Analysis of Supplemental Surgical or Endovascular Treatment for Cerebral Aneurysms in the Endovascular Performed Cases

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Summary

In the 150 endovascular performed cases from May 1997 to Dec 2004, supplemental combination of endovascular and surgical treatments were performed in 46 cases. Characteristics of the treatments were combination for multiple aneurysms, surgical clipping for failed endovascular attempt, embolization for recurrence after clipping, bypass surgery before endovascular parent artery occlusion, surgery for recurrent aneurysms after embolization, and embolization for failed surgical attempt. Sixty seven percent of ruptured and 87% of unruptured cases showed satisfactory clinical outcome (modified Rankin scale = 0 to 2). Supplemental combination of each treatment will support the disadvantage of another treatment, and which improve the clinical outcome of cerebral aneurysm.

Introduction

These ten years, endovascular treatment for cerebral aneurysm has been advanced to become alternative therapy for intracranial aneurysm^{1,2}. Moreover, supplemental combination of endovascular and surgical treatment can treat complex shape or surgically unapproachable aneurysms using single treatment³⁻⁷. The purpose of this study is to show the present status and possibilities of cooperation of endovascular and microsurgical treatment for cerebral aneurysm.

Patients and Methods

From May 1997 to Dec 2004, endovascular treatment were attempted in 150 cases (160 aneurysms), of them 76 cases were ruptured and 74 cases (84 aneurysms) were unruptured cases. In the ruptured cases, there were 21 ICA, 5 MCA, 19 ACA or A-com, 4 PCA, 10 BA, 15 VA and two other branches. In the unruptured cases, there were 45 ICA, 12MCA, 13 ACA or A-com, 10 BA and 4 VA aneurysms. There were eleven dissecting aneurysms of vertebral and other peripheral arteries, and six giant aneurysms of ICA in the both of ruptured and unruptured cases. In the ruptured cases, Hunt and Kosnik (H&K) grade before treatment were as follows: seven on grade I, 29 on grade II, 22 on grade III, 15 on grade IV and three on grade V. In these cases, supplemental combination of both treatments was performed in 46 cases.

Endovascular approaches were performed with advanced imaging technique of digital subtraction angiography and microcatheter technique by single expert neurointerventionalist. The endosaccular coiling with Guglielmi detachable coils, and parent artery occlusion with either coils or balloons.

Microsurgical approach included neck clipping of the aneurysm, direct parent artery occlusion or extra cranial to intracranial microsurgical anastomosis.

The cases of supplemental treatments were assessed retrospectively by reviewing the med-

ical documentation. The clinical outcome of the all cases was assessed at the time of discharge using modified Rankin Scale (mRS). Procedure related complication was assessed during the treatment and acute stage after treatment.

Result

Supplemental combination of both treatments were performed in 22 of 76 ruptured and 24 of 74 unruptured cases. Characteristics of the each treatment were as follows.

1) Combination of Endovascular and Clipping for Multiple Aneurysms

17 cases (37%) (21 aneurysms) underwent both surgical and endovascular treatment for multiple aneurysms. Three of them were ruptured aneurysm after previous surgical treatment for another ruptured aneurysms. Nine of them were discovered at the angiography on the rupture of another aneurysm. Five of them were discovered incidentally on MRA at the brain health check or cerebrovascular symptom. The patients of multiple aneurysms tended to refuse surgery and select endovascular treatments.

2) Surgical Clipping for Failed Endovascular Attempt

There were twelve cases that were surgically clipped for failed endovascular approaches. Nine of them were ruptured and three of them were unruptured aneurysms. Reasons of failed endovascular approach were as follows. We experienced seven cases of difficulties in catheterization. Five of them were ACA and A-com aneurysms, and two of them were IC aneurysms in high aged patients. Three were coil protrusion by small dome or wide neck, and changed to surgery. One was penetration of dome and haematoma occurred. Emergency surgical evacuation and clipping were performed. One case showed anterior choroidal artery originate from the dome and stopped coil embolization. In the operation, wrapping of the aneurysm was performed. Failed endovascular attempt needed surgical clipping to reduce the risk of rebleeding in the ruptured cases and satisfy the patient's wish.

