Floating aortic arch thrombus involving the supraaortic trunks: Successful treatment with supra-aortic debranching and antegrade endograft implantation

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A floating thrombus within the aortic arch is a rare condition that is generally detected after cerebral, visceral, or peripheral embolization. Endovascular exclusion of such mobile thrombus has been described but exclusively involved the descending aorta, or debranching of the supra-aortic trunk was done by open surgical bypass procedure. We present a case with a floating thrombus that extended throughout the whole aortic arch and involved all of the supra-aortic trunks. The pathology was treated by debranching the supra-aortic trunks using a new nonsutured Viabahn-based (W. L. Gore & Associates, Flagstaff, Ariz) technique (Viabahn Open Revascularization TECHnique [VORTEC]) for revascularization of the left common carotid artery and performing an antegrade endograft implantation from the ascending aorta, distal to the origin of the feeding graft for debranching, to the descending aorta in one procedure. (J Vasc Surg 2009;50:1177-80.)

A floating thrombus within the aortic arch is a rare condition that is generally detected after cerebral, visceral, or peripheral embolization. Endovascular exclusion of such mobile thrombus has already been described,2-8 but exclusively involved the descending aorta2-7; or debranching of the supraaortic trunk was done by open surgical bypass procedure.8 We present a patient with a floating thrombus that extended throughout the whole aortic arch and involved all of the supraaortic trunks. The pathology was treated by debranching the supra-aortic trunks using a new nonsutured Viabahn-based (W. L. Gore & Associates, Flagstaff, Ariz) technique (Viabahn Open Revascularization TECHnique [VORTEC]) for revascularization of the left common carotid artery (LCCA) and performing an antegrade endograft implantation from the ascending aorta, distal to the origin of the feeding graft for debranching, to the descending aorta in one procedure.

CASE REPORT

Patient. A 59-year-old woman was referred to our university center due to a progressive floating thrombus within the aortic arch. She underwent transbrachial thrombectomy 4 months before for acute brachial ischemia and was treated since then with Coumadin (Bristol-Myers Squibb, Princeton, NJ). Periodic coldness of the left hand was the only residual symptom, and the patient was neurologically asymptomatic.

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A thoracoabdominal computed tomography (CT) angiography (CTA) showed thrombus extending from the proximal aortic arch and floating downstream into the descending aorta (Fig 1).

The thrombus pedicle involved the brachiocephalic trunk and extended within the LCCA and the left subclavian artery, which were completely or partially occluded (Fig 2).

Cardiac history and investigation revealed no arrhythmia, ischemic heart disease, valvular disease, or intracardiac thrombus. Results of tumor screening were negative, but the preoperative cerebral CT scan revealed two asymptomatic lesions of unknown origin in the posterior semiointal center. Color Doppler ultrasound imaging showed minimal stenosis of internal carotid arteries, occlusion of the left vertebral, and normal antegrade perfusion of the right vertebral arteries. The only positive finding was positive level of activated phospholipid antibody (lupus anticoagulant) and low levels of protein S and protein C, suggesting a probable antiphospholipid syndrome.

Owing to the unknown origin of the two cerebral tumors, it was decided to avoid an arch procedure under circulatory arrest, which would put the patient at risk for cerebral bleeding. Revascularization of the left subclavian artery was not considered necessary because the occlusion was chronic and asymptomatic. Furthermore, the left vertebral artery was also occluded by the distal extension of the thrombus.

Procedure. The supra-aortic vessels were approached through a full-length median sternotomy. The brachiocephalic trunk and LCCA were carefully dissected with a no-touch technique approximately 3 cm distal to their origin. Simultaneously, a bifurcated graft was tailored to the patient’s anatomy ex vivo to serve as a feeding graft for the debranching procedure. For this purpose, to a 10-mm expanded polytetrafluoroethylene (ePTFE) graft (W. L. Gore & Associates) was sewn a 6-mm ring-supported ePTFE side-branch graft (FlowLine Bipore, JOTEC, GmbH, Hechingen, Germany).

After systemic heparinization (100 IU/kg), the aorta was partially clamped with a side-biter clamp, and the proximal end of the 10-mm feeding graft was sutured end-to-side to the ascending
aorta free from calcification, thrombus, or complicated atherosclerotic lesions proven by preoperative CTA. The LCCA was revascularized using the VORTEC technique.9

Briefly, after puncturing the anterior wall of the LCCA in a thrombus-free area, a 7-mm Viabahn endograft was introduced over the wire (Seldinger technique) approximately 2 cm into the LCCA through the origin of the 6-mm interposition side-branch graft (IG). The running suture anastomosis between the feeding and the branched graft for LCCA was constructed ex vivo. The running suture was not knotted, and the Viabahn stent graft was introduced over the wire into the LCCA through an 8F sheath. After Viabahn deployment and ballooning, removal of the sheath, and retrograde and antegrade flushing, the running suture was knotted and blood flow into the LCCA was resumed. The total ischemia time of LCCA was 2 minutes (during Viabahn deployment and balloon inflation). No cerebral protection technique was used. The Viabahn endograft was then fixed to the LCCA with two transmural polypropylene 6-0 sutures. Finally, the origin of the brachiocephalic trunk and the proximal LCCA were interrupted with a ligature and the distal end of the 10-mm feeding graft was anastomosed end-to-side to the brachiocephalic trunk.

Access for the antegrade stent graft insertion was achieved as recently described.10 A 24F sheath was introduced into the ascending aorta, just distally to the debranching graft by gentle manipulation and constant transesophageal echocardiography (TEE) control. A 28-mm (15-cm in length) TAG endograft (W. L. Gore & Associates) was introduced and deployed. No thrombus dislodgement was detected on TEE during endograft placement. Postprocedural CTA, performed immediately after surgery, did not detect any perfusion deficits (Fig 3).

