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Targeted Embolization for Blebs of Ruptured Fusiform Aneurysm Using Very Small-Diameter Ultra-Soft Coils in the Vicinity of the Anterior Communicating Artery: Report of Two Cases

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Abstract

Ruptured fusiform aneurysms in the vicinity of the anterior communicating artery are rare. Treatment of the aneurysms is still controversial especially when it comes to reconstructive treatment of parent artery. It is not clear yet that we should treat whole part of fusiform aneurysms when it bleed. Herein, we report on two patients who developed fusiform aneurysms associated with blebs in the vicinity of this artery who were treated successfully with embolization targeted to the blebs in order to preserve perforators. The postoperative clinical course has been good without any neurologic deficit in either case. Follow-up at 1 year and 2 years has revealed no recurrence. Targeted embolization of blebs could be one of the treatment options for fusiform aneurysmal subarachnoid hemorrhage in the region of the anterior communicating artery.

Keywords: Fusiform aneurysms; Subarachnoid hemorrhage; Bleb; Embolization

Abbreviations

SAH: Subarachnoid Hemorrhage; DSA: Digital Subtraction Angiography; IEL: Internal Elastic Lamina

Introduction

Ruptured fusiform aneurysms in the vicinity of the anterior communicating artery are rare. Treatment of the aneurysms is still controversial especially when it comes to reconstructive treatment of parent artery. Direct clipping is difficult because of the shape and the length of the lesion. On the other hand, endovascular treatment is also difficult because of the presence of perforators in the area. It is not clear yet that we should treat whole part of fusiform aneurysms when it bleed. The goal of this paper is to report the midterm result of targeted embolization for blebs leaving the fusiform part of the aneurysms untreated.

Case Reports

Patient 1

History: The patient was a 45-year-old man who was admitted in a mildly drowsy state with a Glasgow Coma Scale score of 14 (E3V5M6) but no focal neurologic deficit. A computed tomography scan showed a diffuse subarachnoid hemorrhage (SAH, Hunt and Kosnikgrade III; Figure 1A). The first angiogram revealed a fusiform aneurysm in the left anterior cerebral artery (extending from the distal portion of the left A1 to the proximal portion of the left A2) involving a perforator that originated from the fusiform aneurysm with no apparent bleeding point (Figure 1B–1D). We initiated conservative therapy, i.e., mild sedation and induced hypotension. Another angiogram acquired on day13 revealed a bleb on the inferomedial wall of the fusiform aneurysm (Figure 2A). We proceeded to coil embolization for hemostasis on day 20.

Operation: The coil embolization was performed using very small-diameter ultra-soft Target® Nano™ coils (Stryker, Kalamazoo, MI, USA). A 6-FrenchGuider™ Softip™ guiding catheter (Stryker) was placed in the high cervical portion of the left internal carotid artery via the right femoral artery under general anesthesia. After performing three-dimensional rotational digital subtraction angiography (DSA) to determine the optimal working angle, a microcatheter (Excelsior® SL-10®; Stryker) was advanced to the fusiform aneurysm using a Radifocus® guidewire GT (Terumo, Tokyo, Japan). We carefully placed the tip of the microcatheter into the bleb of the aneurysm. The maximal diameter of the bleb was 3.3mm and the neck had a diameter of 1.9mm. We used a Target

