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Clinical Study

Endovascular treatment of ruptured tiny, wide-necked posterior communicating artery aneurysms using a modified stent-assisted coiling technique

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ABSTRACT

The endovascular treatment of patients with tiny, wide-necked aneurysms is technically challenging, due to the small volume for microcatheterization and coil stabilization inside the aneurysm sac. We performed a retrospective study to evaluate the feasibility, effectiveness, and safety of stent-assisted embolization for patients with ruptured, tiny, wide-necked posterior communicating artery (PcomA) aneurysms. Between January 2007 and August 2011, 17 tiny, wide-necked PcomA aneurysms that had ruptured were treated at our institution using a modified stent-assisted technique, with delivery of the first coil inside the aneurysm followed by placement of a self-expanding stent via a second microcatheter. All patients were treated successfully using this modified stent-assisted coiling technique. Initial results showed aneurysm occlusion of Raymond Class 1 in 10 patients, Class 2 in four patients, and Class 3 in three patients. The angiographic follow-up results for 13 patients (mean, 12.5 months) showed that all aneurysms remained stable or improved, without any in-stent stenosis or recurrence. Of the other four patients, three refused angiography for economic or personal reasons, and one was lost in follow-up. Clinical follow-up of 16 patients for a mean of 23.8 months showed no death or rebleeding. These results imply that endovascular treatment of ruptured tiny, wide-necked PcomA aneurysms using our modified stent-assisted coiling technique is safe and feasible. This technique improves the long-term outcomes of these aneurysms by increasing the packing density and diverting the intra-aneurysmal blood flow.

1. Introduction

The posterior communicating artery (PcomA) is a common location for intracranial aneurysms.[1] Endovascular treatment (EVT), as part of the trend toward less-invasive treatment, has become an important therapy for the treatment of intracranial aneurysms.[2] Despite recent advances with coils, microcatheters and adjunct techniques such as balloon- or stent-assisted coiling, which have improved patient outcomes, EVT for tiny aneurysms remains technically difficult.[3] Several factors affect the technical complexity of endovascular coiling, including the volume for microcatheterization. The very small volume of a tiny aneurysm sac increases the rate of complications in EVT. Furthermore, the small space makes it difficult to stabilize coils inside the aneurysm sac, especially for wide-necked aneurysms.[4,5] We report our clinical experience, together with technical considerations and treatment outcomes, of using a modified jailing technique of stent-assisted coiling for treating 17 consecutive patients with tiny, wide-necked PcomA aneurysms that had ruptured.

2. Materials and methods

2.1. Patient demographics

Between January 2007 and August 2011, 17 consecutive patients presenting with ruptured tiny, wide-necked PcomA aneurysms were treated in our department and included in this retrospective study (See Fig. 1). Aneurysms were defined as tiny when the maximum diameter of the sac was 3 mm or smaller. Wide necked was defined as sac diameter/neck diameter = <2. At our institution, EVT is considered the primary treatment option for intracranial aneurysms. The patients included 11 men and six women, aged 38–72 years (mean, 55 years). Using the Hunt and Hess scale, eight patients were classified as Grade I, three as Grade II, four as Grade III, and two as Grade IV (Table 1). Informed consent was obtained from all the patients or their family before surgery.

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Table 1
Clinical characteristics of 17 patients with tiny posterior communicating artery aneurysms treated with stent-assisting coiling

Patient number	Sex	Age	HH grade	Size (mm)	Stent No.	Stent	Coil	Raymond grade (immediate result)	mRS at discharge	Angiographic FU (mons)	Raymond grade (FU Result)	Clinical FU (months/mRS)
1	M	58	I	1.8	1	Enterprise[a]	GDC[c]	II	0	6	Stable	48/0
2	M	54	III	1.2	1	Enterprise[a]	HydroFrame, HydroSoft[d]	I	1	NA	NA	19/0
3	M	62	I	1.9	1	Neuroform[c]	ORBIT[a]	I	0	8	Cured	20/0
4	F	38	III	2.92	1	Enterprise[a]	HydroSoft[d]	I	2	13	Cured	13/1
5	F	55	III	2.6	1	Enterprise[a]	ORBIT[a]	I	0	25	Cured	35/0
6	M	72	I	2.48	1	Enterprise[a]	Matrix[c]	I	0	25	Cured	48/0
7	M	60	I	2.64	1	LEO[b]	ORBIT[a]	III	0	26	Improved	45/0
8	F	45	III	1.68	2	Enterprise[a]	HyperSoft[d]	I	0	12	Cured	24/0
9	M	59	II	2.72	1	Neuroform[c]	Matrix[c]	II	0	6	Improved	24/0
10	M	57	IV	2.72	1	Enterprise[a]	HydroSoft[d]	III	3	6	Improved	9/2
11	F	59	II	2.3	1	LEO[b]	Axium[e]	II	2	12	Improved	17/1
12	M	52	I	1.82	2	Enterprise[a]	HydroSoft[d]	I	1	6	Cured	12/0
13	M	53	I	2.64	1	Neuroform[c]	MicroPlex[d]	III	0	12	Stable	12/0
14	F	54	IV	2.77	1	[c]Neuroform[c]	HydroSoft[d]	II	2	6	Improved	19/1
15	M	64	I	1.85	1	Enterprise[a]	HydroSoft, HyperSoft[d]	I	0	NA	NA	18/0
16	M	47	II	1.91	1	Enterprise[a]	MicroPlex[d]	I	0	NA	NA	18/0
17	F	47	I	2.47	1	Enterprise[a]	GDC[c]	I	0	NA	NA	NA

