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Surgical Neurology International

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SNI: Neurovascular

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Case Report

Stent retrieval for free-floating thrombus attached to carotid artery stenosis: A report of two cases

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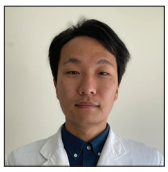

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Received : 16 June 2023
Accepted : 24 July 2023
Published : 04 August 2023

DOI
10.25259/SNI_513_2023

Quick Response Code:

ABSTRACT

Background: We report two cases who underwent mechanical thrombectomy using a stent retriever in advance of urgent carotid artery stenting (CAS) for carotid artery stenosis with free-floating thrombus (FFT).

Case Description: Two patients showing symptomatic carotid artery stenosis with FFT underwent urgent endovascular surgery due to progressive neurological symptoms. The first case showed an FFT with 70% internal carotid artery (ICA) stenosis. After the completion of the common and external carotid artery balloon and distal ICA filter protection, we deployed a 6-mm-diameter stent retriever in the distal part of the stenosis. The white thrombus was retrieved; the angiographic shadow of the FFT disappeared; and CAS was performed. In the second case, due to a 90% severe stenosis lesion with FFT, balloon angioplasty was performed on the lesion using the push wire of the stent retriever. After angioplasty, the stent retriever was smoothly retrieved, and CAS was performed. Postoperative magnetic resonance imaging showed an increase in cerebral embolism in the first case; however, the patient's neurological symptoms improved. The second case showed in-stent plaque protrusion and required two additional stent placements; the patient showed no worsening of his neurological symptoms.

Conclusion: In cases of carotid artery stenosis with FFT, it is technically possible to retrieve a thrombus with a stent retriever. Although thrombus removal may help reduce the risk of ischemic complications in a series of urgent CAS procedures, there are concerns such as mechanical irritation to the carotid artery plaque, and its indications and alternative treatments should be carefully considered.

Keywords: Carotid artery stenting, Free-floating thrombus, Mechanical thrombectomy, Stent retriever

INTRODUCTION

A free-floating thrombus (FFT) of the carotid artery is a rare condition in which a mobile thrombus adheres to the lesion against the background of plaque rupture and other conditions on the arterial wall.[1] FFTs are associated with a high risk of acute ischemic stroke due to distal thrombus embolization; however, the number of cases involving FFTs is small and the optimal treatment approach for such cases has not been established. In previous reports describing endovascular treatment for carotid artery stenosis with FFT, carotid artery stenting (CAS) was performed after providing sufficient distal protection, and the thrombus was crimped

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to the vessel wall by the stent. However, these case series raised concerns regarding the risk of complications due to thrombus fragmentation and distal embolization.[2,10] Despite recent advancements in techniques for retrieving intracranial thrombi using stent retrievers and aspiration catheters, only a few reports have described FFT retrieval associated with carotid artery stenosis. We present two cases in which mechanical thrombectomy with a stent retriever in advance of urgent stenting was performed for carotid artery stenosis with FFT.

