OPEN ACCESS

Case report

Endovascular treatment of asymptomatic free-floating thrombus in the carotid artery bifurcation: a direct aspiration first-pass technique under double balloon protection

Ayumu Yamaoka, Kei Miyata, Satoshi Iihoshi, Nobuhiro Mikuni

Neurosurgery, Sapporo Medical University, Sapporo, Hokkaido, Japan

Correspondence to
Dr Kei Miyata,
miyata@sapmed.ac.jp

Accepted 30 July 2019

SUMMARY

Free-floating thrombus (FFT) in the carotid artery has been reported as a rare cause of acute ischaemic stroke. There are various treatment strategies, but higher risk of distal embolism may limit their applicability. A 77-year-old woman noticed right upper arm weakness. A CT angiogram revealed that a large floating thrombus had strayed across the carotid bifurcation, while another thrombus was present in the right axillary artery. As for the carotid FFT, in spite of anticoagulation therapy, the number of asymptomatic microthrombuses gradually increased on diffusion-weighted MRI. We performed endovascular therapy utilising two temporary occlusion balloon catheters and performed direct aspiration with a reperfusion catheter. The procedure was uneventful. We successfully performed a new endovascular technique for FFT in the carotid bifurcation. Our method is effective, minimally invasive and safe.

BACKGROUND

Free-floating thrombus (FFT) in the carotid artery has been reported as a rare cause of acute ischaemic stroke or transient recurrent ischaemic attacks due to distal embolisation of the thrombus. Although successful outcomes have been reported after medical and surgical treatment for patients with FFT, it is unknown which treatment option is superior.[1] Recent studies have reported that endovascular treatment (EVT), an alternative to surgical thrombectomy for FFT refractory to anticoagulation therapy, yields good long-term outcomes.[2 3]

To date, little is known about the optimal management of asymptomatic carotid FFT in the acute phase. The risk of distal embolism as an adverse effect of EVT still remains to be resolved. We safely performed EVT in a patient with asymptomatic carotid FFT. Here, we report on our innovative procedure which combined a direct aspiration first-pass technique (ADAPT)[4] with distal and proximal balloon protection (PBP), which we call the ADAPT double balloon protection (ADAPT-DBP).

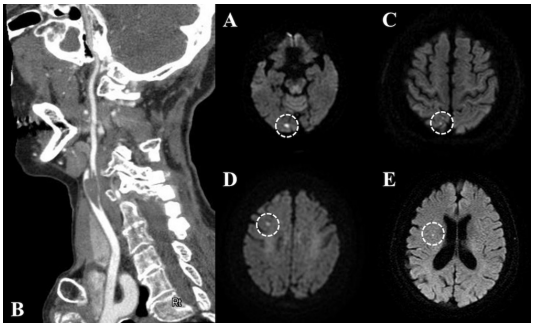

Figure 1 (A) MRI of the head on day 1 showed small hyperintensities in the right occipital lobes. (B) CT angiography of the head and neck revealed a thrombus in the right common carotid artery floating across the carotid bifurcation. (C–E) Serial MRI on days 2, 3 and 6 showed an increase in multiple microthrombuses.

CASE PRESENTATION

A 77-year-old woman had been admitted to the orthopaedic ward in our hospital and had undergone laminoplasty for lumbar spinal canal stenosis. She received perioperative systemic heparinisation for atrial fibrillation. She noticed right upper arm weakness and a cold and painful feeling after the sixth postoperative day. Diffusion-weighted MRI (DW-MRI) of the head demonstrated small hyperintensities in the right occipital lobe (figure 1A). CT angiogram (CTA) revealed that a large floating thrombus had strayed across the carotid bifurcation (figure 1B) and showed another thrombus in the right axillary artery. Vascular surgeons immediately performed surgical thrombectomy for the thrombus in the right axillary artery, and the patient's symptoms improved.

For the carotid FFT, we initially performed medication therapy with oral warfarin. Although serial MRI showed shrinkage of the FFT, the number of asymptomatic microthrombuses gradually increased in DW-MRI (figure 1C–E). We performed endovascular intervention to ensure the prevention of distal embolism on the seventh day after onset of the arm weakness.

