enlarge or hemorrhage following incomplete endovascular treatment[8,11,18,25,26]. In our series, we found 12.8% of near total or incomplete occlusion of GDC group in immediate follow up.

Vinuela et al.[29] reported a multi-center study on the results of aneurysms treated with GDC in 403 patients. They reported that 25.6% of small aneurysms in small necks, 52.0% of small aneurysms in wide necks, 62.1% of large aneurysms and 50.0% of giant aneurysms had an aneurysm remnant after primary treatment. Thirty three cases underwent postembolization surgical treatment, including aneurysm clipping in 21 cases and a variety of surgical procedures in the remaining cases. More importantly, during a clinical follow-up of up to 36 months after treatment, 9 patients (2.2%) with incompletely embolized aneurysms rebled.

Another review by Byrne et al.[1] of a large series of patients treated with GDC after SAH revealed that in those patients available for follow-up angiography, 36% of the cases had a remnant of variable size after initial treatment. Also, on follow-up angiography 6months after first embolization, 85.3% of their coiled aneurysms remained stable but 14.7% of the cases enlarged to some degree. Giant aneurysms had a 100% recurrence rate. According to their report, three of 38 aneurysms with an unstable occlusion and one of 221 aneurysms with a stable occlusion reruptured, and annual rebleeding rate were 0.8% in the first, 0.6% in the second, 2.4% in the third year.

Clipping after clipping

Before endovascular treatment technique was developed, residual aneurysms were managed either conservatively or by performing a reoperation[5,9,15]. Reoperation for residual aneurysms after previous clipping can be associated with a higher risk of morbidity and mortality than the initial operation. Rates of 7% for major morbidity and 5.2% for mortality were reported in the largest series currently available in the literature[5]. Scar adhesion from the previous operation can obscure the anatomy and tether the aneurysm, making reoperation technically more difficult[5,15]. The previous clip can be in a compromising position, which makes reclipping difficult. Removal of an old clip that has scarred down onto the aneurysm neck can be fraught with danger of intraoperative rupture or tearing of the parent vessel. Giannotta and Litofsky[9] reported a series of 19 patients who underwent 20 operative procedures for the treatment of residual aneurysms after previous surgical treatment. They noted that the removal of the previously applied clip was almost always required to completely secure the aneurysm. Further adjuncts to the successful operative retreatment that were regarded as helpful included bony exposure, sharp dissection of the surrounding scar tissue, temporary artery occlusion, adequate management of previously applied coating materials and the liberal use of intra-operative angiography.

Coiling after clipping

Rabinstein et al.[21] reported their experience with 21 cases using endovascular GDC occlusion for the treatment of cerebral aneurysm remnants after incomplete surgical clipping. In their series, endovascular coli embolization resulted in complete occlusion in 17 of 21 treated patients (81%) and near-complete occlusion in the remaining four. There were no serious complications related to endovascular treatment. Clinical outcomes were generally favorable and all treated aneurysms remained asymptomatic after coiling for the duration of the follow-up (range, 40days~5.5years). They noted that poor outcomes were significantly associated with a history of SAH before the primary surgery and short interval (less than 1month) between clipping and endovascular coiling. Given our experiences, we recommend coil embolization of the choice in cases that the residual aneurysmal neck had been narrowed by previous clipping.

Clipping after coiling

Neurosurgical management of intracranial aneurysm after endovascular procedures has been documented previously. Gurian et al.[10] reported of ten patients that had surgical occlusion of their aneurysms after incomplete GDC occlusion. Seven patients had direct clipping of the aneurysm while two patients had a trapping procedure performed. All cases made good recovery. Their decision to operate on residual aneurysms was based on multiple factors including the location of the aneurysm, the age and condition of the patient and the size of the residual.

When aneurysmal neck clipping of previous incompletely coiled aneurysm is difficult because of not enough coil-free

neck space, some have proposed the removal of the protruding coils[2,12] or to angiographically follow the aneurysm features until the neck is coil-free[10,28], thus making clipping easier. According to literatures, we found it very dangerous to remove indwelling coils, due to the strong adhesion of this material to the intraaneurysmal thrombosis. Fortunately, our complementary clipping cases after incomplete coiling had enough coil-free space, so clipping was possible without any need for removal of the indwelling coils. The important aspect is to clip the neck rest and not remove the coils in the case of enough coil-free neck space.

Coiling after coiling

Repeated embolization of previously surgically treated aneurysms has also been reported[13,20]. Horowitz et al.[13] reported their clinical experience in the treatment of residual aneurysms found after previous endovascular treatment. Nine patients were retreated, five surgically and four using further coiling. They recommended further embolization as the ideal method of retreatment if the anatomy is favorable because of the fact that surgery is likely to be difficult with a potential risk of parent vessel occlusion or damage.

Multidisciplinary approach

When occlusion after endovascular or surgical treatment is incomplete, a new multidisciplinary approach should be carried out. Which residual aneurysms are optimal for surgical reclipping and which ones are optimal for coiling have not been well elucidated. Patients with cerebrovascular disorders who visit our center are evaluated by a combined neurovascular unit of neurosurgeons and neuroendovascular interventionists, all of whom make a joint decision regarding the management strategy for each patient. The method of choice has to be individualized and several factors have to be considered. The primary modality of treatment, the configuration and size of the remnants, the neurosurgeon and neuroradiologist's opinion on the ease or difficulty of the retreatment procedure using either modality and the relative risks involved with each, all play a role in the decision making process. As endovascular techniques continue to evolve, they now offer an alternative to surgical clipping in the management of cerebral aneurysms. They can also be a useful adjunct to surgery in the treatment of complex aneurysms that can be best handled through a combined approach. Surgical and endovascular strategies can be successfully integrated into a single therapeutic plan, the order of the interventions depending on the particular characteristics of each patient. This is particularly true in cases of aneurysm remnants. Furthermore, the combination of a partial surgical clipping with narrowing of the aneurysm neck and subsequent endovascular treatment of aneurysm residuum may be a new therapy for those aneurysms that cannot be treated by either modality alone. If only partial clipping of a broad neck aneurysm can be performed with surgical creation of a neck, the subsequent coil placement has a higher chance of success.

Conclusion

Even in an experienced neurosurgeon's hands, aneurysm remnants following treatment with either surgical or endovascular therapy are a major challenge. Such aneurysms may have a large unoccluded remnant, or an unstable residual aneurysm growing with time. In both cases, they are at risk of further rupture. The indications and techniques for their remnant are not simple. Given our experiences, we recommend coil embolization of the choice in cases that the residual aneurysmal neck had been narrowed by previous clipping. On the other hand, if the residual aneurysm has enough space to clip but not enough to coil, we recommend the microsurgical clipping. A multidisciplinary team should be formed and trained for close follow-up of these patients. This team will have to choose between further follow-up observation and new attempt at endovascular or surgical treatment.

This report describes our experience with seventeen patients who had treatment for residual aneurysms after surgical or endovascular treatment. The treatment of cerebral aneurysm remnants can be performed effectively using a variety of modalities. The original purpose of the treatment, which is complete obliteration of the aneurysm, can thus be achieved.

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