Endovascular Treatment of Wide-Neck, Ruptured and Unruptured Aneurysms without Supporting Devices

A Single Center Experience

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SUMMARY – *Despite of development of various supporting devices in the endovascular treatment (EVT) of wide-neck aneurysms, the procedure remains very challenging. We describe a small series of patients with relatively wide-neck aneurysms treated only by use of 3D coils without supporting devices. In the period July 2011 - August 2012, we treated 23 patients with aneurysm necks > 4 mm or dome/neck ratios < 2. Aneurysms were located in the anterior circulation in 16 patients and in the posterior circulation in seven. The size of aneurysms ranged from three to 21 mm. EVT was achieved by introducing 3D coils of different dimensions in a “Russian doll” fashion. Immediate angiographic results showed complete aneurysm obliteration in 15 patients, small neck remnant in two, and coil protrusion/herniation in four. In one of these cases we had an occlusion of the parent artery and in another case occlusion of the ascending branch (superior cerebellar artery), fortunately both patients remained symptom-free. Clinical results were excellent in 19 patients. One patient developed mild neurologic deficit in the treated territory immediately after the procedure; the patient recovered with mild hemiparesis. One patient developed a delayed stroke in another territory: after treatment the patient left hospital with dysphasia and hemiparesis. The use of 3D coils without neck supporting devices may be a useful alternative in selected cases of wide-neck aneurysms. Larger series with longer follow-up are needed to evaluate the value of this approach.*

Introduction

The endovascular treatment (EVT) of wide-neck intracranial aneurysms has always been a challenge, especially in small intracranial vessels where the introduction of stents or balloons may be technically difficult or impossible. There are also well-known side-effects of antiplatelet therapy that make stent-assisted treatment very delicate in acutely ruptured aneurysms.

This study presents a small series of patients with wide-neck aneurysms treated only by use of 3D coils, without supporting devices. 3D coils are designed to provide an anatomically compliant scaffold within the aneurysm

that covers the neck, thereby facilitating retention of additional coils placed inside the aneurysm.

Patients and Methods

In the period from July 2011 to August 2012 we treated 21 patients with aneurysm necks wider than 4 mm, or dome-to-neck ratio less than 2. Two patients had two aneurysms and both aneurysms were treated in each case. Patients comprised 18 women and three men ranging in age from 35 to 64 years (mean age 53.58).

Seven patients were treated in the acute phase of SAH (from days 2 to 5); in five pa-

Table 1

Table 2

tients treatment was postponed two weeks to three months after hemorrhage. Nine patients were examined for other reasons and the aneurysm was found incidentally.

The size of aneurysms ranged from 3 to 21 mm (mean value 10.8 mm). The size of the neck was greater than 4 mm in five aneurysms (from 4.2 to 6.5 mm), and the dome-to-neck ratio was less than 2 in 18.

Endovascular treatment was achieved by use of 3D coils of different dimensions. The aneurysms were framed by deploying one or more successive 3D coils of decreasing size. With the first coil we tried to form a basket that would bridge the neck of the aneurysm, and we subsequently filled the dome with smaller 3D coils in a "Russian doll" fashion.

Results

Immediate Angiographic Results

We had one major complication: major protrusion of coil packing towards the parent artery (internal carotid artery, ICA) with subsequent occlusion of the ICA. Fortunately, a very good collateral circulation from the opposite side filled the ICA in a retrograde manner,

so the patient recovered well without any neurologic deficit. In one patient with a basilar artery (BA) aneurysm, the left SCA was not shown after embolization, but the patient did not have any clinical symptoms.

Clinical Results

Nineteen patients remained symptom-free. One patient developed mild neurologic deficit in the treated territory immediately after the procedure. She recovered with mild hemiparesis. One patient developed a delayed stroke in another territory: after treatment the patient left hospital with dysphasia and hemiparesis.

Follow-up

We have a three-month follow-up study for 15 patients. In one patient the small neck remnant is still seen. In one patient with a large aneurysm of the BA tip there was a compaction of coil packing and she had to be retreated. In other 13 patients a complete obliteration of the aneurysm was shown (Figure 1,2,3).

One of them was the patient with the occlusion of the parent artery; on the control

Table 3 Characteristics of aneurysms and coils used for treatment.