TREATMENT

Intravascular treatment

The procedure was performed under local anaesthesia. We selected two occlusion catheters: a 9Fr OPTIMO Balloon Guide Catheter (BGC) (Tokai Medical Products, Aichi, Japan) for PBP and a 6Fr

To cite: Yamaoka A, Miyata K, Iihoshi S, *et al*. *BMJ Case Rep* 2019;**12**:e230295. doi:10.1136/bcr-2019-230295

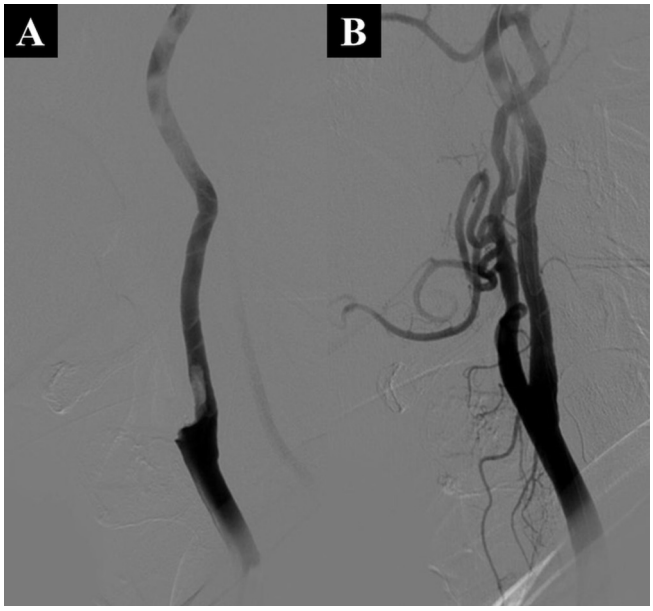

Figure 2 (A) Preoperative right common carotid angiogram (lateral view) showed a free-floating thrombus located across the carotid bifurcation, antegrade flow in the right internal carotid artery (ICA) and right external carotid artery (ECA) occlusion. (B) Postoperative right common carotid angiogram (lateral view) showed complete patency of the right ICA and the ECA.

300 cm Carotid GUARDWIRE PS (GW) (Medtronic, Minneapolis, Minnesota, USA) for distal balloon protection.

A 9Fr 25 cm arterial long sheath was inserted into the right femoral artery. A 5Fr 125 cm JB 2 shaped catheter with a 0.035 inch guidewire was carefully advanced into the right common carotid artery (CCA) at the proximal portion of the FFT. Using this catheter as the axis, we carefully guided the BGC to the right CCA.

Control angiography of the right CCA showed partial contrast defect in the carotid bifurcation and complete occlusion of the external carotid artery (ECA) (figure 2A). Through the GW, a 5MAX ACE068 Reperfusion Catheter (ACE) (Penumbra, Alameda, California, USA) was inserted into the lumen of the BGC and was guided to the proximal right carotid bifurcation. First, PBP was secured through maximal inflation of the balloon of the BGC (figure 3A). The GW was carefully advanced across the FFT and was positioned at the distal internal carotid artery (ICA). The balloon of the GW was inflated to 6 mm to establish the DBP (figure 3B).

Second, the ACE was moved slowly to the carotid bifurcation under direct aspiration via the ACE which was directly connected with the Large Lumen Aspiration Tubing, a MAX Canister and a MAX Pump (figure 3C). We confirmed that the ACE was in an appropriate position with no backflow of blood to the MAX Canister, which indicated that the thrombus was wedged into the ACE. We waited for approximately 40 s in position, then slowly pulled back the ACE. A red thrombus was found in the MAX Canister. Subsequently, a white thrombus was also caught in the Y connector and the three-way stopcock after manual blood aspiration from the BGC (figure 4). Finally, we repeated the manual aspiration several times via a 6Fr Advance Aspiration Catheter (Medtronic) (figure 3D), which we had navigated through the GW. Aspirated blood was intravenously injected via a venous sheath through the filtration filter. We deflated the BGC first and the GW subsequently.