3) Embolization for Recurrence after Clipping

Seven cases were recurrence after open surgery for ruptured aneurysms. Five cases (IC;

1, A-com; 3, VA-PICA; 1) showed acute stage recurrences including 2 rebleedings (A-com; 1, VA-PICA; 1). Rebleedings included a case of wrapping for ruptured A-com aneurysm, and a case of clipping for VA-PICA aneurysm. Two cases showed chronic stage recurrence (A-com; 1, BA-SCA; 1) including one rebleeding. Two cases were recurrence after clipping for unruptured aneurysms. Of them, one was small A-com aneurysm discovered by brain health check and recurrence occurred after four years from the clipping. And the other was small left M2 aneurysm that discovered by the rupture of another aneurysm and recurrence occurred after seven years from the clipping. All of nine cases were successfully treated by embolization.

4) Bypass Surgery before Parent Artery Occlusion for Giant Aneurysm

There were three cases treated with endovascular parent artery occlusion after extracranial to intracranial bypass surgery for giant ICA aneurysms. The bypass surgery was selected in the cases of insufficient internal cranial artery stump pressure at the balloon occlusion test in the treatment for IC cavernous giant aneurysm. The endovascular trapping after bypass was safely performed monitoring neurological symptoms.

5) Surgery for Recurrent Aneurysms after Embolization

There were four recurrent aneurysms after coil embolization, which were surgically treated. Three of them were ruptured aneurysms (VA-PICA; 2, P1; 1) and one was unruptured giant thrombosed ICA aneurysm. P1 aneurysm recurrent after 10 months from the initial treatment and two VA-PICA aneurysms recurred after two to three months from the first treatment. The reasons of the recurrence were incomplete coil packing with neck remnant in the ruptured cases. Two of them were treated with simple neck clipping and one of VA-PICA aneurysm was treated with PICA occlusion with OA-PICA anastomosis. We experienced a case of recurrence after coil embolization for thrombosed giant ICA aneurysm. In this aged lady, first embolization was selected before surgery for abdominal aortic aneurysm. Coil compaction occurred after five months and rupture of cerebral aneurysm occurred after 15 months. The aneurysm was treated with surgical trapped of ICA with STA-MCA anastomosis. All of surgical approaches were successfully performed.

6) Embolization for Failed Surgical Attempt

We experienced a case of 64 years man presented with subarachnoid haemorrhage of Hunt and Kosnik grade III by the ruptured IC-PC aneurysm. Clipping was impossible because of severe atherosclerosis of left ICA. Coil embolization was selected at the chronic stage.

Complications

There were no mortality and morbidity associated with endovascular procedure for ruptured and unruptured aneurysms. Transient thromboembolic complications occurred in two of unruptured and one of ruptured cases. Rerupture during the procedure occurred in three of ruptured cases, which did not influenced outcome. In the surgical cases, one case presented with fatal cerebral infarction after clipping for IC dorsal aneurysm, which showed rupture during surgery.

Clinical Outcome (table 1 A,B,C)

In the ruptured cases, 53 (69.7%) showed good outcome of mRs 0 to 2. Poor outcome of mRs three to five were 18 (23.3%) cases and death occurred in five (6.6%) cases. In the total ruptured cases, mRs 0 was forty seven, one was four, two was two, three was three, four was six, five was nine and six was five cases. Eighteen (81.8%) of 22 combined cases and 33 (64.8%) of 54 endovascular cases showed good outcome of mRs 0 to 2.