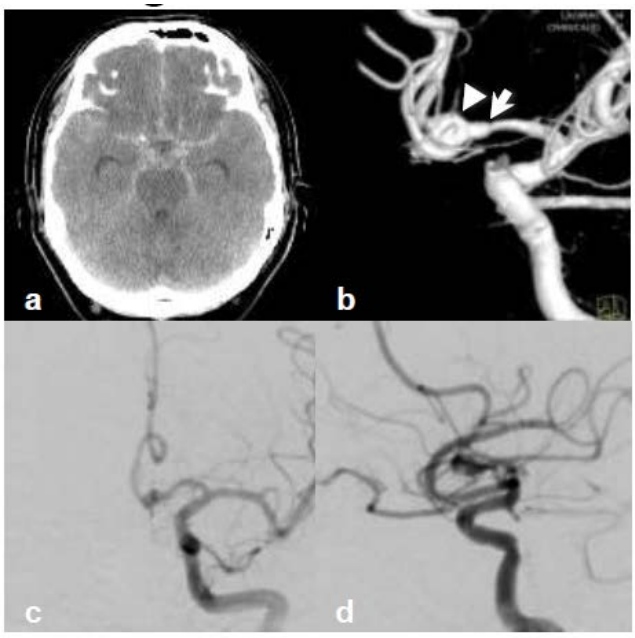

Figure 1: (A) A computed tomography scan of the head taken on arrival showing a diffuse subarachnoid hemorrhage. (B–D) Three-dimensional digital subtraction angiography images showing a fusiform aneurysm in the left A1–A2. (B) A Towne's view and a lateral view on digital subtraction angiography performed on day 0. At this time, a bleb was not seen. The arrow head indicates the fusiform aneurysm and the arrow indicates slight narrowing of the left A1.

360 Nano coil (diameter 3mm/length 4cm) as the first coil and successfully made the frame. Target 360 Nano coils were used as the second coil (1.5 mm/2 cm) and third coil (1mm/2cm). All coils were placed without difficulty in deployment. The bleb was not delineated on an angiogram with a packing density of 39.2% after placement of the third coil (Figure 2B).

Postoperative course: Strict blood pressure control was maintained in the perioperative period. The postoperative course was favorable with no severe complications. Transient right lower limb hemiparesis and minor stroke, possibly caused by vasospasm, were seen in the left striate body and anterior limb of the internal capsule. However, the perforator of the left A1–A2 was clearly delineated on postoperative angiography at day 32. The patient's modified Rankin scale score at 3 months after embolization was 0, and he returned to his previous occupation at this time. Follow-up angiography 10 months after embolization showed no recurrence of the embolized bleb and that the left A1–A2 remained fusiform. There has been no evidence of recurrence of the bleb on magnetic resonance angiography performed periodically in the 22 months since embolization (Figure 2C, 2D). The fusiform portion of the left A1–A2 seems to be gradually diminishing on magnetic resonance angiography.

Patient 2

History: The patient was a 64-year-old woman who presented complaining of sudden headache and vomiting. She was mildly drowsy with a Glasgow Coma Scale score of 14 (E4V4M6) and had no focal neurologic deficit. Diffuse SAH (Hunt and Kosnikgrade III) was diagnosed on a computed tomography scan (Figure 3A). Angiography revealed a fusiform aneurysm in the anterior communicating artery with formation of a bleb (Figure 3B, 3C). Coil embolization for hemostasis was undertaken immediately.

Operation: The coil embolization was performed using Target Nano coils. The tip of a 7-French guiding catheter (Fubuki; Asahi-Intecc Co., Ltd., Aichi, Japan) was placed at the cervical segment of the left internal carotid artery. A microcatheter (Excelsior SL-10) was advanced into the fusiform aneurysm using a Radifocus guidewire GT (Terumo). We carefully placed the tip of the microcatheter into the bleb of the aneurysm. The length of the bleb (2.7mm)was much longer than the transverse diameter (1.6 mm × 1.9 mm), so we used a Target 360 Nano coil (1.5mm/2cm) as the first coil to pack the fundus of the bleb and then packed the neck of the bleb using a Target 360 Nano coil (1mm/2cm) as the second coil. After placed the second coil, the bleb was not delineated in an angiogram with packing density of 47.2%, so the procedure was completed (Figure 3D).

Postoperative course: The postoperative course was favorable with no complications. The patient's modified Rankin scale score at 4 months after embolization was 0, and she returned to her normal daily activities at this time. Follow-up magnetic resonance angiography 1 year after embolization showed no evidence of recurrence (Figure 3E, 3F).

