



Treatment of blood blister-like aneurysms of the internal carotid artery with stent-assisted coil embolization[☆]

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ABSTRACT

Objectives: Blood blister-like aneurysms (BBAs) are aneurysms arising from the nonbranching arterial trunk, which are usually small and located at the anterior wall of supraclinoid internal carotid artery. These aneurysms are quite dangerous due to their fragile neck. This paper aims to evaluate the application of stent-assisted coil embolization in the treatment of BBAs.

Methods: A retrospective review of the aneurysm database in our institution identified 8 patients carrying BBAs planned to be treated by stent-assisted coil embolization. The clinical characteristics, angiographic outcome, and follow-up results were reviewed.

Results: Stent-assisted coil embolization was successfully performed in 5 cases (62.5%). Two procedures were treated with sole stent deployment (25%). One patient suffered intra-operative rupture (12.5%) and endovascular trapping was performed. The modified Rankin scale (mRs) score in living patients at discharge was 1 in four cases, 2 in one case, and 3 in one case. Two patients died of post-operative hemorrhage (25%). The mRs score at 9–36 months' follow-up was 0 in four cases, 1 in one case, and 2 in one case. All patients were followed up angiographically, and regrowth was observed in three patients, who accepted further endovascular treatments.

Conclusion: Stent-assisted coil embolization may probably reduce the mortality, but may not be a cure for all BBAs.

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1. Introduction

Blood blister-like aneurysms (BBAs) are aneurysms arising from the nonbranching arterial trunk, which are usually small and located at the anterior wall of supraclinoid internal carotid artery. BBAs of the ICA account for about 0.3–1% of intracranial aneurysms, or 0.9–6.5% of ICA aneurysms [1]. These aneurysms are also called anterior wall, superior wall, and dorsal wall aneurysms. BBAs are thin and fragile hemispherical bulges, and can progress into a sacular shape. They are at high risk of recurrent hemorrhage no matter their shape or the treatment modality chosen [2–5]. Different strategies of endovascular treatments have been attempted to treat BBAs, but the results are still controversial. In this article, we present our experiences and treatment outcomes of BBAs of the ICA treated by stent-assisted coil embolization.

2. Patients and methods

2.1. Inclusion criteria

The inclusion criteria include: (1) aneurysms located at supraclinoid ICA projecting anteriorly; (2) nonbranching sites; (3) initially small (maximum diameter less than 10 mm); (4) SAH corresponding to the aneurysm; (5) rapid growth (less than 2 weeks) on repeated angiograms (CTA, MRA, or DSA); (6) irregular wall of the aneurysm or of the parent artery. An aneurysm was included as a BBA of the ICA when criteria 1–4 were all matched, and either of criterion 5 or 6 was matched as well. Every case was confirmed by two specialists of our unit.

2.2. Patient population

A retrospective review of the aneurysm database between November 2004 and April 2009 in our institution identified 14 patients carrying BBAs out of 1390 patients (1%). Stent-assisted coil embolization was performed in 8 patients, whose clinical characteristics, procedural data, angiographic and follow-up results were reviewed. The data of the other 6 cases treated by surgical clipping, conventional coiling, or endovascular trapping were not presented.

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Table 1
Data for eight patients diagnosed with BBAs of the ICA.

Case no.	Age (years)/sex	H&H grade	Lesion location	Neck/dome (mm)	Irregular wall of the aneurysm or artery	Growth
1	30F	2	C7–C6	2.8/2.2	Yes	–
2	56F	2	C7	1.7/1.9	Yes	– ^a
3 ^b	43M	4	C7	1.5/1.4	Yes	Yes
			C7	1.3/1.2	Yes	Yes
4	34F	2	C7–C6	3.4/3.7	No	Yes
5	50F	2	C6	3.1/7.2	Yes	– ^a
6	37F	1	C7–C6	4.0/3.5	Yes	– ^a
7	54F	2	C6	2.1/1.3	Yes	Yes
8	62F	3	C6	3.8/3.1	Yes	– ^a

^a Endovascular treatment was performed immediately after the BBAs were identified.

^b This patient carried two BBAs on the same artery.

Seven of the eight patients were female. Onset age ranged from 30 to 62 years old (46 on average). Preoperative Hunt and Hess grade was I in one, II in five, III in one, and IV in one.

2.3. Periprocedural medication

All patients received systemic heparinization after placement of the sheath. The activated clotting time (ACT) was maintained at 2–3 times the baseline throughout the procedure. Low-molecular-weight heparin (40 mg, q12 h, I.H.) was administered immediately after the procedure for 3 days.

