Treatment of Cerebral Aneurysms: Surgical Clipping and Coil Embolization

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Summary

The present series provides a balanced overview of the treatment of aneurysms in surgical clipping and coil embolization.

Between January 2004 and March 2006, 76 consecutive patients with cerebral aneurysms underwent endovascular embolization and/or surgical clipping. Of these, 42 patients suffered an aneurysmal subarachnoid hemorrhage (SAH), while the remaining 34 patients had nonruptured cerebral aneurysms.

Of the 23 surgically treated patients, 17 (73.9%) achieved a favorable outcome. Of the 19 patients who underwent endovascular embolization, 12 (63.2%) achieved a favorable outcome. Three patients (15.8%) who underwent endovascular embolization needed to undergo re-treatments, while no re-treatment was needed in the surgically treated patients. Of the 34 nonruptured aneurysms, 12 (35.3%) were treated using surgical clipping, while 22 (64.7%) underwent endovascular embolization. The complication rates of the two treatment modalities demonstrated no significant difference.

A combined microsurgical-endovascular team approach is thus considered to provide the most effective means to achieve favorable outcomes for patients with cerebral aneurysms.

develop new strategies in the treatment of cerebral aneurysms. There is now a choice of several therapeutic alternatives for the management of cerebral aneurysms. The published reports of early clinical and angiographical results of endovascular treatment have been promising¹. In the International Subarachnoid Aneurysm Trial (ISAT), a randomized prospective study of the outcomes of endovascular and surgical treatment of ruptured cerebral aneurysms, investigators found that patients treated by endovascular methods had a 22.6% lower relative risk of joining the poor outcome group (Rankin Scale Score 3 – 6) at one year posttreatment than the patients treated by surgical methods². The study data allow us to conclude that patients with a subarachnoid hemorrhage and an aneurysm anatomy indicating a high likelihood of success with endovascular therapy should therefore be offered this option. However, to a certain extent, ISAT only confirms data that have already been shown in other studies, with some reservations and revelations.

The present series provides a balanced overview of the treatment of aneurysms in surgical clipping and coil embolization, our findings thus support the policy of “Clip and Coil, not Clip versus Coil”.

Clinical Material and Methods

Between January 2004 and March 2006, a total of 76 consecutive patients with cerebral aneurysms underwent endovascular embolization

Introduction

Recent advancements in neurosurgery and interventional neuroradiology have led us to

and/or surgical clipping at Murakami Memorial Hospital, Asahi University. Of these, 42 patients suffered an aneurysmal subarachnoid hemorrhage (SAH), and all patients were admitted within 48 hours of suffering an SAH, nine patients were male, and 33 were female ranging in age from 23 to 93 years (mean 63.7 years). The remaining 34 patients had nonruptured cerebral aneurysms, ten patients were male, and 24 were female ranging in age from 14 to 80 years (mean 59.1 years).

Decisions on how to treat an aneurysm were taken on a case-by-case basis, depending on the 3D CT angiography findings (aneurysm location, size, shape, dome-neck ratio, incorporation of normal branches, and tortuosity of the proximal vessels) and the clinical data (patient age, baseline neurological condition, and systemic comorbidities).

Endovascular treatment was chosen as the first line treatment for patients with aneurysms, which had the following characteristics; a dome-neck ratio >1 and no incorporation of normal branches. Patients over 80 years of age and poor grade patients (WFNS grade 4) were also candidates for endovascular treatment as the first choice treatment. Surgical clipping was applied to other patients and it was also performed in the instance of either failed or attempted endovascular treatment. All endovascular and surgical procedures were performed by the first author.

Follow-up angiography was performed six months following the endovascular procedures, unless a plain craniogram demonstrated a coil deformity. On follow-up, the patients were evaluated to measure their functional ability based on the Glasgow Outcome Scale at six months, one year and then annually after treatment.