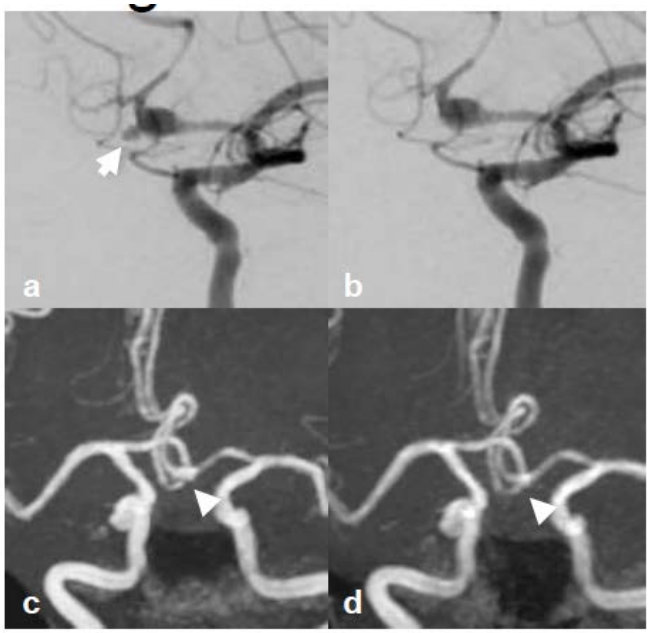

Figure 2: (A) A follow-up angiogramon day 13 showing formation of a bleb on the inferomedial wall of the fusiform aneurysm (arrow). (B) A postoperative angiogram showing that the bleb had completely disappeared. (C, D) The bleb has not been seen on follow-up magnetic resonance angiography at 6 (C) and 22 (D) months. The fusiform aneurysm indicated by the arrowhead is still present but is slightly diminished.

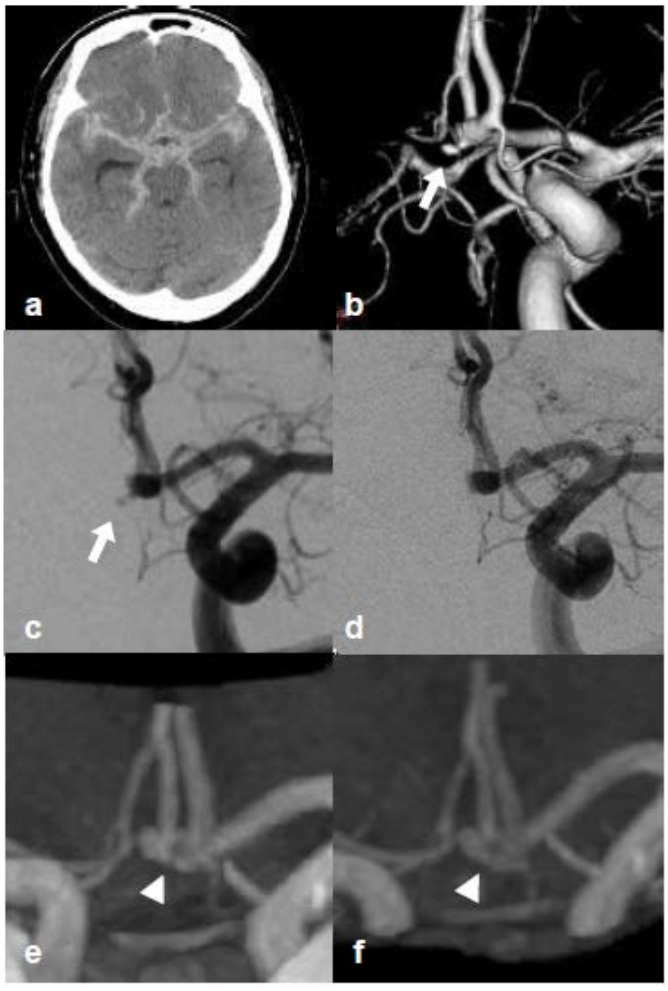

Figure 3: (A) A computed tomography scan of the head taken on arrival showing a diffuse subarachnoid hemorrhage. (B, C) Three-dimensional DSA (B) and a Towne's view on conventional DSA (C) of the left internal carotid artery shows a fusiform aneurysm with a bleb (arrow) on the anterior communicating artery. A Towne's view on postoperative conventional DSA shows complete obliteration of the bleb. (E, F) The bleb has not been seen on follow-up magnetic resonance angiography at 6 months (E) and 12 months (F). The fusiform aneurysm (indicated by the arrowhead) is still present. DSA, digital subtraction angiography.