CASE DESCRIPTION

Case 1

Case 1 involved a 64-year-old man who began experiencing numbness in the right hand one morning. Scattered infarction in the left hemisphere and a stenotic lesion in the origin of the left internal carotid artery (ICA) were noted [Figures 1a and b]. He was hospitalized and started on dual antiplatelet therapy, but 2 days later, his right paralysis and aphasia worsened, and he was transferred to our hospital. His National Institutes of Health Stroke Scale score was 17. No extensive cerebral infarction was observed on the perfusion computed tomography images. Emergency angiography showed 60%–70% stenosis of the left ICA origin and a 3–4 mm mobile thrombotic shadow attached to the distal part of the stenosis lesion [Figure 1c]. At that time, the lack of emergency access to the operating room and surgeons made it difficult to choose carotid endarterectomy (CEA) as a treatment, so we opted for endovascular treatment. A 9-Fr sheath was placed in the right femoral artery, and an Optimo 9F balloon catheter (Tokai Medical Products, Aichi, Japan) was guided into the left common carotid artery (CCA). A Scepter XC balloon catheter (4 × 11 mm; Microvention, Aliso Viejo, CA, USA) was guided into the left external carotid artery (ECA) using an ENVOY 5 Fr guiding catheter (Johnson and Johnson, Miami, FL, USA) guided to the left CCA. After the left ECA and CCA were blocked, Spider FX (Medtronic Vascular, Santa Rosa, CA, USA) was passed through the lesion using 0.014-inch CHIKAI black (Asahi Intecc Co., Ltd., Aichi, Japan), and a filter was developed at the petrous portion of the ICA. The filter was placed distally enough so as not to interfere with subsequent stent retriever deployment. Then, a 0.021-inch Trevo Trak 21 (Stryker, Kalamazoo, MI, USA) microcatheter was passed through the lesion, and a stent retriever, Tron FX 6 × 50 mm (Microvention), was deployed to cover the thrombus at the distal part of the stenosis [Figure 1d]. When the stent retriever was recovered, a white-toned thrombus was extracted, and the thrombus shadow disappeared on angiography [Figure 1e]. After percutaneous transluminal angioplasty (PTA) was performed using RX-Genity (3.5 mm × 40 mm; Kaneka Medics, Osaka, Japan), and a 10 × 31 mm Carotid Wallstent (Stryker) was deployed into the stenotic area. After additional PTA using a Sterling Balloon Dilatation Catheter 4.5 × 30 mm (Boston Scientific Co., Natick, MA, USA), the lesion was confirmed to be well-dilated, and the procedure was completed [Figure 1f]. Although postoperative magnetic resonance imaging (MRI) showed new lesions on diffusion-weighted imaging [Figure 1g], the patient's right-hand paralysis and aphasia symptoms improved significantly. Microscopic evaluation revealed that the retrieved thrombi contained fibrin, red blood cells, inflammatory cells, and cholesteric clefts and were consistent with detached plaques from atherosclerotic lesions [Figures 1h and i]. A schematic illustration of the device and procedure is presented in Figures 2a-c.

Case 2

Case 2 involved an 81-year-old man with a medical history of diabetes mellitus, atrial fibrillation, and coronary artery disease. He presented to our hospital with mild left-sided hemiparesis. MRI showed diffuse infarction in the right cerebral hemisphere and severe stenosis of right ICA origin [Figures 3a and b]. Although dual antiplatelet therapy was started, his left paralysis and aphasia worsened 2 days later, and emergency endovascular surgery was performed. Emergency angiography showed 90% stenosis of the origin of the right ICA with small FFTs attached to the distal part of the stenotic lesion [Figure 3c]. A 9-Fr sheath was placed in the right femoral artery and a Mo.Ma Ultra 9F balloon catheter (Medtronic) was guided into the right CCA. After the left ECA and CCA were blocked by the Mo. Ma balloon, flow reversal condition was achieved by connecting Mo. Ma with a sheath inserted into the femoral vein using an external connector with a filter. The Filter Wire EZ (Boston Scientific Co.) was guided and developed at the petrous portion of the ICA. Then, a 0.021-inch Trevo Trak 21 microcatheter (Stryker) was passed through the lesion, and a stent retriever, EMBOTRAP III 6.5 × 45 mm (Cerenovus, Irvine, CA, USA), was deployed to cover the thrombus at the distal part of the stenosis [Figure 3d]. An Rx-Genity Balloon Dilatation Catheter (3.5 × 40 mm; Kaneka medics) was guided to the lesion along the push wire of the stent retriever [Figure 3e]. PTA was performed, and the stent retriever was retrieved using the PTA balloon catheter. Angiography confirmed the disappearance of the FFT, and a 10 × 31-mm Carotid Wallstent (Stryker) was placed [Figures 3f and g]. A white-toned thrombus was extracted, postoperative MRI showed no increase in cerebral infarction, and the patient's neurological symptoms improved [Figures 3h and i]. One week later, intra-stent plaque protrusion was identified by ultrasound, and an additional stent placement (10 × 31 mm Carotid Wallstent, Stryker) was performed. After 2 weeks, in-stent plaque protrusion was observed again; therefore, disruption of the thrombus by balloon and additional stent placement

