Pseudoaneurysm formation caused by the withdrawal of a Trevo ProVue stent at a tortuous cerebral vessel: a case report

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Pseudoaneurysm formation caused by the withdrawal of a Trevo ProVue stent at a tortuous cerebral vessel: a case report

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Abstract

This is the first report on the mechanism of pseudoaneurysm formation after withdrawal of a stent retriever. A 79-year-old woman developed cardiogenic embolization of the distal middle cerebral artery (M2). The deployed stent retriever bent because of vessel tortuosity. After withdrawal of the stent with strong resistance, complete revascularization was achieved, but an extravasation was detected at the site. Eight hours after disappearance of the extravasation, re-bleeding occurred with aneurysm-like pooling of contrast media. Direct surgical observation confirmed a pseudoaneurysm formation. The pseudoaneurysm was likely formed by avulsion of a fine vessel during withdrawal of the stent retriever at a tortuous vessel.

Keywords: complication, mechanical thrombectomy, pseudoaneurysm, stent retriever, tortuous vessel, Trevo ProVue

Introduction

Although iatrogenic intracranial hemorrhage associated with thrombectomy may cause critical sequelae, few reports have detailed the mechanism of hemorrhagic complications associated with stent retrieval [5]. This is the first report detailing the mechanism of a hemorrhagic complication after withdrawing a stent retriever for thrombectomy based on direct intraoperative confirmation of the injury.

Case report

A 79-year-old woman, hospitalized with atrial fibrillation and cardiac failure, had a cardiogenic embolization of the left distal middle cerebral artery (MCA) with a National Institute of Health Stroke Scale (NIHSS) score of 12 (Fig. 1A). The time course was more than 4.5 hours after onset, and recombinant tissue-type plasminogen activator was not administered. A 9-Fr Optimo balloon catheter (Tokai Medical Products, Aichi, Japan) was navigated into the internal carotid artery. A 5MAX ACE reperfusion catheter (Penumbra, Oakland, CA) was navigated to the ophthalmic bend at the carotid siphon. Thrombectomy was attempted twice with a 3MAX catheter (Penumbra), resulting in partial recanalization with a fine vessel originating from the bifurcation (Fig. 1B). When a Trevo ProVue 4×20 mm thrombectomy device (Stryker, Kalamazoo, MI) was deployed across the thrombus, the stent was profoundly bent because of vessel tortuosity (Fig. 1C,D). Strong resistance was felt while pulling the stent retriever in a careful manner, and this resistance subsequently disappeared. After thrombectomy, complete revascularization was confirmed, but the fine vessel bifurcating from the M2 segment disappeared and extravasation was detected from this site (Fig. 1E). The extravasation disappeared 10 minutes later (Fig. 1F, 2A). Rebleeding occurred 8 hours later with an aneurysm-like pooling of contrast media (Fig.2B,C). The patient was rushed to the operating room for surgical hemostasis. After fronto-temporo-parietal craniectomy, a temporary clip was applied to the superior M2 origin. Direct surgical observation showed that vessel injury was restricted to a narrow range and covered by hematoma outside the arterial wall, consistent with pseudoaneurysm formation (Fig. 2D). A pseudoaneurysm was likely formed by avulsion of the fine vessel when withdrawing the stent re

triever. The fine vessel was not found intraoperatively because of the thick hematoma around the affected vessel. A clip was applied to the injured distal M2 segment of MCA, which was sacrificed without further rebleeding. The patient was transferred to an affiliated hospital for rehabilitation with an NIHSS of 15.

Discussion

To our knowledge, this is the first report on the mechanism of pseudoaneurysm formation caused by withdrawal of a Trevo ProVue stent, based on direct intraoperative findings. The main factor contributing to vessel injury was vessel tortuosity, as the deployed stent retriever was bent to a more than 90-degree angle (Fig. 3A). Because of sharp flexion, the withdrawal force could not be effectively transferred to the thrombus (Fig. 3B). The pulling force mainly acted on the bent MCA without much force on the thrombus itself, applying a harmful force to the MCA. Subsequent vascular dislocation enabled the stent retriever to straighten and be withdrawn, concurrently triggering avulsion of a fine vessel from the M2 segment of the MCA (Fig. 3C). In recent reports on procedural vessel perforation due to stent retriever withdrawal, vessel injury was considered to be associated with vessel tortuosity [3, 6]. The other main factor contributing to complications was the distal location of occluded vessel. The relatively loose attachment of distal arteries with the parenchyma and the relatively high radial force of the stent retriever in relation to the vessel size may cause such complications. The other mechanisms of vessel injury, including vessel perforation and dissection with guidewire, microcatheter, and stent retriever could not be completely denied.

