Efficacy of Endovascular Surgery for Unruptured Internal Carotid Artery Aneurysms Presenting with Cranial Nerve Symptoms

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Summary

Whether endovascular surgery is able to reduce the mass effects of unruptured aneurysms is still controversial, although some reports have suggested efficacy in cases of internal carotid artery aneurysms with cranial nerve palsy. Here we assessed outcome in a series of cases.

Between April 1992 and April 2005, 18 patients with unruptured internal carotid artery aneurysms presenting with cranial nerve palsy were treated by endovascular surgery. The patients were two males and 16 females aged from 19 to 84 (mean 59.6 years). Aneurysms were located in the cavernous portion in 14, at the origin of the ophthalmic artery in one and at the origin of P-com in three. The aneurysms were all embolized using Guglielmi detachable coils, Interlocking detachable coils, Cook's detachable coils or Trufill DSC and detachable Balloons were applied to occlude the proximal parent artery. We analyzed the efficacy of endovascular surgery for such aneurysms retrospectively.

The mean aneurysm size was 21.4 mm and the mean follow-up period was 57.7 months. Palsy of IInd cranial nerve was evident in three patients, of the IIIrd in eight, of the Vth and Vth in one each, and of the VIth in nine. Post embolization occlusion was complete in nine patients and neck remnant in the other seven.

Regarding complications of endovascular surgery, one case (5.6%) showed TIA after emboli-

zation. Overall 11 (46%) cranial nerve symptoms showed complete resolution, eight (33%) showed some improvement, and five (21%) were unchanged. In three cases (12.5%), the symptoms worsened after treatment. The shorter the duration of symptoms was a factor predisposing to resolution of symptoms. In complete resolution cases, the timing of treatment after symptoms appeared and the time of complete resolution were in proportion.

These results showed that there is no difference in reduction of mass effects between surgical clipping and endovascular surgery for unruptured internal carotid artery aneurysms. With endovascular surgery, the rapidity of treatment after symptoms is the most important factor for successful results.

Introduction

The standard treatment of patients with aneurysms causing cranial nerve palsy has been direct surgery¹⁻³. Since this is difficult to perform for cavernous portion internal carotid artery aneurysms, endovascular surgery may be needed for such cases.

However, endovascular treatment of unruptured aneurysms causing mass effects on cranial nerves is still controversial^{4,6}. The present study was conducted to evaluate its efficacy for a series of internal carotid artery aneurysms with cranial nerve palsy.

Material and Methods

Between April 1992 and April 2005, 18 patients with unruptured internal carotid artery aneurysms with cranial nerve palsy were treated by endovascular surgery in our institution. All were retrospectively examined for their clinical symptoms over time for analysis of efficacy. The patients were two males and 16 females aged from 19 to 84 (mean 60.6 years). The aneurysms were located in the cavernous portion in 14, at the origin of ophthalmic artery in one and at the origin of P-com in three. Embolization was performed under focal anesthesia after systemic heparinisation with a bolus of 2000 IU, followed by continuous injection of 200 IU/min and maintenance of an activated coagulation time (ACT) more than twice the control value. A microcatheter (Excelsior, Excel 14 or SL-10; Boston Scientific, Natick, Massachusetts) was carefully inserted into the aneurysm with the guidewire and embolization was achieved using Guglielmi detachable coils (GDC; Boston Scientific, Natick, Massachusetts), interlocking detachable coils (IDC; Boston Scientific, Natick, Massachusetts), Cook's detachable coils (CDC; Cook Inc.), Trufill DCS (Johnson & Johnson) or detachable balloon occluded proximal parent artery. Post embolization, anti-platelet therapy using aspirin was started, and continued for six months. The following cranial nerve symptoms and signs were evaluated and all patients were followed by MRA and thin slice MRI.