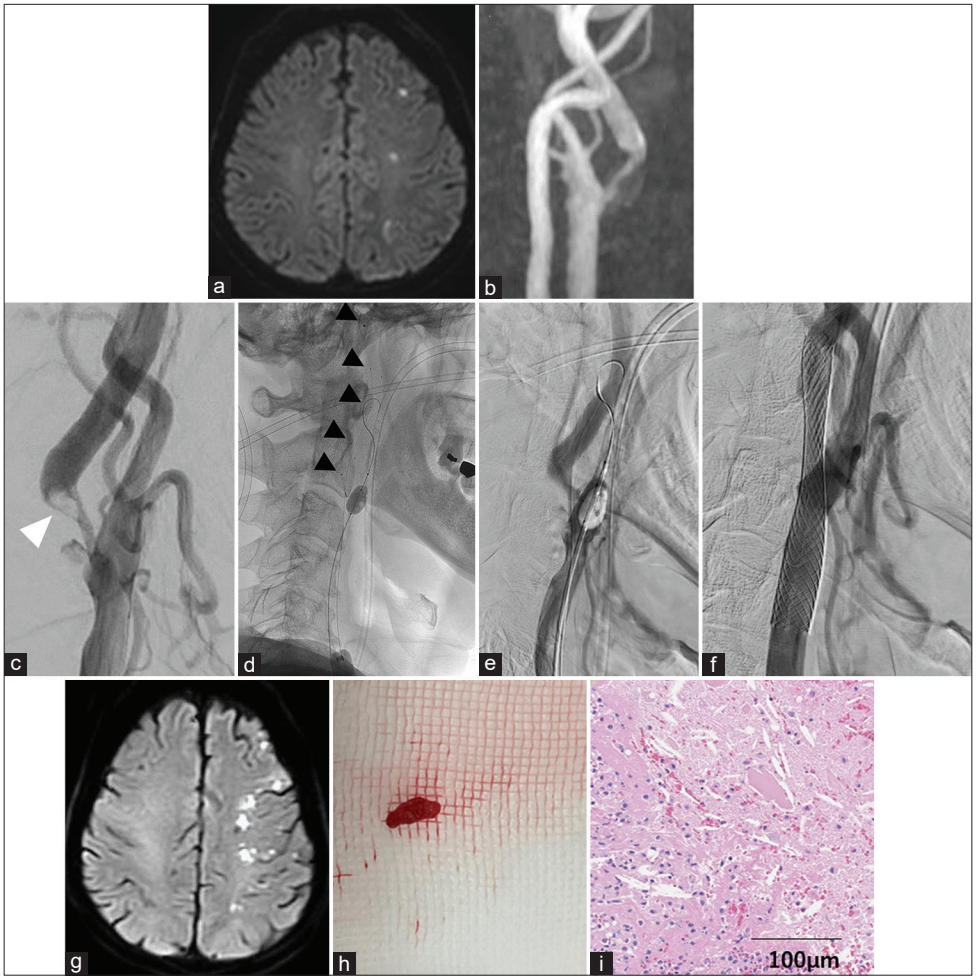

Figure 1: A 64-year-old man with symptomatic left carotid artery stenosis and free-floating thrombus (FFT). (a) Magnetic resonance imaging (MRI) shows diffuse spotty infarctions in the left hemisphere. (b) MRA shows stenosis in the left internal carotid artery (ICA). (c) Digital subtraction angiography (DSA) shows moderate ICA stenosis with a FFT (white arrow). (d) Tron FX 6 × 50 mm (Microvention, Tustin, CA, USA, black arrows) is deployed to cover the thrombus. (e) After stent retriever retrieval, the thrombus image on DSA disappears. (f) Carotid Wallstent (Stryker, Kalamazoo, MI, USA) is deployed. (g) Postprocedural MRI shows increased diffuse infarcts. (h) White thrombus retrieved by the stent retriever. (i) Microscopic, the retrieved thrombi contain fibrin, red blood cells, inflammatory cells, and cholesteric clefts.

(10 × 30 mm CASPER Rx, Microvention) was performed [Figures 3j-l]. He was transferred to a rehabilitation hospital with a modified Rankin Scale score of 3 and did not require further procedures. A schematic illustration of the device and procedure is presented in Figures 4a-c.