To avoid such complications, one solution is to not perform any kind of thrombectomy in more distal arteries, which frequently results in no significant improvement in the neurological deficit due to cerebral infarction. Although intra-arterial thrombolysis is a considerable alternative rescue method to mechanical thrombectomy for distal artery occlusions, in a series of 147 MCA occlusions that were

treated using intra-arterial thrombolysis with urokinase, the successful recanalization rate (defined as thrombolysis in myocardial infarction 2/3) was lower for M2 occlusions (63.2%) than for M1 occlusions (77.6%) [1]. The 5MAX ACE and ACE 64 penumbra catheters have distal outer diameters of 5.4 and 5.8 Fr (1.80 and 1.93 mm), respectively, which may be too large for the distal M2 segment, the diameter of which is approximately 2 mm [4]. The 3MAX reperfusion catheter, which has a distal outer diameter of 3.8 Fr (1.27 mm), reportedly provided favorable recanalization without complications in six cases of distal artery occlusion including the M2 segment [4]. This report did not discuss target-vessel tortuosity in detail, and the efficacy and safety of 3MAX or 4MAX (distal diameter of 4.3 Fr; 1.43 mm) catheters in tortuous distal arteries remains unproven. For distal and small-vessel occlusions, the Trevo XP ProVue Retriever 3×20 mm, which is called “Baby Trevo” and is smaller than the 4×20 mm Trevo ProVue stent, was reportedly useful [2]. In this report, complete recanalization of the artery targeted by the Baby Trevo was achieved in all cases, while parenchymal hematomas occurred in two [2]. This smaller stent retriever was not available at the time of the presented case. If there is strong resistance on pull back of a stent retriever in a tortuous vessel, one rescue method is partial resheathing of the stent retriever by advancing a Trevo Pro 18 microcatheter beyond the bend of the vessel (Fig. 3D). Withdrawal of the stent positioning the catheter beyond the bending point transfers the pulling force directly to the thrombus, reducing direct vessel injury. In cases of remaining resistance after this partial resheathing, the stent retriever should be completely resheathed and removed.

In conclusion, the methods to avoid a severe vessel injury by using a Trevo ProVue stent retriever (4×20 mm) for distal-vessel occlusion with high degree of tortuosity could be the following: 1) partial resheathing of the deploid stent retriever in case of strong resistance of pulling; 2) total resheathing and stent removal when partial resheathing of the stent does not remedy the pulling resistance; 3) use of a smaller stent retriever (Trevo XP ProVue, 3×20 mm); 4) abandonment of mechanical thrombectomy before the occurrence of critical complications.

Conflict of Interest statement: No conflict of interest.

Informed consent: Informed consent was obtained from the family of the patient.

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Figure legends

Figure 1 A: Left internal carotid artery (ICA) angiogram (anteroposterior view) showing the occlusion at the superior division of the left M2 segment (arrow).

B: Left ICA angiogram (anteroposterior view) after partial recanalization (double arrow) showing a fine vessel originating from the superior division of M2 (small arrowheads) and residual thrombus.

C: The Trevo ProVue stent deployed beyond the thrombus is sharply bent due to the highly tortuous junction of the M1 and M2 segments of the middle cerebral artery (dotted arrows).

D: Left ICA angiogram just after deployment of the stent retriever demonstrating revascularization of the occluded lateral vessel of the M2 segment without extravasation of contrast medium, re-occlusion of the medial vessel of the M2 segment, and the fine vessel.

E: Left ICA angiogram just after thrombectomy with the stent retriever showing complete recanalization with extravasation from the superior division of the M2 segment (large arrowheads).

F: Left ICA angiogram 10 minutes after thrombectomy showing arrest of extravasation without depicting a fine vessel from the site of extravasation.

Figure 2 A: Head computed tomography postembolectomy showing the subarachnoid hemorrhage with extravasated contrast agent in the left hemisphere.

B: Computed tomography after the patient deteriorated into consciousness disturbance demonstrating enlargement of the left Sylvian hematoma.