F = female, M = male, FU = follow-up, HH = Hunt and Hess scale, GDC = Guglielmi detachable coil, mRS = modified Rankin scale, NA = No available follow-up.
[a] Codman and Shurtleff, Raynham, MA, USA.
[b] Balt, Montmorency, France.
[c] BostonScientific, Boston, MA, USA.
[d] MicroVention Inc, Tustin, CA, USA.
[e] Covidien, Dublin, Ireland.

The study was reviewed and approved by the Institutional Review Board at our hospital.

2.2. Aneurysm classification

Four-vessel cerebral angiography was preoperatively performed for all patients. The characteristics of the aneurysms (the dome and neck sizes) were analyzed using precise measurements on three-dimensional angiograms. As determined by the diameter of the PcomA and the ipsilateral posterior cerebral artery, five patients had aneurysms accompanied by an ipsilateral fetal-type posterior cerebral artery. In our cohort, the maximum diameter of the aneurysm was 2–3 mm in 10 patients and <2 mm in the other seven patients.

2.3. Endovascular treatment

EVT was usually performed under general anesthesia. A 6-French sheath was placed in the femoral artery using the Seldinger technique. After diagnostic angiography, working projections were obtained for stent delivery and coil packing. A 6-French guiding catheter (Envoy; Codman, Miami Lakes, FL, USA) was inserted into the petrous portion of the internal carotid artery to give enough support for the manipulation of double microcatheters.

We usually navigated the microcatheter (PROWLER SELECT + microcatheter, Codman) for delivery of an Enterprise stent (Codman and Shurtleff, Inc., Raynham, MA, USA) or a LEO stent (Vasco + 25 microcatheter; both Balt, Montmorency, France) over a standard microguidewire into the M1 segment of the ipsilateral middle cerebral artery (Figs. 1 and 2C). For Neuroform stent (Stryker Neurovascular, Freemont, CA, USA) delivery, the Renegade microcatheter (Stryker Neurovascular) with pre-loaded Neuroform stent was navigated as distally as possible beyond the aneurysm neck. Another steam-shaped microcatheter (PROWLER-14; Cordis Neurovascular, Bridgewater, NJ, USA) or Echelon-10 (ev3, Plymouth, MN, USA), chosen on the basis of the aneurysm direction and the curvature of the proximal parent vessel, was navigated into the aneurysm dome or near the neck. After positioning of the microcatheters, a HyperSoft (MicroVention, Tustin, CA, USA) or complex coil was partially deployed into the aneurysm sac, and then the stent and delivery system were advanced beyond the neck within the microcatheter. The stent was semi-deployed or fully deployed after the completion of embolization or once a satisfactory coil basket covering the entire perimeter of the aneurysm was achieved (Fig. 2F). Immediate postoperative angiography was performed to determine the efficacy of endovascular coiling and the patency of the parent artery. All of the interventional procedures were performed by neurosurgeons with extensive experience in interventional vascular procedures (JML, YX, BH, QHH and WYZ).

2.4. Anti-platelet aggregation

All patients received systemic heparinization, before the angiographic catheter was inserted, after placement of the sheath. They were administered heparin (0.6–0.8 mg/kg body weight) intravenously, followed by hourly boluses (half of the dose of 1 hour ago, but no less than 10 mg) and the activated clotting time was maintained at 2–3 times the baseline clotting time throughout the procedure. For one patient, early in our experience, who was transferred to our hospital 23 days after aneurysm onset, clopidogrel (75 mg daily) and aspirin (300 mg daily) were administered for 3 days before surgery. For the other 16 patients, who had acutely ruptured aneurysms (within 3 days of onset), a loading dose of clopidogrel and aspirin (300 mg each) was administered orally or rectally 2 hours before stenting, after cerebral angiography revealed a definite wide-necked aneurysm requiring a stenting technique. All of the patients were maintained on aspirin (300 mg daily) and clopidogrel (75 mg daily) for 6 weeks, followed by aspirin alone (100 mg daily) indefinitely. From June 2010, thromboelastograms were analyzed, and we found that 100 mg aspirin per day effectively inhibited platelet aggregation. Therefore, after this time, 13 patients were treated with aspirin (100 mg daily) and clopidogrel (75 mg daily) for 6 weeks, followed by aspirin alone (100 mg daily).