Patient no.	EVT	Age	Sex	Localisation of aneurysm	Size of dome	Size of neck	Dome/ Neck ratio	First coil	Packing	Complications
1	2 weeks after SAH	63	F	ACoA	7	3.8	1.84	GDC 6×15	GDC 5×9	Small neck remnant
2	Acute SAH	38	F	V3 segment of DVA	7	3.9	1.79	GDC 7×20	GDC 3×5	Coil protrusion, small thrombus on protruded coil loop dissolved by Aggrastat, small neck remnant
3	2 weeks after SAH	53	F	ICA C6 segment	7.7	4.4	1.75	Microplex 7×21	Cachemire 6×15, 5×7, 2.5×2	NO
4	Acute SAH	50	F	MCA bifurcation	6.5	4	1.62	GDC 6×15	Axium 5×10 Cachemire 4×8	Herniation of 2 loops, mild stroke immediately, good recovery.
5	3 weeks after SAH	64	M	SCA	5.4	2.9	1.86	Axium 6×15	–	NO
6	2 weeks after SAH	44	F	SCA	3	2	1.5	Axium 4×8	Axium 2×4	NO
7	No bleed	54	F	ICA, C5 segment	8.7	4	2.17	Microplex 9×28	Microplex 8×24 5×16	NO
8	Acute SAH	35	F	BA tip	15	6	.5	Microplex 16×48	Target 15×40 Target 13×30 Cachemire 12×19 Target 10×30 Target 7×20	3 days after intervention stroke in another territory, moderate recovery
9a	Acute SAH	60	F	ICA C6 l segment	21	6.5	3.23	Axium 20×50	Microplex 18×55, 14×43 Axium 10×30	NO
9b	Acute SAH	60	F	ICA C7 r	6	3.5	1.71	Cachemire 6×15		NO
10	No bleed	60	F	ICA C5	5	3.5	1.42	Axium 5×10		NO
11	st.post stroke	50	F	MCA	6.5	3.5	1.85	Axium 7×20	Axium 5×10	NO
12	Acute SAH	60	F	ICA C7 segment	10	5	2	Target 10×30	Microplex 9×2 Target 9×20 Axium 7×20	NO
13	No bleed	68	F	ACoA	6.2	3	2.1	Target 6×15	Axium 5×10	NO
14	No bleed	53	F	ICA C7 segment	4	2.5	1.6	Axium 4×12		NO
15	No bleed	38	F	ICA C5C6 segment	7.7	3.5	1.87	Axium 7×20	Axium 6×20	Occlusion of the parent artery, recanalised at 3 month control angiography
16a	3 months after SAH	58	F	SCA	6	4	1.5	Target 6×15,	Target 4×10 3×8	Occlusion of SCA, asymptomatic
16b	3 months after SAH	58	F	PCA	5	3.3	1.51	Target 5×10	Target 2×4	NO
17	Acute SAH	53	M	BA tip	5.5	3.5	1.57	Axium 6×15	Target 4×10, 2×4	NO
18	No bleed	55	F	ICA C6 segment	10	5.7	1.75	Axium 9×30	Axium 3 × 6	NO
19	No bleed	54	F	ICA C6 segment	4.5	3.5	1.28	Axium 5×10	Axium 4×12	Small protrusion of one loop, resolved at 3 month control angiography
20	No bleed	48	F	ICA C4 segment	5.8	3	1.93	Target 6×15	Axium 4×12	NO
21	Acute SAH	26	M	ACoA	5.2	2.8	1.85	Axium 5×10	Target 2×3	NO

ACoA: anterior communicating artery; GDC: Guglielmi detachable coils; RVA: right vertebral artery; ICA: internal carotid artery; MCA: middle cerebral artery; BA: basilar artery; SCA: superior cerebellar artery; PCA: posterior cerebral artery.

Figure 1 53-year-old man; third day after SAH. BA aneurysm measuring 5.5 mm, neck 3.5 mm before (A) and after treatment (B,C).

Figure 2 53-year-old woman with an aneurysm on the ophthalmic segment of the ICA measuring 7 mm, neck width 4.4 mm, delayed treatment (15 days after SAH) before (A) and after (B) treatment.

Figure 3 60-year-old woman with an asymptomatic C5 aneurysm measuring 5 mm, neck 3.5 mm before (A) and after treatment (B).

A

B

C

D

E

Figure 4 53-year-old woman. ICA (C5C6) aneurysm found incidentally measuring 7.5 mm, neck 4 mm. A-C) Occlusion of ICA by coil basket. Good collateral circulation from the opposite side. She was clinically symptom-free. D,E) Control angiography after 3 months. The ICA is patent and the aneurysm is completely excluded from the circulation.

A

B

C

D

Figure 5 54-year-old woman. Asymptomatic aneurysm of ICA C6 segment measuring 4.5 mm, neck 3.5 mm. A,B) Immediately after treatment there was a slight protrusion of the coil package towards the parent artery without hemodynamic disturbances. C,D) Three months after treatment the package is completely inserted in the aneurysm and the ICA shows regular contours.

angiography the parent artery (ICA) was completely patent and the aneurysm was obliterated (Figure 4). In another patient with a slight protrusion of coil packing after the intervention, the control angiography showed the coil package was pushed completely into the aneurysm by the blood flow (Figure 5). In one patient there is still a herniation of two loops into the branch of the MCA without further neurologic deficit.

Discussion

Several literature reports concluded that the use of 3D coils facilitated the treatment of wide-neck aneurysms not amenable treatment with conventional helical coils and also that 3D coils improved the initial coil packing density^{1,2}.

These studies showed that intracranial aneurysms may be packed with complex shaped coils used in a concentric fashion with features largely favorable for stable long-term results

from coiling and a very low incidence of recurrence at six months³.

Besides 3D coils alone, some authors consider other similar methods: a double catheter and catheter-assisted technique, as a viable alternative for management of aneurysms with unfavorable wide-neck or dome-to-neck ratios⁴. A very interesting approach is a multicatheter technique for treatment of an aneurysm with the branch incorporated into the sac⁵.

Conclusion

Unlike the techniques using supporting devices, the use of 3D coils does not lead to instant thrombosis and the use of antiplatelet therapy is avoided. However, this method does not offer secure protection against coil protrusion through the neck. The use of 3D coils without neck supporting devices may be a useful alternative in selected cases of wide-neck aneurysms. Larger series with long-term follow-up are needed to evaluate this approach.

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