The patient’s postoperative course was uneventful. She was asymptomatic and was discharged 7 days after the procedure. Combination therapy with a platelet inhibitor (aspirin, 300 mg) and Coumadin, which was started immediately after the intervention, was administered. A CTA at discharge showed no brain damage. Stereotactic biopsy of the two brain tumors 2 months later showed a partially coagulated and partially nonorganized hematoma, without any sign of malignancy. Unfortunately, the patient died 5 days after the brain tumor biopsy with signs of a massive myocardial infarct. Permission for postmortem examination could not be obtained.

DISCUSSION

A thrombus, generally developing secondarily to an atherosclerotic plaque,11 located within the aortic arch, is rare (0.08%).12 Extensive endoaortic thrombosis can be observed in patients with primary hematologic disorders11,13 such as antiphospholipid syndrome, paraneoplastic coagulation disorder, aspergillosis,14 and long-term treatment with steroids.15 A floating thrombus is defined as a nonadherent part of the thrombus floating within the aortic lumen. The natural history of such floating thrombus is not well known. Clinical presentation ranges from asymptomatic disease to symptoms related to cerebral, peripheral, or visceral embolization.12 Embolization of nonfloating and floating thrombus is reported in 12% and 75% of patients, respectively.16
Various different treatment modalities have been described. Medical treatment (anticoagulation, thrombolysis) may lead to complete dissolution of the thrombus in most patients. However, embolization remains the major concern with this approach. Thrombectomy, thromboendarterectomy, and aortic replacement carry a high morbidity, mainly due to cerebral complications occurring in up to 29% of the patients.

Surgery requires careful analysis of CTA, which has replaced TEE as the diagnostic modality and planning tool of choice. Before any VORTEC procedure, we carefully analyze the CTA studies and reconstructions to detect potential problems and plan for the optimal puncture site. In this patient, the thrombus extended from the aortic arch within the first 2 cm of LCCA origin. However, 10 cm of nonaltered LCCA was left from the distal end of thrombus to the carotid bifurcation, which was sufficient for a safe puncture above the thrombosed area of the LCCA, insertion of the guidewire (approximately 3 to 4 cm), catheter, and finally, the Viabahn stent graft in the LCCA.

The use of cerebral protection techniques needs to be clarified. We did not use any distal protection technique during Viabahn stent graft deployment in this patient. Our experience has led us to conclude that additional protection techniques are not necessary and may even be harmful by complicating the procedure, resulting in potential dissections, prolonged ischemia time, or access problems. Furthermore, the diameter of the deployed Viabahn stent graft is wider than that of the target vessel, so that the thrombus is trapped between the Viabahn and the inner wall of the artery.

Why was the VORTEC procedure in this young patient preferred instead of suturing the distal end of the 6-mm graft to the LCCA? We presumed that open surgery in this obese patient (BMI 30.3) with a hostile, short neck would require more extensive LCCA dissection, thereby increasing the risk for embolization. In addition, the ischemia time for open surgery would have been significantly longer than that for the VORTEC procedure. We were concerned that after complete cross-clamp of LCCA during open bypass surgery, ischemia-reperfusion injury might result in secondary bleeding within the two lesions of unknown origin.

Criado et al reported the first use of an endograft to cover a recurrent floating thrombus located in the descending aorta. In their case, surgical thrombectomy had been performed 1 month earlier. Since then, several authors have reported their experience with endograft implantation. In all but one of these patients, treatment was limited to the descending aorta, and in most patients, the proximal landing zone of the endograft was located distal to the left subclavian artery and never crossed the LCCA. In our patient, endovascular exclusion of the arch thrombus required coverage of the entire arch (ascending aorta to descending aorta), necessitating a preliminary debranching of the supra-aortic vessels.

The hybrid debranching and endovascular approach is a less invasive option than open surgery. It can also be applied to treat simultaneously lesions of the thoracic and abdominal aorta. Although the risk of accidental embolization seems to be low, it can probably not be eliminated completely, even with antegrade endograft implantation. Debranching the supra-aortic vessels, including interruption of the normal anatomical inflow from the arch before any endovascular manipulation within the aortic arch, eliminates cerebral embolization associated with endovascular manipulations. Antegrade endograft introduction and deployment through the ascending aorta reduces the risk of embolization compared with crossing the lesion in a retrograde manner with wires or devices that have limited flexibility. If embolization occurs, surgical embolectomy or thrombus aspiration can be performed with usual techniques. A drawback of our technique is the inability to obtain material for histologic examination. However, this can be done by obtaining thrombus material by aspiration biopsy through the aortic wall or by opening the aneurysm sack once the endograft has been deployed.

Clear recommendations regarding anticoagulation regimens to be used before and after endograft exclusion of mobile thrombus of the thoracic aorta are missing. Reports of seven patients have been published. Anticoagulation was used in three patients to avoid thrombus progression and embolization. Two of the seven patients did not receive anticoagulation before the intervention. Some re-
ceived anticoagulation in combination with aspirin. After endografting, oral anticoagulation was administered to all but one patient receiving clopidogrel. One case report did not mention anticoagulation. In our patient, with suspicion of antiphospholipid syndrome, long-term combination therapy with aspirin and Coumadin was used.

To our knowledge, this is the first case description of hybrid treatment of a floating arch thrombus by VORTEC debranching, a sutureless anastomosis technique that potentially reduces the risk of cerebral embolization.

REFERENCES


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