Results

Our patient details are summarized in table 1. The mean aneurysm size was 21.4 mm (range 5 to 40 mm). Three patients had palsy of the II, eight of the III, one each of the IV and V, and nine of the VI cranial nerve. The timing of treatment by endovascular surgery was a mean of 176.9 days after the initial symptoms appeared. The mean follow-up period was 57.7 months. Post-embolization occlusion was complete in nine patients and seven had neck remnants. The final occlusion results were complete in 14 patients and neck remnant in the remaining four.

Overall, 11 (46%) cranial nerve symptoms showed complete resolution, eight (33%) symptoms showed some improvement, and five (21%) symptoms were unchanged. However, in three cases (12.5%), symptoms worsened temporarily after treatment. In complete resolution cases, the aneurysm mean size was 19.6 mm (range 10 mm to 40 mm) and the mean follow-up period was 71.1 months (table 2). The timing of treatment in these cases was 140.2 days (mean), and the time to complete resolution was 137.6 days (mean) (table 2). In partial improvement cases, aneurysm mean size was 18.4 mm (range 5 mm to 35 mm) and the mean follow-up period was 38.2 months (table 2). The timing to treatment in these cases was 125.5 days (mean) (table 2). In unchanged cases, aneurysm mean size was 27 mm (range 15 mm

Figure 1 The relationship of the timing to treatment and change in symptoms. The shorter the period before treatment is the most important factor for better resolution.

Table 1 Summary of our 18 aneurysms cases with CNS palsy treated by endovascular surgery.

case No	Age/ Sex	Location of An	CNS	Size (mm)	Treatment	Occlusion rate at post embolization	Result	Complication	Timing of treatment (day)	Timing of CNS deficits improved (day)	Period of CNS deficits complete resolution
1	59/F	Lt. IC	III VI	40	IDC	complete	complete unchange	none none	181	2 none	13 months none
2	74/F	Lt. IC	III VI V	35	IDC	neck rem	complete improvement complete	none none none	91	47 47 47	68 days none 68 days
3	69/F	Rt. IC cavernous	III	25	GVB	complete	complete	temporary worsening	244	3	14 days
4	54/F	Lt. IC cavernous	VI	21	GVB	complete	complete	none	242	50	65 days
5	20/F	Rt. IC cavernous	VI	27	IDC	neck rem	complete	none	88	60	375 days
6	38/F	Lt. IC	VI	20	GDC	complete	improvement	new cranial nerve deficit (Vth)	51	205	none
7	61/F	Lt. IC-Opt.	II	30	GDC	neck rem	complete	none	64	26	26 days
8	19/F	Lt. IC cavernous	II	10	GDC	complete	complete	none	527	116	375 days
9	74/F	Rt. ICPC	III	5	GDC	complete	improvement	temporary worsening	2	83	none
10	68/F	Rt. IC cavernous	VI	18	IDC	neck rem	improvement	none	116	23	none
11	70/F	Lt. IC cavernous	III IV VI	20	GDC	neck rem	complete complete complete	none none none	21	1 1 1	31 days 31 days 66 days
12	71/M	Lt. IC	VI	15	GDC	neck rem	unchange	none	720	none	none
13	78/M	Lt. ICPC	III	7	GDC	complete	improvement	none	99	51	none
14	84/F	Rt. ICPC	III	8	GDC	complete	improvement	none	14	37	none
15	57/F	Lt. IC cavernous	VI	30	GVB	complete	improvement	none	226	16	none
16	58/F	Bil. IC cavernous	II III	30	GVB	complete	unchange unchange	none none	400 400	none none	none none
17	58/F	Lt. IC cavernous	II	20	GDC+CDC+DCS	complete	unchange	temporary worsening	930	none	none
18	60/F	Lt. IC cavernous	III	24	GDC+CDC+DCS	neck rem	improvement	none	370	21	none

GDC; Guglielmi detachable coil, IDC; Interlocking detachable coil, GVB; Gold valve balloon, CDC; Cook's detachable coil, DCS; Trufill DCS

Figure 2 The relationship of the timing to treatment after symptoms appeared and the timing for resolution in complete resolution cases. The period of complete resolution of cranial nerve deficits is in proportion to the timing to treatment after symptoms appeared.

to 40 mm) and the mean follow-up period was 43.4 months (table 2). The timing to treatment was 526.2 days (mean) (table 2). The relationship of the timing to treatment and change in symptoms are shown in figure 1. The shorter the period for treatment is the most important factor for better resolution. In those where this was complete, the timing to treatment after symptoms appeared and the time for resolution were in proportion (figure 2).