DISCUSSION

FFT is described by several overlapping terms, such as intraluminal thrombus and mobile thrombus, but is generally defined as an elongated thrombus attached to the arterial wall and showing periodic motion associated with the cardiac cycle. A previous review reported that complete dissolution of the FFT, without any further neurologic progression, occurred in 86% of patients treated medically, including those who received anticoagulation and antiplatelet therapy.[1] However, urgent surgical intervention is considered to address concerns regarding hemodynamic ischemia due to severe stenosis or distal embolism due to a giant thrombus. In several CAS case series, stents were used to cover the FFT and compress it to the vessel wall. Tsumoto *et al*. described six cases of intraluminal thrombosis in patients who underwent CAS under distal or proximal balloon protection and reported complications such as distal embolism (n = 1), stent occlusion (n = 1), and in-stent thrombus (n = 1).[10] Bhogal *et al*. reported seven cases of CAS, with one case showing clot protrusion that necessitated a second stent deployment and another case showing in-stent

Figure 2: Schematic illustration of the device and procedure applied in case 1. (a) Lateral view of pretreatment angiography, (b) schema after completion of protection, and (c) schema with the stent retriever deployed.

thrombosis that necessitated a repeat procedure.[2] Although the underlying vulnerable plaque may be the cause of these complications, stent placement without FFT removal may be more likely to cause thromboembolic complications associated with CAS.

Successful thrombus retrieval using a stent retriever or aspiration catheter has been reported in cases involving FFT without moderate or severe stenotic lesions.[3,4,8,12] However, few reports have described a combination of mechanical thrombectomy and CAS in cases of carotid artery stenosis with FFT. Tomoyose *et al*. reported a case of FFT attached to severe stenosis of the ICA origin, in which the thrombus was removed by an aspiration catheter after PTA against the stenotic lesion.[9] To the best of our knowledge, no reports have described treatment combining FFT retrieval using a stent retriever with CAS. We hypothesized that retrieval of free-floating thrombi before CAS might reduce the risk of thrombus fragmentation and distal embolism. In cases involving severe stenosis, the stent retriever deployed distal to the stenosis may be difficult to retrieve. In case 2, the lesion was dilated by placing a PTA balloon over the push wire of the stent retriever before retrieval. This method was previously reported as a procedure for simultaneous treatment of thrombectomy of tandem lesions,[7,11] and this time, the stent retriever was retrieved without resistance by the same procedure. In cases of moderate stenosis, as in the first case, the stent retriever could be safely retrieved without PTA.

In case 1, postoperative MRI showed an increase in embolic cerebral infarction compared to the initial image. Since the patient was transferred to digital subtraction angiography (DSA) without MRI after symptom exacerbation, it is possible that the infarction had already increased before the endovascular procedure. We attempted to prevent distal embolism as much as possible by blocking the ECA and CCA. In addition, since the blood flow from the superior thyroid artery remains even if the ECA is blocked, a distal ICA filter was used for distal protection in both cases. One of the problems with our method of removing floating thrombi with a stent retriever is the complexity of the procedure and the risk of technical complications. Interference between the distal filter and the stent retriever may make removal of the device difficult, and it is necessary to ensure that the filter can be placed enough distal to the petrous portion of the ICA. In our cases, the position of the filter did not change during stent retrieval; however, interference of both devices during retrieval should be careful. There is also concern that using multiple devices will lead to increased medical costs.

Another critical consideration in this procedure is mechanical damage to the carotid plaque surface due to stent retriever friction. In case 2, despite successful FFT retrieval, in-stent plaque protrusion occurred and required two additional sessions of stent placement. The use of a stent retriever for the case of ICA stenosis with fragile plaque may cause intimal injury and destruction of the fibrous cap which