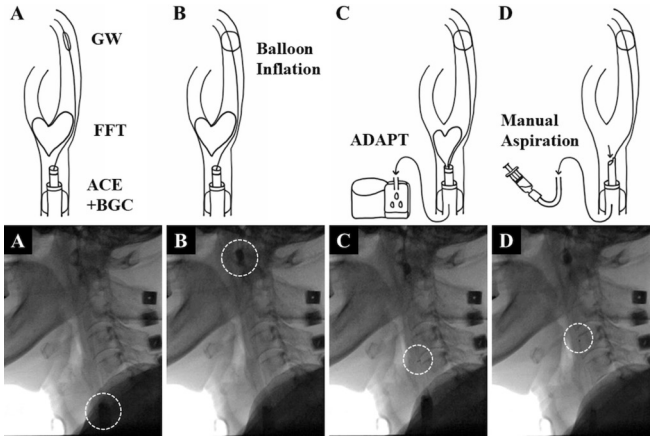

Figure 3 Schematic illustrations and fluoroscopic images explaining our method of endovascular thrombectomy under a direct aspiration first-pass technique double balloon protection (ADAPT-DBP). Through a 300 cm Carotid GUARDWIRE PS (GW), a 5MAX ACE068 Reperfusion Catheter (ACE) was inserted into the lumen of the balloon guiding catheter (BGC) and guided to the proximal right carotid bifurcation. (A) The balloon of the BGC was maximally inflated to protect the right common carotid artery. The GW was carefully advanced across the free-floating thrombus (FFT) into the right internal carotid artery (ICA) and positioned at the right cervical ICA just near the petrous. (B) The balloon of the GW was inflated and DBP was established. (C) The ACE was carefully advanced to the FFT and the thrombus was aspirated by means of ADAPT. (D) Through the GW, the ACE and an aspiration catheter were exchanged, and manual aspiration was performed with the aspiration catheter. Finally, the BGC and the GW were deflated. The schemas in the upper panel were drawn by AY.

OUTCOME AND FOLLOW-UP

Postoperative angiography showed the absence of the thrombus in the carotid bifurcation (figure 2B). The operation time was 1 hour and 16 min, and the total dose of heparin was 3000 units. DW-MRI on the day after the procedure revealed no new ischaemic changes. The patient was discharged on the 29th day after onset.

DISCUSSION

Our method enabled the successful removal of a carotid FFT under anticoagulation therapy which had increased the number of new asymptomatic cerebral ischaemic lesions. ADAPT-DBP has two distinctive characteristics: the necessity of two temporary occlusion balloon catheters for carotid artery stenting (CAS) as an embolic protection device and the need for multiple aspiration methods, that is, both ADAPT and an aspiration catheter with coaxial system of the GW.

Our procedure was safe and effective with a reliable DBP system that incorporates a GW and PBP to reliably prevent distal embolism. The DBP reduces the risk of new lesions on DW-MRI after CAS procedures compared with simple distal protection with a balloon or a filter.[5] A previous report has shown the efficacy of suction thrombectomy with a flow reversal system under PBP.[6] In our case, since the ECA was occluded due to migration of the thrombus, we could not adapt the system. In addition, thrombus aspiration through the BGC might be unsuccessful when there is some distance between the catheter tip and the thrombus. Some cases of FFT have been treated with a method combining stentriever thrombectomy with a distal protection filter (DPF).[7] It is unclear, however, whether a DPF can sufficiently prevent the migration of cardiogenic large thrombuses. Unlike the distal