The complete resolution rates for CN symptoms were 50% for optic nerves, 44% for III, 100% for IV, 100% for V and 33% for VI cranial nerves (table 3). In intracranial aneurysm cases, the mean size was 12.5 mm. These cases showed complete resolution of CN symptoms in 25%, and some improvement in 75% (table 4). In extradural aneurysm cases, these mean size was 23.9 mm, complete resolution of CN symptoms was found in 50%, some improve-

ment in 25% and no change in 25% (table 4). Regarding complications of endovascular surgery in our cases, one (5.6%) showed TIA after embolization.

Discussion

Generally surgical clipping for intracranial aneurysms with mass effect symptoms has advantages with regard to reduction of the mass effect for cranial nerves compared with endovascular surgery. In a published report of clipping surgery for unruptured aneurysms, Drake et Al¹⁰ reported 37% of 27 patients showed complete resolution or improvement. Peiris et Al¹³ reported a 30% success rate in ten cases, Ferguson et Al¹¹ 45.8% in 24 cases, Herose et Al¹⁴ 55.6% in 18 cases, Symon et Al¹⁵ 71% in 14 cases, Whittle et Al¹⁶ 0% in six cases and Rice et Al¹⁷ 57.1% in seven cases. For rup-

Table 2 The results of endovascular surgery for the aneurysms with CNS palsy.

	Case No. of CN	Size of An (mean · mm)	Timing of treatment (mean · day)	Timing of started improvement of CNS (mean · day)	Period of complete resolution of CNS (mean · day)
complete resolution	11	19.6	140.2	32.2	137.6
some improvement	8	18.4	125.5	60.4	(—)
unchanged / worsened	5	27	526.2	(—)	(—)

tured aneurysms, Giombini et Al⁹ reported 62% of patients treated within 14 days of initial symptom appearance to show complete resolution as compared to 25% of patients treated after 14 days (table 5).

However, cavernous portion internal carotid artery aneurysms are very difficult to treat by clipping and therefore recently interest has therefore focused on reports that endovascular surgery for aneurysm with mass effect is effective because of reduction of aneurysm size after endosaccular embolization^{4,5}. There is no standard management by endovascular surgery for intracranial aneurysms with mass effect symptoms, but Halbach et al.⁴ reported 50% of patients to show complete resolution of CN symptoms after endovascular surgery.

Malish et Al³ reported completed resolution in 32% of cases, Kim et Al⁶ in 29% and Kazekawa et Al⁸ in 42%. These reports and our present results indicate that there is no difference in rates of reduction of the mass effect between surgical clipping and endovascular surgery. Furthermore, endovascular treatment for aneurysms with mass effects by endosaccular embolization has also been described^{1,2,7}.

What factors influence outcome of endovascular surgery? Halbach et Al⁴ emphasized detrimental effects of a long duration of symptoms such as calcification of aneurysm walls. Malish et Al³, in contrast, reported small size of aneurysm and short duration to be positive factors. Kazekawa et Al⁸ found cases treated within 12 months of initial symptom to have good outcomes. In our patients, the times to treatment after symptoms appeared was 140.2 days in complete resolution cases, 125.5 days in partial improvement cases and 526.2 days in unchanged cases. The aneurysm mean sizes were 19.6, 18.4 and 27 mm, respectively.

Is the location of an aneurysm related to results of endovascular surgery? Kim et Al⁶ reported showed better improvement or resolution with intradural as opposed to extradural aneurysms. In our cases, all intracranial cases showed improvement or resolution, whereas resolution was complete in 50% of extradural aneurysm cases but no change resulted in 25%.

