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Tiny intracranial aneurysms: Endovascular treatment by coil embolisation or sole stent deployment

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ABSTRACT

Purpose: Tiny intracranial aneurysms pose a significant therapeutic challenge for interventional neuroradiologists. The authors report their preliminary results of endovascular treatment of these aneurysms.
Methods: Between January 2002 and December 2009, 52 tiny intracranial aneurysms (defined as ≤3 mm in maximum diameter) in 46 patients (22 men; mean age, 57.9 years) were treated by endosaccular coil embolisation or sole stent deployment in the parent artery. Of 52 aneurysms, 29 had ruptured and 23 remained unruptured. The initial angiographic results, procedural complications, and clinical outcomes were assessed at discharge. Imaging follow-up was performed with cerebral angiography.
Results: One aneurysm coiling procedure failed because of unsuccessful micro-catheterization. Forty-three aneurysms were successfully coil embolized, of which complete occlusion was obtained in 14, subtotal occlusion in 18 and incomplete occlusion in 11. The other 8 aneurysms were treated by sole stent deployment in the parent artery. Procedural complications (2 intraprocedural ruptures and 3 thromboembolic events) occurred in 5 (9.6%) of 52 aneurysms, resulting in permanent morbidity in only 1 (2.2%, 1/46) patient. No rebleeding occurred during clinical follow-up (mean duration, 46.7 months). Of the 16 coiled aneurysms that receiving repetitive angiography, 6 initially completely and 3 subtotally occluded aneurysms remained unchanged, 4 initially subtotally and 3 incompletely occluded aneurysms progressed to total occlusion. Five sole stent deployed aneurysms received angiographic follow-up (mean duration, 10.0 months), of which 3 remained unchanged, 1 became smaller and 1 progressed to total occlusion.
Conclusion: Endovascular treatment of tiny intracranial aneurysms is technical feasible and relatively safe. Coil embolisation seems to be effective in preventing early recanalisation, whereas sole stenting technique needs further investigation to determine its effectiveness.

1. Introduction

For tiny intracranial aneurysms, muscle wrapping with or without coating has been preferred to direct surgical clipping for a long time because of technical difficulty. Endovascular treatment of intracranial aneurysms has experienced a revolution since the introduction of GDCs in the early 1990s, and the results of the International Subarachnoid Hemorrhage Trial (ISAT) recently showed the superiority of the endovascular coiling to the classical surgical clipping of ruptured intracranial aneurysms in the survival benefits that continued for at least seven years [1]. Nevertheless, endovascular treatment for the tiny lesions has been sporadically reported and seems to be controversy for high failure rates [2,3]. The authors report their preliminary results on management of tiny aneurysms by either endosaccular coiling or sole stent deployment in the aneurysmal parent artery, to assess its feasibility, safety as well as effectiveness.

2. Materials and methods

2.1. Patients and aneurysms

Between January 2002 and December 2009, 46 patients with 52 tiny intracranial aneurysms (defined as ≤3 mm in maximum diameter in this study) diagnosed on the basis of cerebral angiography were treated by endovascular therapy. There were 22 men and 24

Abbreviations: GDCs, Guglielmi detachable coils; ISAT, the International Subarachnoid Hemorrhage Trial; SAH, subarachnoid hemorrhage; ACoA, anterior communicating artery; PCoA, posterior communicating artery; ICA bifurcation, bifurcation of internal carotid artery; MCA, middle cerebral artery; AChA, anterior choroidal artery; VA, vertebral artery; PICA, posterior inferior cerebellar artery; GOS, Glasgow Outcome Scale; ISUIA, International Study of Unruptured Intracranial Aneurysms.

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women who ranged in age from 27 to 83 years (mean, 57.9 years). Thirty-four of 46 patients presented with SAH confirmed by CT scan. According to the Hunt-Kosnik Scale, the clinical conditions at admission of 46 patients were Grade 0 in 12, Grade I in 11 patients, Grade II in 14, Grade III in 7 and Grade IV in 2.

Of 52 tiny aneurysms, 29 had ruptured and 23 remained unruptured. Of the 23 unruptured tiny aneurysms, 10 were detected in patients presenting with SAH and were additional to another ruptured aneurysm; 12 were incidentally detected in patients receiving angiography for suspicious ischemic cerebrovascular disease; 1 was symptomatic by mass effect.

The locations of 52 tiny aneurysms were ACoA ($n = 11$), PCoA ($n = 15$), ophthalmic artery ($n = 12$), ICA bifurcation ($n = 1$), MCA ($n = 8$), AChA ($n = 1$), pericallosal artery ($n = 2$), VA ($n = 1$), and PICA ($n = 1$).