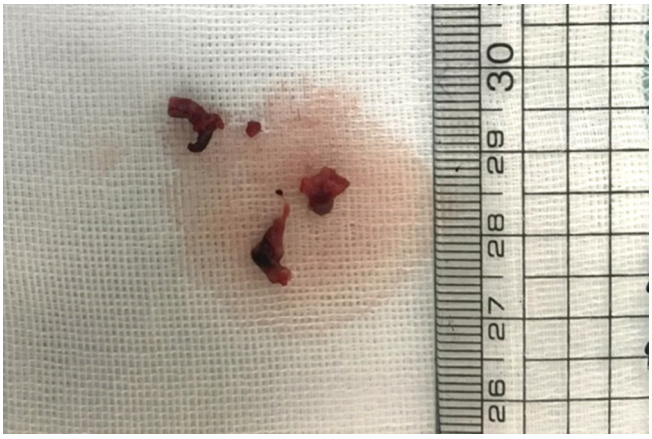

Figure 4 The red and white thrombuses aspirated through the Balloon Guide Catheter.

balloon, there is also the possibility that the filter might not cover the entire cross-section of the vessel, so that emboli might be able to pass by the filter without being caught.[8]

We were able to reliably adhere the reperfusion catheter to the thrombus under complete blood flow obliteration. In our case, since the FFT was positioned across both the ICA and ECA, we considered that ADAPT was more suitable than stent thrombectomy. In addition, when stentriever is used in combination with a distal protection device such as a DPF or GW, the guidewire for distal protection and the microcatheter for stentriever deployment are navigated to the ICA at the same time, which may increase risk during the procedure. ADAPT-DBP requires only a single guidewire such as the GW.

Learning points

- Carotid free-floating thrombus (FFT) is rare but may present with severe symptoms.
- We report a case of asymptomatic carotid FFT concurrently presenting with axillary artery occlusion.
- Our method, which consists of two temporary occlusion balloon catheters and direct aspiration with a reperfusion catheter, enabled a successful outcome for asymptomatic carotid FFT.

Thus our method is effective, safe and minimally invasive. However, if an ACE was advanced close to the inflated balloon on the GW, there is a risk that the balloon would be pulled into the ACE during ADAPT. In cases in which our method was unsuccessful, additional procedures such as thrombus fragmentation using inflated percutaneous transluminal angioplasty balloon and stent deployment implanted in the lesion could increase the chance of successful revascularisation under the DBP.

Contributors AY and KM designed the study and wrote the initial draft of the manuscript. SI and NM contributed to decision of the treatment strategy and assisted in the preparation of the manuscript. All the authors have contributed to data collection and interpretation and critically reviewed the manuscript. They approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Bhatti AF, Leon LR, Labropoulos N, *et al*. Free-floating thrombus of the carotid artery: literature review and case reports. *J Vasc Surg* 2007;45:199–205.
2 Park JW, Lee DH, Choi CG, *et al*. Various endovascular approaches to the management of free floating carotid thrombi: a technical report. *J Neurointerv Surg* 2012;4:336–8.
3 Tan AP, Taneja M, Seah BH, *et al*. Acute free-floating carotid artery thrombus causing stroke in a young patient: unique etiology and management using endovascular approach. *J Stroke Cerebrovasc Dis* 2014;23:e437–e439.
4 Turk AS, Spiotta A, Frei D, *et al*. Initial clinical experience with the ADAPT technique: a direct aspiration first pass technique for stroke thrombectomy. *J Neurointerv Surg* 2014;6:231–7.
5 Nakazaki M, Nonaka T, Takahashi A, *et al*. Double balloon protection during carotid artery stenting for vulnerable carotid stenosis reduces the incidence of new brain lesions. *Acta Neurochir* 2016;158:1377–86.
6 Parodi JC, Rubin BG, Azizzadeh A, *et al*. Endovascular treatment of an internal carotid artery thrombus using reversal of flow: a case report. *J Vasc Surg* 2005;41:146–50.
7 Giragani S, Balani A, Agrawal V. Stentriever thrombectomy with distal protection device for carotid free floating thrombus: a technical case report. *J Neurointerv Surg* 2017;9:e33.
8 Vos JA. Evidence overview: benefit of cerebral protection devices during carotid artery stenting. *J Cardiovasc Surg* 2017;58:170–7.