Results

The patients' clinical conditions at the time of admission and the treatment modalities used are shown in table 1, while the locations of the aneurysms and the treatment modalities used are shown in table 2. Of the 24 internal carotid artery (ICA) aneurysms, ten (41.7%) were treated using surgical clipping, while 14 (58.3%) underwent endovascular embolization. Of the 21 middle cerebral artery (MCA) aneurysms, 16 (76.2%) were treated using surgical clipping, four (19%) underwent endovas-

cular embolization, and one patient with a ruptured right MCA aneurysm with an ill-defined neck and mild vasospasm adjacent to the aneurysm underwent tentative coil embolization followed by definitive neck clipping in the chronic stage. Of the 21 anterior cerebral artery (ACA) aneurysms, eight (38.1%) were treated using surgical clipping, 11 (52.4%) underwent endovascular embolization, and two cases underwent coil embolization followed by surgical neck clipping. Of the 14 posterior circulation aneurysms, two (14.3%) were treated using surgical clipping, and 12 (85.7%) underwent endovascular embolization.

In the follow-up of the 23 surgically treated patients with SAH, 17 (73.9%) achieved a favorable outcome (good recovery: GR and moderately disabled: MD). Of the 19 patients with SAH that underwent endovascular embolization, 12 (63.1%) achieved a favorable outcome. The outcome of the surgically treated group and the group of patients that underwent endovascular embolization, according to the admission WFNS grade, are summarized in tables

Table 1 Summary of clinical conditions at the time of admission and the treatment modalities in 42 patients with aneurysmal SAH.

Grade	Clipping	Embolization	Coil-Clip	Total
1	12	8	1	21
2	3	3	1	7
3	1	2	0	3
4	6	4	1	11
total	22	17	3	42

Table 2 Treatment modalities of 80 cerebral aneurysms according to lesion location

location	Clipping	Embolization	Coil-Clip	total
ICA	10	14	0	24
MCA	16	4	1	21
ACA	8	11	2	21
BA	1	6	0	7
VA	0	5	0	5
PCA	1	1	0	2
total	36	41	3	80

3 and 4 respectively. The causes of unfavorable outcome (severely disabled: SD, Vegetative survival: V and Dead: D) of the surgically treated group and the group of patients that underwent endovascular embolization are listed in table 5. One patient with a basilar apex aneurysm underwent endovascular embolization had a rebleeding of the aneurysm 16 days after the initial endovascular treatment, and died, while no rebleeding was observed in the surgically treated patients. Three out of 19 patients (15.8%) who underwent endovascular embolization needed to re-treatment following the initial endovascular treatment, while no re-treatment needed in the surgically treated patients.

Of the 34 cases with a nonruptured aneurysm, 12 (35.3%) were treated using surgical clipping, while 22 (64.7%) underwent endovascular embolization. Of the 12 surgically treated patients, one transient ischemic complication occurred, while two transient ischemic complications were observed in the 22 patients that underwent endovascular embolization.

Discussion

Recent advances in neurosurgery and interventional neuroradiology have led us to develop new strategies in the treatment of cerebral aneurysms. The published reports of early clinical and angiographical results of endovascular treatment have been promising¹. The International Subarachnoid Aneurysm Trial (ISAT) is a well-designed and well-executed, randomized, controlled trial on a large number of patients. These data provide the highest level of evidence supporting the use of detachable coils for patients with ruptured cerebral aneurysms suitable for endovascular therapy². The study data allow us to conclude that patients with subarachnoid hemorrhage and aneurysm indicating a high likelihood of success with endovascular therapy should be offered that option. The publication of the results of this trial has sparked heated debate regarding the best current treatment for ruptured intracranial aneurysms³.

In Europe, particularly in the United Kingdom, the study has had a profound effect on the management of ruptured intracranial aneurysms. On the other hand, the ISAT has not had such a significant impact on the neurosurgical vascular practices in Japan and the US. A major criticism of the ISAT is that only a mi-

Table 3 Outcome of the surgically treated group according to the admission WFNS grade.

Grade	GR	MD	SD	V	D	Total
1	12	1	0	0	0	13
2	3	0	0	0	0	3
3	0	0	0	0	1	1
4	0	1	2	1	2	6
total	15	2	2	1	3	23

Table 4 Outcome of the group of patients underwent endovascular embolization according to the admission WFNS grade.