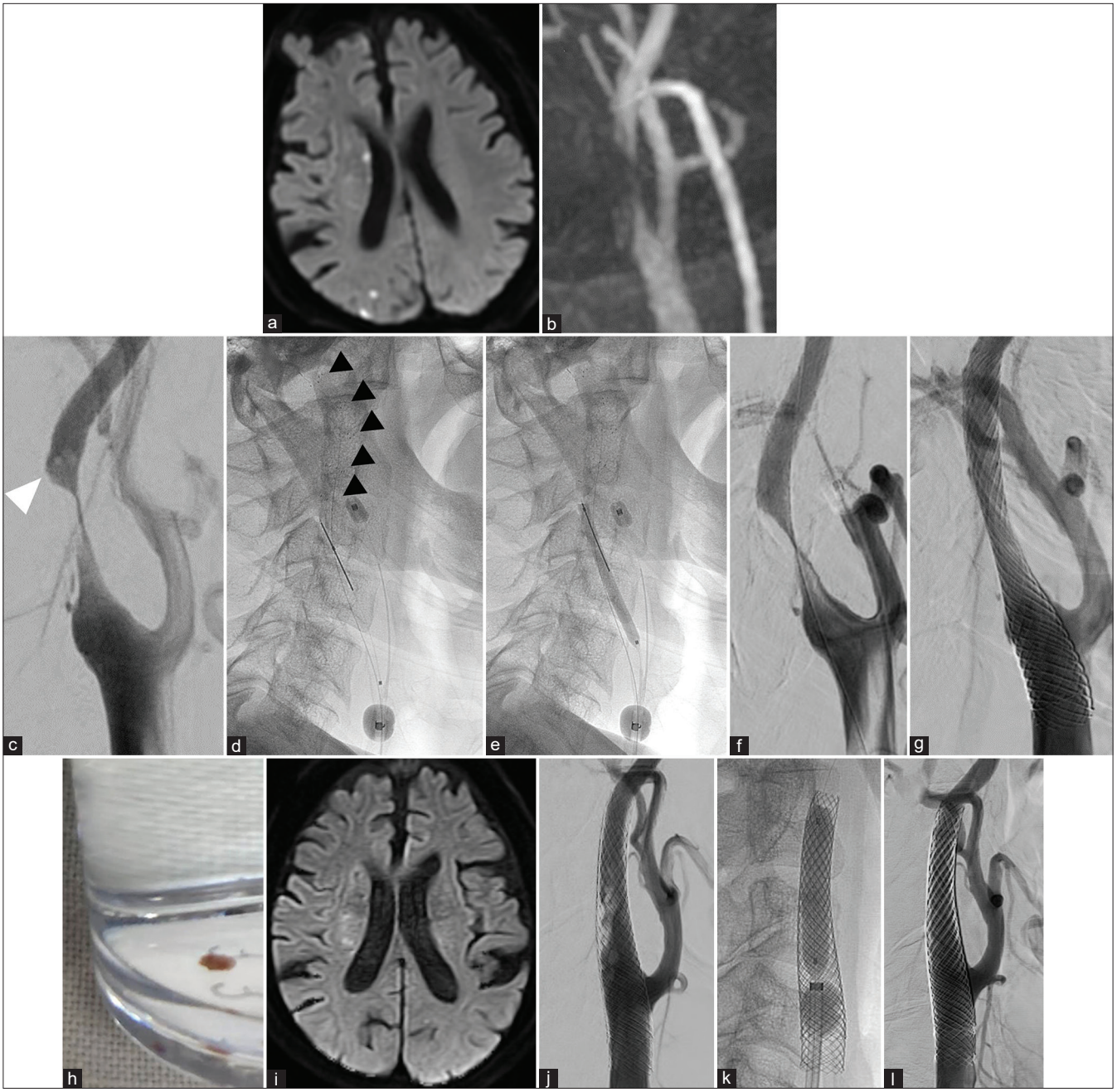

Figure 3: An 81-year-old man with symptomatic right carotid artery stenosis and free-floating thrombus (FFT). (a) Magnetic resonance imaging (MRI) shows diffuse spotty infarctions in the patient's right hemisphere. (b) MRA shows stenosis in right internal carotid artery (ICA). (c) Digital subtraction angiography (DSA) shows severe ICA stenosis with FFT (white arrow). (d) EMBOTRAP □ 6.5 × 44 mm (Johnson and Johnson, Miami, FL, USA, black arrows) is deployed to cover the thrombus. (e) A balloon dilatation catheter guided to the lesion along the push wire of the stent retriever is inflated. (f) After stent retriever retrieval, the thrombus image on DSA disappears. (g) Carotid Wallstent (Stryker, Kalamazoo, MI, USA) is deployed. (h) White thrombus retrieved by the stent retriever. (i) Postoperative MRI shows no increase in infarction. (j) DSA shows recurrence of in-stent plaque protrusion after additional stent placement. (k) Balloon dilation with proximal balloon protection and distal filter protection. (l) Final image after placement of the third stent (10 × 30 mm CASPER Rx, Microvention, Tustin, CA, USA).

may promote further plaque rupture, plaque protrusion, and thrombosis. Aspiration thrombectomy with a large-bore aspiration catheter may avoid such mechanical damage to the plaque. However, in cases of severe stenosis such as case 2, PTA is required before the aspiration catheter can reach the thrombus. PTA itself causes traumatic damage to the plaque,

