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Overlapping stents for blood blister-like aneurysms of the internal carotid artery☆

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ABSTRACT

Objective: Blood blister-like aneurysms (BBAs) are unique due to their high risk of recurrent bleeding associated with their fragile neck. The best treatment for BBAs is still controversial. This paper sought to evaluate the safety and efficacy of stent-assisted coiling and subsequent overlapping stents (SAC + OS) in the treatment of BBAs.

Methods: Fifteen consecutive patients with ruptured BBAs managed with SAC + OS were enrolled in this study. The clinical characteristics, procedural data, angiographic outcome, and follow-up results were reviewed.

Results: SAC + OS were successfully performed in all 15 cases. The instant angiographic result was total occlusion in 6 cases, residual neck in 7 cases, and residual aneurysm in 2 cases. Angiographic follow-ups revealed total occlusion in all 6 cases treated by triple or quadruple stents, and 6 of 9 cases treated by double stents. Major recanalization was detected in 3 cases treated by double stents. The modified Rankin Scale score at 4–52 months follow-up (23.8 months on average) was 0 in 6 cases, 1 in 8 cases, and 3 in one case.

Conclusion: Stent-assisted coiling and subsequent overlapping stents are feasible and safe for BBAs. It can be helpful to further decrease the risk of recanalization with more stents. Early angiographic follow-up within 2 weeks is recommended.

1. Introduction

Blood blister-like aneurysms (BBAs) are small or tiny aneurysms at a non-branching arterial trunk, which usually protrudes from the anterior wall of the supraclinoid internal carotid artery (ICA). These lesions make up 0.9–6.5% of all ICA aneurysms [1]. Pathological studies suggest that the BBAs may be a subtype of dissecting aneurysms [2] or pseudoaneurysms [3], and the risk of early recurrence and post-operative rebleeding are quite high due to its fragile wall [4,5]. The optimal treatment for BBAs is still controversial [5–11], have been attempted worldwide, but the optimal treatment is still controversial. We reported the application of stent-assisted coiling (SAC) in treating BBAs earlier [12]. Instead of reduced post-operative rebleeding, SAC failed to cure the BBAs, and most of the cases recanalized [12]. Recently, we applied overlapping stents on the basis of SAC, which apparently reduced the recurrence rate. This study aimed to evaluate the safety and feasibility of overlapping stents in treating BBAs.

2. Patients and methods

2.1. Patient population

This retrospective study was approved by our institutional review board, and informed patient consent was not required. Fifteen consecutive patients with ruptured BBAs were managed with SAC and subsequent overlapping stents between April 2009 and December 2013, which were placed at our institution. All cases met the inclusion criteria described in our prior study. A total of 15 consecutive patients (M:F = 3:12; median age, 47 years; range, 21–57 years) with 15 BBAs (Hunt–Hess grade at admission: 1 in 2 cases, 2 in 5 cases, 3 in 6 cases, 4 in 1 case, and 5 in 1 case, Table 1) were identified and enrolled in this study. The symptoms at onset included headache in all 15 cases, vomiting in 13 cases, and decreased level of consciousness in 8 cases. None of the patients

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Table 1
Data for 15 patients diagnosed with BBA of the ICA.

Case no.	Age (yrs)/ sex	H&H grade	Lesion location	Neck/ dome (mm)	Irregular wall of the aneurysm or artery	Growth
1	54F	2	C6	2.1/1.3	Yes	Yes
2	33F	3	C7	2.8/2.5	Yes	–[a]
3	42F	1	C6	3.1/2.8	No	Yes
4	21F	3	C6	6.9/1.9	Yes	–[a]
5	39F	4	C7–C6	4.1/2.4	Yes	Yes
6	57M	2	C6	2.8/2.5	Yes	–[a]
7	37F	3	C6	3.8/2.8	No	–[a]
8	56M	2	C6	2.5/2.4	No	–[a]
9	40F	1	C7	2.3/2.3	Yes	Yes
10	50F	2	C7–C6	3.7/2.6	Yes	–[a]
11	47F	2	C6	5.2/2.9	Yes	–[a]
12	52F	3	C7	2.1/2.5	Yes	Yes
13	44F	5	C6	2.31/2.6	No	Yes
14	49F	3	C7	4.1/1.4	Yes	–[a]
15	57F	3	C7	4.5/2.6	No	Yes

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

has important comorbidities or risk factors for bleeding, and the previous mRS score of every patient is zero.

Fifteen BBAs were sited at the anterior wall of the C7 or C6 segment of ICA, of which five were located at the C7 segment, eight at the C6 segment (Fig. 1), and another two at the junction of the C7 and C6 segments (Fig. 2). All the aneurysms were small, with a maximum diameter of less than 10 mm.