Grade	GR	MD	SD	V	D	Total
1	8	0	0	0	0	8
2	2	0	1	0	1	4
3	0	1	0	0	0	1
4	0	1	2	1	2	6
total	10	2	3	1	3	19

nority of the patients evaluated at the participating centers were indeed enrolled in the trial. For inclusion in the study, the patient in question had to have an aneurysm judged by both a neurosurgeon and a neurointerventionalist to be equally amenable to surgery or endovascular embolization. As a result, only 2143 of the 9559 patients screened at the participating centers were actually enrolled in the trial, 78% were excluded. 9% of the exclusions were for refusal to participate, while the remaining 69%

Table 5 Causes of unfavorable outcome and death according to the treatment modality in 42 patients with aneurysmal SAH.

Cause of unfavorable outcome	Clipping	Embolization
effect of primary bleed	4	4
complication of treatment	1	1
rebleeding	0	1
vasospasm	1	1
systemic complication	0	0
total	6	7

were excluded from the study because the aneurysm could not be treated by either procedure. A large proportion of these aneurysms were excluded because they probably had a configuration that was not suitable or ideal for coiling. The results of this study therefore do not necessarily justify embracing endovascular embolization as the therapy of choice for the entire population of patients with ruptured intracranial aneurysms. Furthermore, the endpoint in ISAT was assessed at one year. The longer-term durability of endovascular therapy, however, remains to be determined. It is possible that an early gain in the lowered rate of periprocedural morbidity and mortality from endovascular therapy, such as that found in this study, could be offset to some degree by a later increase in morbidity and mortality from later aneurysm rebleeding related to aneurysm remnants or recurrences. In fact, in the ISAT, the rate of postprocedural hemorrhage up to one year in the endovascularly treated patients was 2.6 times that in the surgically treated ones. The long-term follow-up data from the ISAT and other studies should therefore help provide an answer to these questions.

The main concerns of endovascular treatment are the substantial proportion of aneurysms that are initially incompletely occluded and the possibility of the coiled aneurysm re-opening over time with inherent risks of rebleeding. After microsurgical clip application, the incidence of aneurysm rest has been assessed at between 4 and 9%, and reaching a rate as high as 19% for giant aneurysms. The risk of hemorrhage from these residual aneurysms is estimated to be between 0.5 and 1.5% per year. In contrast, after the endovascular placement of coils, the incidence of a residual aneurysm is estimated to be 40% in a routine review⁴.

Hayakawa, et Al, showed 40% rate of recanalization in small aneurysms with wide necks and a rate greater than 80% in large and giant aneurysms on follow-up angiography 17 months after endovascular coil embolization resulted in an incomplete aneurysm exclusion in 72 patients⁵. A high incidence of recanalization was promoted in such cases with an in-

completely obliterated aneurysm^{6,7,8}. The follow-up results were less satisfactory in the cases involving incompletely obliterated lesions⁹, whereas there was no doubt about the long term durability of surgical clipping.

When making case-by-case evaluation by a combined team of microsurgical and endovascular therapists based on the individual characteristics of each aneurysm, it is likely that a combined microsurgical-endovascular team approach will provide the means to achieve the best outcomes for the entire population of patients with ruptured intracranial aneurysms^{9,10}. In treating an individual patient with a ruptured aneurysm, multiple factors must be considered when choosing the optimal course of treatment.

Such factors include the aneurysm location, size, shape, and orientation; the tortuosity of the proximal vessels and the parent artery; the presence of calcifications at the aneurysm neck; neck/dome ratio; and patient's chronological and biological age, systemic comorbidities, life expectancy, and neurological condition. For example, it might be more appropriate for an elderly patient or a poor-grade patient with a limited life expectancy to receive no specific treatment or a treatment that is safer than one that provides decades of cure. Similarly, a young patient might forego a safer treatment for one that is more permanent. Excellent results can be obtained with complementary surgical clipping and coil embolization. The two treatment options can be successfully used interchangeably and at times in a complementary fashion to protect the patient from an aneurysm rupture while trying to minimize the complications related to treatment.

Conclusions

The method of treatment for each individual patient should be based on an objective selection of the safest and the most effective treatment. It is likely that a combined microsurgical-endovascular team approach will provide the best means to achieve the favorable outcomes for the entire population of patients with intracranial aneurysms.

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