The mRs 0 of endovascular cases for unruptured aneurysm is 52 (100%) in 52 endovascular only cases, and 20 of 24 supplementary combined cases. In the supplementary combined cases, there were one mRs 2, one mRs 3 and two mRs 4. Three of them showed multiple aneurysms and initial neurological deficits existed by the first subarachnoid haemorrhage from another aneurysm. One was rebleeding from the recurrence of thrombosed giant ICA aneurysm, and was surgically trapped. In the all of unruptured cases, 70 of 74 cases (94.6%) resulted in mRs 0.

Discussion

Early clinical outcome of ruptured aneurysm was significantly better than surgical treatment by the randomized prospective study¹. The endovascular approach is a good treatment option

Table 1A Clinical outcome of total cases.

mRS	Unruptured	%	Ruptured	%
0	70	94.6	47	61.84
1	0	0	4	5.263
2	1	1.35	2	2.632
3	1	1.35	3	3.947
4	2	2.7	6	7.895
5	0	0	9	11.84
6	0	0	5	6.579
Total	74	100	76	100

Table 1B Clinical outcome of combined cases.

mRS	unruptured	%	ruptured	%
0	20	83.3	16	72.7
1	0	0	2	9.1
2	1	4.2	0	0
3	1	4.2	1	4.5
4	2	8.3	1	4.5
5	0	0	0	0
6	0	0	2	9.1
Total	24	100	22	100

Table 1C Clinical outcome of the cases treated solely with endovascular approach.

mRS	Unruptured	%	Ruptured	%
0	52	100	31	57.4
1	0	0	2	3.7
2	0	0	2	3.7
3	0	0	2	3.7
4	0	0	5	9.3
5	0	0	9	16.7
6	0	0	3	5.6
Total	52	100	54	100

for patients in whom complete obliteration cannot be achieved by surgical clipping⁸. Reoperation for recurrent aneurysm after clipping is difficult and increased risk of complications⁹. Multiple remote aneurysms can treat at single session in ruptured and unruptured cases without extended craniotomy and surgical difficulties¹⁰.

In the endovascular treatment, there was 8% of treatment failure³. The main reason of treatment failure was inability to catheterize the aneurysm⁶ because of aneurysm location or ves-

sel tortuosity. The second common reason is coil extrusion of the aneurysm⁶. In the coil extrusion cases, the rate of fundus-to-neck rate was less than two or the neck diameter was greater than 5 mm⁶. A complex broad-neck aneurysm treated solely with endovascular technique might require balloon remodeling or stent placement before coiling. The risk of these technique may be greater than those of direct clipping or simple arterial occlusion^{3,11,12}. Usually, ruptured aneurysm with hematoma should be treated with open craniotomy, however, there was a report of hematoma evacuation after coil embolization for ruptured cerebral aneurysm¹³.

Surgical clipping obtains less number of recurrent cases than endovascular approach, and treatment failure was almost none³. Incomplete treatment was 4.6% in surgical clipping, whereas, 33.7% in endovascular treatment^{3,14}. Surgical accessibility is the most important factor, and varies considerably with aneurysm location³. Aneurysms in the posterior circulation are less accessible than those in the anterior circulation^{3,15}. In the anterior circulation, it is also

difficult to access the carotid aneurysm at petrous to the clinoidal segment^{3,16}. Endovascular method can access these locations where surgical access is limited. Moreover, neck or vessel calcification by atherosclerosis may reduce the surgical access and clipping procedure.

Fusiform and complex wide-necked aneurysms that cannot be clipped or occluded with coils remain difficult lesions to treat and are associated with a high incidence of complications. Flow redirection with surgical bypass and endovascular trapping of proximal vessel is one of strategy for these aneurysms^{3,5}. The balloon occlusion test after bypass can confirm the collateral flow and neurological symptom with angiography, and which promise the safety of the treatment³.

In the aneurysm treatment, we have to understand the benefit and disadvantage of both endovascular treatment and surgical clipping. Supplemental combination of each treatment will support the disadvantage of another treatment, and which improve the clinical outcome in the aneurysm treatment.

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