When stent-assisted coil embolization was planned, a loading dose of clopidogrel and aspirin (300 mg each) were administered orally or rectally at 2 h before stenting. All these patients were continued on aspirin (300 mg) and clopidogrel (75 mg) postoperatively for 6 weeks followed by aspirin alone at 300 mg for 6 months, and at 100 mg maintained indefinitely.

3. Results

3.1. Angiographic features

Angiographic features were summarized in Table 1. Nine aneurysms carried by eight patients were sited at the anterior wall of the C7 or C6 segment of ICA, of which three were located at C7 segment, three at the C6 segment, and another three at the junction of C7 and C6 segment. All the aneurysms were small (max diameter less than 10 mm), five of which were tiny aneurysms (max diameter within 3 mm).

3.2. Results of the primary treatment

Stent-assisted coil embolization was successfully performed in five patients (62.5%). According to the Raymond classification, the instant results were classified into grade I in one, grade II in three, and grade III in one. Two procedures (cases 2 and 3) were performed by sole stent deployment (25%) with failure to navigate the microcatheter into the aneurysmal sac through the stent mesh after the successful deployment. The instant result after stenting showed no angiographic change. One patient (case 6) suffered intra-operative rupture when we were delivering a coil after successful deployment of the stent. We controlled the hemorrhage promptly, evaluated the collateral flow, and then performed endovascular trapping at the lesion segment of the ICA. The patient recovered from the attack, but lost acuity of her left eye. Six of the eight patients recovered well, and the modified Rankin scale (mRS) score was 1 in four patients, 2 in one, and 3 in one. Two patients died (25%) of recurrent hemorrhage. One of them (case 1, illustrated) suffered post-operative rebleeding at the 16th day, and the other (case 3)

suffered rebleeding on the next day of the surgery. Table 2 provides details of the primary treatments.

3.3. Follow-up and further treatment

The modified Rankin scale score at 9–36 months' follow-up (21.5 months on average) was 0 in four patients, 1 in one, and 2 in one. All patients were followed up angiographically. The patient with left ICA trapped (case 6) was followed up by an MRA, and the other five cases were followed up by DSA at 1–12 months post-operatively. One residual aneurysm (case 8) proved to be totally occluded angiographically 6 months later. Decreased contrast filling was identified in one BBA (case 2) treated with sole stent at 6 months' follow-up, and maintained stable at 27 months' MRA follow-up. Recanalization was confirmed in two BBAs with residual necks (cases 4 and 5) and one totally embolized BBA (case 7), and accepted further endovascular treatments. Follow-up results and further treatments were presented in Table 2.

3.4. Illustrative cases

3.4.1. Case 1

This 30-year-old lady presented with sudden onset of severe headache and vomiting. A CT scan revealed diffuse subarachnoid hemorrhage (SAH) (Fig. 1A). Her neurological status was unremarkable except for signs of meningeal irritation. Cerebral angiography revealed a tiny broad based aneurysm at the left supraclinoid ICA, and an apparent stenosis was shown beside the lesion (Fig. 1B). The aneurysm arose from the anterior wall, and was close to the opening of the anterior choroidal artery (AChA). After induction of general anesthesia, a balloon-expanding stent (BX 3.5/8) was deployed across aneurysm neck under 10 atm. The aneurysm was further embolized with a single coil of DCS 10 2/6. Postprocedural angiogram showed near complete occlusion of the aneurysm (Fig. 1C). Subsequently, the patient was given routine anticoagulation and antiplatelet treatment. She recovered well and was discharged at the 8th postoperative day with moderate headache. At the 16th postoperative day, this patient suffered a sudden headache again and fell into coma soon, and a CT scan revealed diffuse SAH and intra parenchymal hematoma in the left frontal lobe. Emergent cerebral angiography revealed aneurysm recanalization (Fig. 1D). Her relatives gave up further surgery and the patient died due to rebleeding 2 days later.

3.4.2. Case 4

This 34-year-old woman experienced a sudden severe headache with nausea and vomiting. She was neurologically intact except for residual headache and stiff neck. A CT scan revealed diffuse SAH. Initial DSA showed a tiny (maximal dimension of 2.9 mm) aneurysm at the anteromedial wall of the right distal ICA (Fig. 2A). Fourteen days later, the patient was transferred to our center, and cerebral

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