Discussion

Treatment of the ruptured fusiform aneurysms is still controversial especially when it comes to reconstructive treatment of parent artery. It is not clear yet that we should treat whole part of fusiform aneurysms when it bleed. We have reported two cases of fusiform aneurysm with blebs in the proximal anterior cerebral artery complex that were treated successfully by targeted coil embolization of the bleb using very small-diameter ultra-soft Target Nano coils. Because of the presence of perforators, we packed only the blebs, not fusiform aneurysm itself. No recurrence has been seen in either patient during 1 and 2 years of follow-up after embolization.

Mizutani T, et al. reported the pathological findings of fusiform and dissecting aneurysms [1]. They reported on unruptured fusiform aneurysms with smooth contour that were clinically stable. On their pathological examination, they had stretched or fragmented internal elastic lamina (IEL) and moderately thickened intima mainly comprised of collagen fibers. The clinical and radiological follow up for 2 to 5 years showed no significant progression. They also noted three cases with SAH that had saccular blebs located on fusiform aneurysms in the anterior circulation. Their pathological examination revealed the blebs arose from a portion of minimally disrupted IEL. Based on their findings, the ruptured fusiform aneurysms associated with blebs have the localized fragile bleeding point and stable fusiform part. These findings may support our strategy of focal hemostasis with small-coil embolization of disrupted blebs leaving fusiform portion of aneurysms untreated followed by strict medical control of blood pressure.

We used very small-diameter ultra-soft coils to successfully embolize blebs that were very small with a maximal diameter of 3.3mm and seemed to be fragile with potential for re-rupture during the procedure. Past reports indicated a higher procedure-related rupture rate using coil embolization for small ruptured aneurysms. Nguyen et al. reported that small ruptured aneurysms (≤3 mm) were five times more likely to result in procedure-related rupture than larger aneurysms in their series of 668 patients who underwent coil embolization [2]. However, the patients in that study were treated between 1992 and 2007 and most of the cases were embolized with GDC 10 coils. vanRooij WJ, et al. reported that although procedure-related rupture was more frequent in very small (≤3 mm) aneurysms (occurring in 7.7% of their cases), this was not associated with an increase in overall morbidity and mortality rates [3]. Again, the patients in their series were treated between 1995 and 2008, and several types of 1.5-mm to 3-mm coils (including GDC 10, Trufill DCS mini complex coils, and Nexus and Axium coils) were used during the study period. In contrast, there are some more recent reports of favorable clinical results using endovascular treatment for very small aneurysms [4]. Yamaki VN, et al. reported a meta-analysis of studies evaluating endovascular treatment of very small aneurysms. They noted that long-term complete occlusion was achieved in 91% of 1105 very small aneurysms (including 844 ruptured aneurysms) with a recanalization rate of 7% and 79% of patients having a good long-term neurologic outcome on follow-up [5]. Jindal G, et al reported 14 cases of ultra-small aneurysms with a maximal diameter <3 mm and an average volume of approximately 4 mm^3 that were treated with 1-mm and 1.5-mm Target Nano coils [6]. All patients in that series had SAH or a prior history of SAH, except for one patient who had an irregular aneurysmal morphology. They reported that the coils were placed successfully in all patients without difficulty in deployment or intraoperative rupture, with a high packing density of 24–83% (mean 51%). The initial complete occlusion rate was 70% and the recanalization rate was 25%. The authors concluded that use of Target Nano coils was safe and effective for ultra-small aneurysms. In our institution, from Jul. 2018 to Oct. 2020, 9 cases of ultra-small ruptured aneurysms (maximal diameter <3 mm) were treated by coil embolization. All cases were treated successfully with high mean packing ratio of 35.3%, without re-bleeding and recurrence. Seven cases were embolized with only Target Nano coils. According to the manufacturer, Target Nano coils are eight times softer than standard Target coils. Furthermore, with the advent of endovascular treatment devices, coil embolization of very small aneurysms, even ones that have ruptured, can be performed safely.

We believe that the outcomes in these two cases confirm the safety and efficacy of our treatment strategy. The embolization procedure, even for small-diameter blebs, is likely to be safe with development of coils and devices for endovascular treatment. Although the long-term efficacy for preventing re-bleeding is still unclear, we anticipate that our strategy of targeted hemostasis using small-diameter ultra-soft coils followed by best medical treatment may become a preferred treatment option for fusiform aneurysms involving perforators.

Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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