C: Three-dimensional computed tomography angiography showing the pseudoaneurysm (dotted circle). The white arrow, double arrow, and arrowhead indicate the M1 segment, inferior division of the M2 segment, and superior division of the M2 segment of the left MCA, respectively.

D: The intraoperative finding corresponds to the dotted circle of Figure 2C; a small vessel injury is demonstrated at the bifurcation of the superior division of the left M2 segment (black arrow).

Figure 3 A: An illustration of sharp bending of a stent retriever due to tortuous configuration of a vessel.

B: The withdrawing force (arrow) does not fully transfer to the thrombus (dotted arrow) because of sharp flexion of the stent retriever.

C: The withdrawing force triggers a vessel dislocation, which results in avulsion of a fine vessel (arrowheads).

D: A partial resheath of the stent retriever by advancing a Trevo Pro 18 microcatheter (yellow catheter) beyond the bending point of the vessel permits the withdrawing force to be transferred directly to the thrombus (arrow).

Figure 1

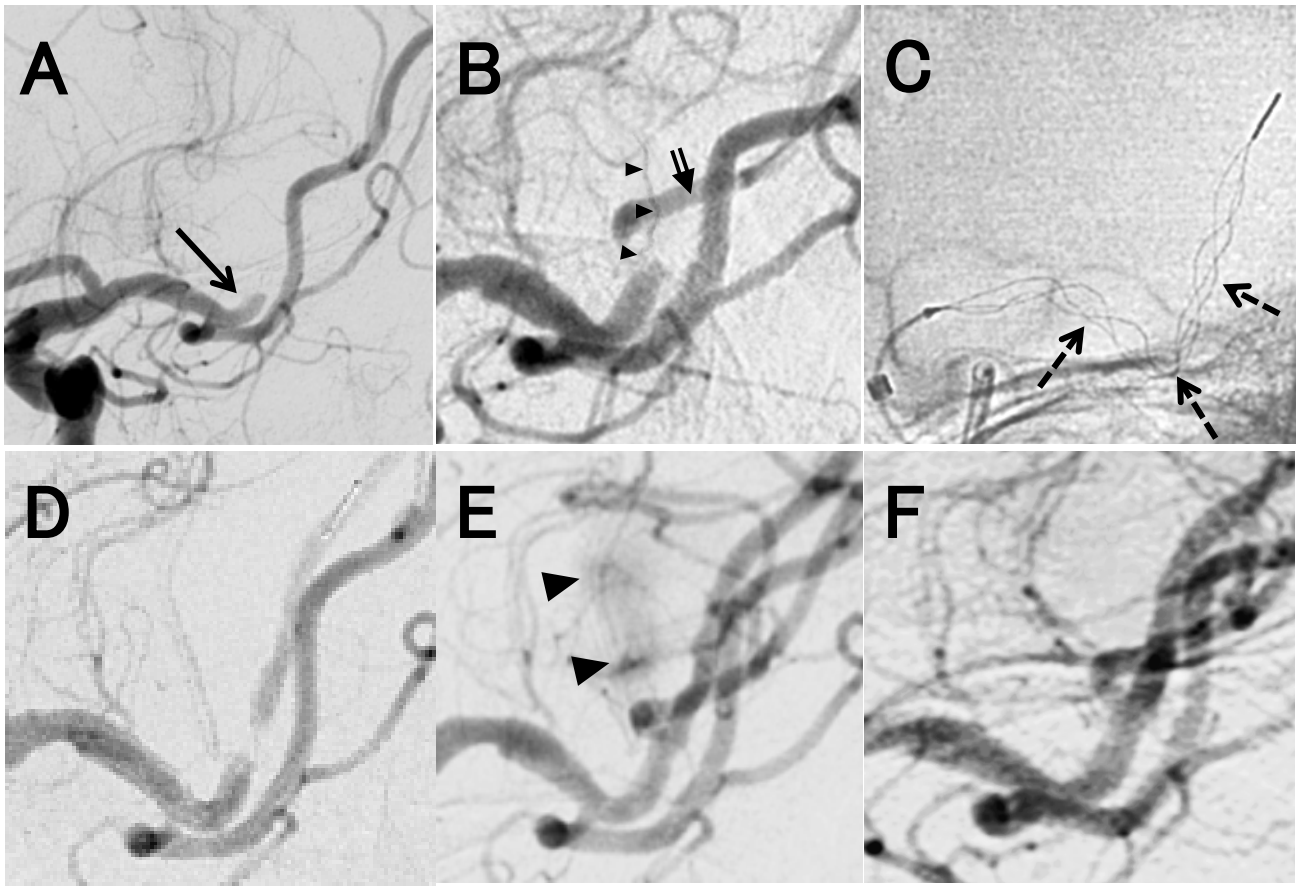

Figure 2

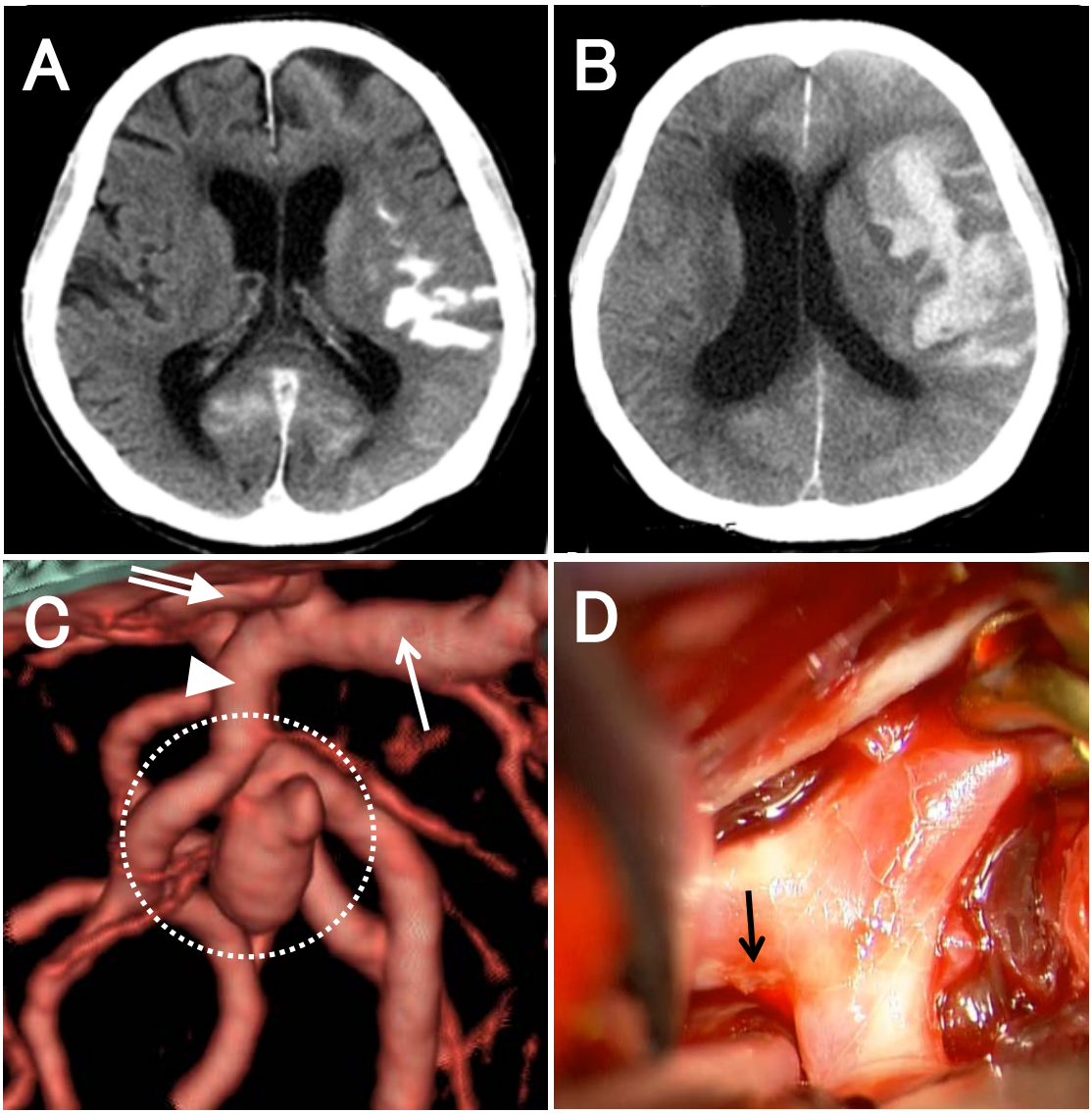

Figure 3