2.2. Endovascular therapeutic procedures

Endovascular therapeutic procedures were performed on a biplane angiographic unit. All patients were under general anesthesia, systemic heparinization, and transfemoral arterial access. Each aneurysm size was measured on 3D rotational angiography, or on 2D angiography according to the outer diameter of guiding catheter or a reference calibration object taped to the patient's head, and the size was corrected by comparing with the loop size of the first inserted coil. In this series, two types of microcatheters and three types of 2–3 mm coils (in diameter) were used: Prowler-10 (Cordis Endovascular, Miami, FL) and Excelsior SL-10 (Boston Scientific Corp., Fremont, CA) microcatheters; GDC (Boston Scientific Corp., Fremont, CA), Microplex (Microvention Inc., Aliso Viejo, CA), Sapphire and NXT (Micro Therapeutics Inc., Irvine, CA) coils. If the first coil was not stable after being deployed into the aneurysm sac, balloon remodeling or stent assistance or balloon and stent assistance was the next choice. Two types of balloons and three types of stents were the authors' preferences: Hyperform or Hyperglide balloons (Micro Therapeutics Inc., Aliso Viejo, CA); Neuroform (Boston Scientific Corp., Fremont, CA), LEO (BALT, Montmorency, France) or Enterprise (Codman Neurovascular, Miami, FL) stents.

If the above-mentioned endosaccular coiling procedures failed, sole stent deployment in the aneurysmal parent artery was performed. Otherwise, surgical clipping was recommended.

Initial aneurysm occlusion grade was defined as follow according to the ISAT's score: Grade one, complete occlusion with no contrast filling of the aneurysm sac; Grade two, subtotal occlusion with minor residual sac filling or neck remnant; and Grade three, incomplete occlusion with substantial residual sac filling.

Dual antiplatelet therapy was routinely given to patients who received stent assisted coiling or sole stent deployment. For unruptured aneurysms, aspirin 100 mg daily and clopidogrel 75 mg daily were given 3 days before the procedure. For ruptured aneurysms, a loading dose of clopidogrel (300 mg) and aspirin (between 100 and 300 mg) was given via the nasogastric tube once the stent was deployed. After the procedure, clopidogrel 75 mg daily for 3 months and aspirin 100 mg daily for 1 year were prescribed to all these patients.

2.3. Procedural complications

Periprocedural complications such as aneurysm ruptures or thromboembolic events were recorded.

2.4. Clinical and angiographic follow-up

The patients' clinical outcomes were assessed before discharge according to the GOS. All patients were evaluated clinically 4–6 weeks after treatment and then were followed up at outpatient clinic or by telephone. Follow-up angiography was routinely recommended 3–6 months after treatment, and some patients received further repetitive angiographies.

3. Results

3.1. Initial angiographic results

The mean aneurysm size of 52 tiny aneurysms was 2.5 ± 0.5 mm (range, 1.6–3.0 mm) in maximum diameter. Forty-six (88.5%, 46/52) of them were relatively wide-neck (defined as $\geq 3/4$ in neck-to-dome ratio in this study).

Coil embolisation for an unruptured ophthalmic artery aneurysm failed due to the difficulty of navigation of the microcatheter, and then surgical clipping was recommended. Forty-three of 52 aneurysms were successfully endosaccular coil embolized, and the length of coils inserted varied from 10 to 130 mm (mean, 41.7 mm; median, 30 mm). Ten aneurysms were embolized with stent assistance, four with balloon remodeling, and four with balloon and stent assistance (Fig. 1). Of the 43 coil embolized aneurysms, 14 (32.6%, 14/43) were completely occluded, 18 (41.7%) were subtotally occluded and 11 (25.6%) were incompletely occluded.

Eight of 52 aneurysms were treated by sole stent deployment in the parent artery. In the stent-assisted coiling procedures of 1 ruptured aneurysm and 2 unruptured aneurysms, the microcather could not be inserted into the aneurysm sac through the mesh or the coil was not stable in the sac after the stent had been deployed, sole stenting became the final treatment. Four unruptured tiny aneurysms were detected from 4 patients who presented with cerebral ischemic symptoms and 1 ruptured lesion was detected from 1 patient who just recovered from SAH. These 5 patients were distressed for the risk of future aneurysm rupture/re-rupture and we chose sole stenting after considering the technical difficulty of endosaccular coiling (four of the 5 aneurysms were 2 mm or less in diameter).

As a result, no angiographic change was observed immediately after stenting in all 8 aneurysms.

3.2. Procedural complications

Procedural complications occurred in 5 (9.6%, 5/52) of 52 tiny aneurysms, which included 2 (3.8%, 2/52) intraprocedural aneurysm ruptures and 3 (5.8%, 3/52) thromboembolic event.

An unruptured tiny aneurysm ruptured during the procedure and coiling was continued until the aneurysm was occluded. Post-procedural CT scan showed a little amount of SAH and the patient only had transient headache. During another procedure for a ruptured tiny aneurysm, re-rupture occurred and the patient developed hemiparesis caused by an intracranial hematoma attributable to the re-rupture, but she finally recovered without any neurologic disability at discharge.

In 3 ruptured tiny aneurysms, thromboembolic alone or associated with cerebral vasospasm, resulted in transient hemiparesis in two patients and permanent deficit in one (2.2%, 1/46) patient.

Therefore, the procedural permanent morbidity rate was 2.2% (1/46) and mortality rate was 0%.

3.3. Clinical outcome at discharge

The clinical status of 46 patients before discharge was Grade V or IV in 45 and Grade III in 1 patient, according to the GOS.