The BBAs were diagnosed on the basis of the following criteria: (1) aneurysms located at the supraclinoid internal carotid artery (ICA) projecting anteriorly; (2) nonbranching sites; (3) initially small (maximum diameter less than 10 mm); (4) subarachnoid hemorrhage (SAH) corresponding to the aneurysm; (5) rapid growth (less than 2 weeks) on repeated angiograms (CTA, MRA, or DSA); and (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 as well as whether either criterion 5 or 6 was matched. Every case was confirmed by two specialists from our unit.

2.2. Endovascular treatment

The procedures were performed under general anesthesia as early as possible after the diagnosis. Close-cell designed self-expanding neurovascular stent(s) (Enterprise, Solitaire, or LEO) was/were preferred for reconstruction of the parent artery based on the operator's experience and the hemodynamic modification status after deployment of the first stent. SAC was applied via the modified jailing technique [13]. The angiographic result was evaluated using the Raymond scale [14].

2.3. Peri-operative medication

All patients received systemic intravenous heparin at the beginning of the procedure for an activated clotting time between 250 and 300 s during the procedure. The loading doses of the dual antiplatelet medication (300 mg aspirin and 300 mg clopidogrel) were preloaded rectally 2 h before stenting. All patients were continued on antiplatelet therapy consisting of clopidogrel (75 mg) for at least 6 weeks and aspirin (100–300 mg) indefinitely.

2.4. Clinical and angiographic follow-up

Follow-up angiography was performed within 2 weeks and at 3 months after embolization. Magnetic resonance angiography (MRA) was recommended 6 months and 1 year after treatment, and annually thereafter. Clinical outcomes at discharge and follow-ups were assessed using the modified Rankin Scale (mRS) score through neurologic examination or a telephone interview, and results were recorded based on the most recent clinical follow-up at the time of the study.

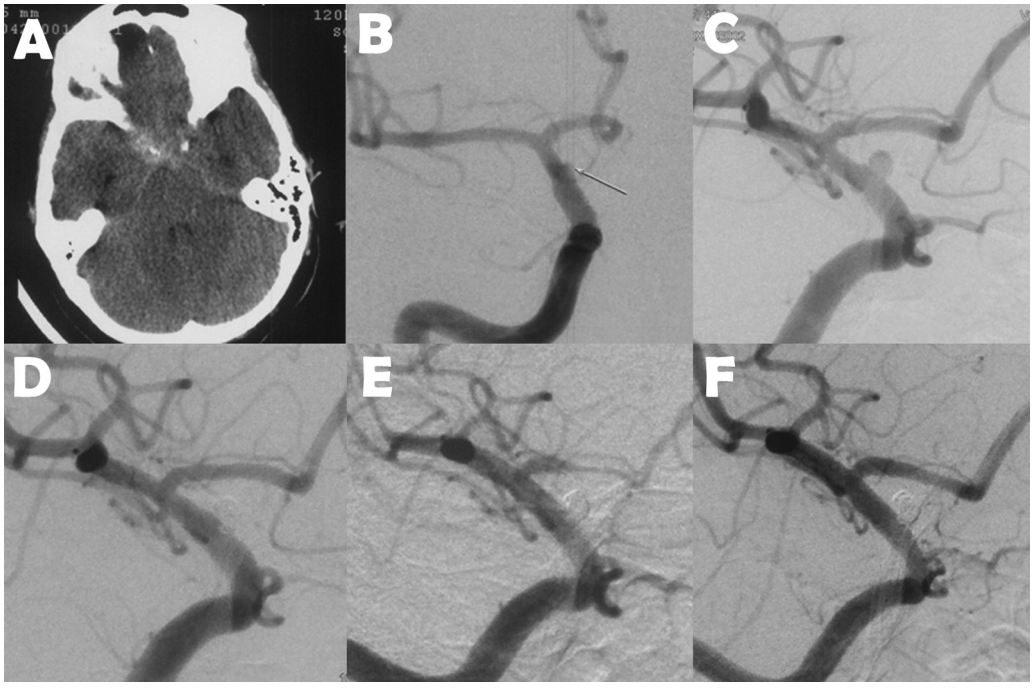

Fig. 1. Radiography for case 13. A: CT scan revealed diffuse SAH; B: cerebral angiography at admission showed a wide neck tiny aneurysm at the C6 segment of the right ICA. The treatment was delayed because the patient suffered cardiac arrest. C: cerebral angiography 7 uneventful days later revealed apparent enlargement of the BBA. D: instant angiographic result with or without subtraction revealed total occlusion of the aneurysm. E: angiogram obtained at the 6th post-operative day for severe vasospasm confirmed the total occlusion of the BBA. F: angiographic follow-up at 3 m post-operatively revealed no contrast filling into the BBA.