One reason for poor results is that extradural aneurysms exhibit symptoms very slowly, so the duration of pressure on cranial nerves is long. Endovascular treatment for ICPC aneurysms allowed complete resolution in 80% of series described by Miyachi et Al in a text-

Table 3 Summary of the clinical data and the results of the treatment in our cases.

	Cases
Sex	
male	2
female	16
Location	
IC cavernous	14
IC-Ophthalmic	1
ICPC	3
An size (mean; mm)	21.4
Symptoms of CNS	
II	4
III	9
IV	1
V	1
VI	9
Timing of EVS (mean; day)	229.5
Results of CNS	
complete resolution	46% (11/24)
improvement	33% (8/24)
no change+B50	21% (5/24)
Resolution rate(cranial nerve)	
II	50% (2/4)
III	44% (4/9)
IV	100% (1/1)
V	100% (1/1)
VI	33% (3/9)
Temporary worsening	12.5%(3/24)
The date of improvement (mean; day)	44.1
The date of complete resolution (mean; day)	137.6
An; aneurysm, EVS; endovascular surgery	

Table 4 The comparison of clinical data and results for treatment of intradural or extradural aneurysm.

	cases No	size of An (mean;mm)	follow-up (month) (days)	timing of treatment (mean)(days)	cranial nerve deficits		
					complete resolution	some improvement	unchanged
intradural	4	12.5	23	44.75	25%	75%	0%
extradural	14	23.9	65.15	250.8	50%	25%	25%

Table 5 The results of treatment for the aneurysms with CNS palsy in published reports.

	case No.	cranial nerve deficits			timing of treatments (mean;day)	improvement Noted at: (mean; day)
		complete resolution (%)	improvement (%)	no change or worsening (%)		
Endovascular surgery						
Unruptured An						
Halbach et Al (1994)	26	50	42,3	7,7	180	?
Guglielmi et Al (1998)	19	32%	42%	26%	620.5	?
Kim et Al (2003)	7	29%	43%	29%	?	82.5 days
Our cases (2005)	18	50%	29%	21%	229.5	36 days
Direct surgery						
Unruptured An						
Drake (1979)	27	37*		63	?	?
Peiris et Al (1980)	10	30*		70	?	?
Ferguson et Al (1981)	24	45.8*		54.2	?	?
Heros et Al (1983)	18	55.6*		44.4	?	within 180-360
Symon et Al (1984)	14	71.*		28.6	?	?
Whittle et Al (1984)	6	0*		100	90	(-)
Rice et Al (1990)	7	57.1*		42.9	?	?
Ruptured An						
Giombini et Al (1991)	13	62	38	0	before 14	?
Giombini et Al (1991)	36	25	55	20	after 14	?
*included complete resolution and improvement cases, An;aneurysm						

book. These aneurysms cause CN symptoms from early stages, and therefore tend to be treated immediately. In contrast, results for optic nerve disorders with paraclinoid aneurysms are less positive. Thornton et Al¹² reported six cases, in only two of which was resolution complete and 38% patients became blind after treatment. Upper and upper-inside type ophthalmic and carotid anterior wall type aneurysms have high optic nerve disorder rates, and symptoms frequently worsen after treatment. Malish et Al³ found many patients with ophthalmic aneurysms to need re-treatment, and discussed three reasons for poor results. The first is that optic symptoms appear very slowly. The second is that the pressure point is near the optic canal so the space of nerve decompression is very narrow. The last is that ischemic complications for optic nerves may be caused by endovascular treatment. In our se-

ries, three cases had temporary worsening of symptoms after embolization. From basic research, the aneurysms may enlargement temporarily after endosaccular embolization. However, in our cases the volumes of aneurysms were reduced after one month.

Conclusions

The present results indicated that there may be no differences in rates for reduction of mass effects between surgical clipping and endovascular surgery for cases of unruptured internal carotid artery aneurysms presenting with cranial nerve symptoms. With endovascular surgery, rapidity of treatment after symptoms appear is the most important factor for successful results. In future, covered stent therapy might be substituted for endovascular coil embolization for these aneurysms.

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