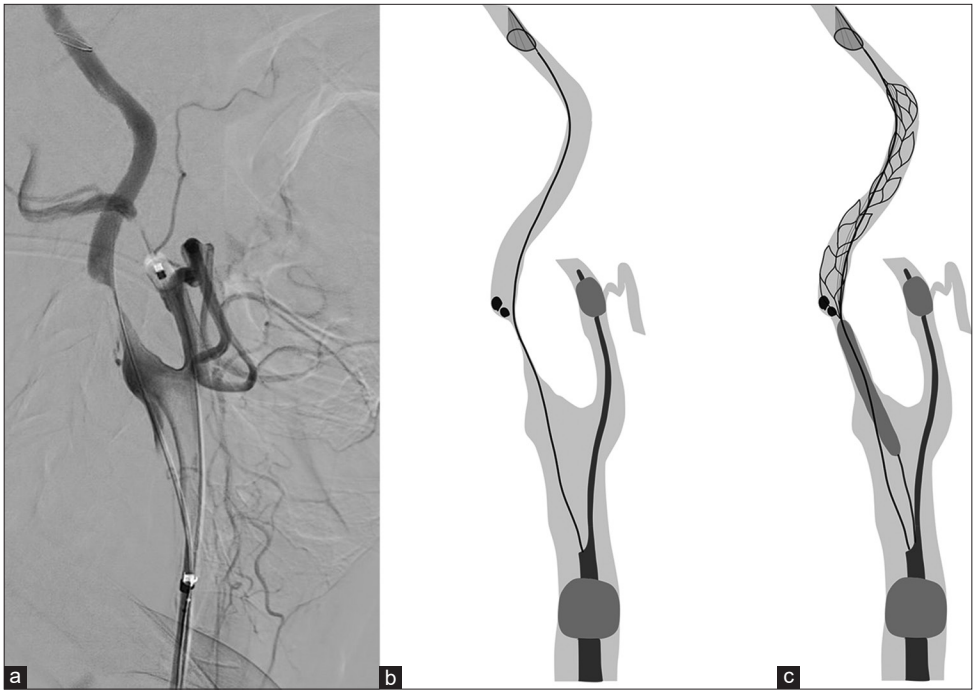

Figure 4: Schematic illustration of the device and procedure applied in case 2. (a) Lateral view of pretreatment angiography. (b) Schema after completion of protection. (c) Schema with the stent retriever deployed and the dilatation balloon expanded along the push wire.

causing dissection of the intima at the microscopic level, even though it is unnoticeable on angiography.[5,6] Although there are differences among facilities, we used a predilation balloon (3.5 × 40 mm) similar to that used in normal CAS procedures for case 2. There is no consensus on how much dilatation, especially in carotid artery lesions, is necessary for safe stent retrieval. If the stent retriever cannot pass through the stenosis, an additional larger dilatation balloon should be used, or the stent retriever should be re-sheathed for safety. The efficacy and safety of the use of stent retrievers for FFT attached to carotid stenotic lesions is still highly controversial and should be carefully considered in its indications, including alternative treatment options.

No previous studies have compared CEA and CAS for carotid stenosis with FFT. Treatment selection should be performed after considering the factors that increase the risk associated with each procedure, such as the stenosis rate, plaque characteristics, degree of calcification, anatomical conditions, use of antiplatelet drugs, and surgeon proficiency, should be considered, as with normal ICA stenosis. One advantage of choosing CAS is that the operation time can be shortened with minimal vascular manipulation while avoiding general anesthesia. Another benefit of endovascular treatment is the opportunity to immediately perform intracranial mechanical thrombectomy if a distal embolism occurs during the procedure. CEA can safely revascularize carotid stenotic lesions with FFT by directly accessing and occluding the distal ICA and should always be considered as an alternative treatment. Secondary treatment with CEA after endovascular therapy including floating thrombus retrieval and PTA is also a considerable option for high-risk lesions.

CONCLUSION

We reported successful two cases of ICA stenosis with FFT in which thrombectomy with a stent retriever was performed before urgent CAS. Although its indications and alternative treatments should be carefully considered due to some concerns such as mechanical irritation to the carotid artery plaque, this procedure may help reduce the risk of distal embolization of thrombus and ischemic complications.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Yamamoto Y, Yamamoto N, Matsuda T, Kuroda K, Yamaguchi I, Sogabe S, *et al*. Stent retrieval for free-floating thrombus attached to carotid artery stenosis: A report of two cases. Surg Neurol Int 2023;14:274.

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