Cerebral embolic protection devices (EPDs) such as carotid filters were first introduced as an adjunct to carotid artery stenting out of concern for increased rates of procedure-related atheromatous plaque embolization compared with carotid endarterectomy. Here, we report the use of a carotid filter device for embolic protection during high-risk coronary artery bypass grafting and ventricular assist device explantation in a patient with a recent history of embolic cerebrovascular accident from severe aortic atherosclerosis.

Case Report

A 67-year-old man with no known history of coronary artery disease presented to an outside hospital with acute shortness of breath. Initial chest x-ray demonstrated complete opacification of the lung spaces consistent with decompensated pulmonary edema. The ECG demonstrated pan-ST segment depressions with ST elevation in lead V1 and was concerning for severe left main coronary artery stenosis. He was transferred to Columbia University Medical Center in cardiogenic shock for emergent angiography and evaluation for coronary intervention.

At catheterization, left ventriculography showed an ejection fraction of 15% to 20% with global hypokinesis. Coronary angiography revealed a right dominant system with a thrombotic 90% stenosis of a trifurcating distal left main coronary artery (Figure [A]). The right coronary artery was occluded proximally and filled retrograde via the left circulation (Figure [B]). Despite initial stabilization after aggressive diuresis, insertion of an intra-aortic balloon pump, and aspiration thrombectomy of the left main coronary artery, the patient continued to decompensate. A CentriMag biventricular assist device (BiVAD) was implanted (Thoratec, CA). During the BiVAD implantation, transesophageal echocardiography revealed that the aorta was severely atherosclerotic (Figure [C]). On the first postoperative day, the patient was thought to have mild left lower extremity weakness, but this finding was attributed to ongoing postoperative sedation. The following day when the patient was fully awake, he was noted to have a left lower extremity motor deficit. No arrhythmic episodes were documented after his initial procedure. A neurology consultation was obtained and a head computed tomography was performed. The computed tomography showed multiple scattered hypodensities involving the posterior right frontal lobe, left occipital lobe, and bilateral cerebellar hemispheres consistent with embolic infarcts (Figure [D]). These findings, in combination with the patient’s left lower extremity weakness, were presumed secondary to aortic manipulation during BiVAD implantation. His neurological status improved significantly during the next few days, and he had only minor residual deficits. In preparation for definitive cardiac management, he underwent a myocardial viability study that demonstrated global hypokinesis but no scar in the distribution of the left anterior descending artery. He was then scheduled for BiVAD explant and coronary artery bypass grafting.

Given his calcific atherosclerotic aorta and recent history of cerebral embolic disease, we decided to place bilateral carotid artery EPDs to prevent additional cerebral emboli during further (inevitable) aortic manipulation. The decision to place EPDs was based on documented stroke risk reduction during carotid artery stenting with distal EPD placement in conjunction with our concern for this patient’s high risk of recurrent stroke.1,2

In the operating room, bilateral femoral artery access was established and the patient was systemically heparinized with 30,000 U of heparin. Aortic arch and carotid artery angiograms were performed. The left internal carotid artery had a 60% stenosis, and the right had a 70% stenosis (Figure [E] and [F]). Bilateral carotid artery filters (EmboShield NAV6; Abbot Vascular, IL) were then deployed in the internal carotid arteries via a bifemoral artery approach (Figure [G]). The BiVAD was explanted with minimal aortic manipulation, and a 4-vessel coronary artery bypass grafting was completed without complication.

The patient was weaned from bypass with excellent biventricular function. Both carotid filters were then retrieved. Immediate inspection revealed thrombotic and atherosclerotic debris trapped in the filter mechanism (Figure [H]). The patient completed an uneventful postoperative course. He returned to the operating room the next day for assessment of his neurological status. The right common carotid artery was aspirated with multiple embolic protection filters (Emboshield NA V6; Abbot Vascular, IL) and the left common carotid artery was occluded distal to the bifurcation of the internal and external carotid arteries. Bilateral carotid endarterectomy was completed without complication. The patient was weaned from bypass with excellent biventricular function. Both carotid filters were then retrieved. Immediate inspection revealed thrombotic and atherosclerotic debris trapped in the filter mechanism (Figure [H]). The patient completed an uneventful postoperative course. He returned to the operating room the next day for assessment of his neurological status.

Correlation of Findings

Among the findings from this case study, we report the use of carotid filters during high-risk coronary intervention with a ventricular assist device. We describe a case with multiple embolic phenomena involving the aorta and cerebral circulation. The patient was found to have multiple embolic infarcts involving the posterior right frontal lobe, left occipital lobe, and bilateral cerebellar hemispheres. The causal link between the aortic manipulation and cerebral embolic stroke is supported by the positive findings of the computed tomography and the negative findings of the magnetic resonance imaging. The use of carotid filters was successful in preventing additional cerebral emboli during the high-risk procedure. The patient's neurological status improved significantly during the next few days, and he had only minor residual deficits. In preparation for definitive cardiac management, he underwent a myocardial viability study that demonstrated global hypokinesis but no scar in the distribution of the left anterior descending artery. He was then scheduled for BiVAD explant and coronary artery bypass grafting.


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home with full neurological function and no residual motor deficits after subacute rehabilitation.

**Discussion**

We present a novel application for the use of carotid filter devices during BiVAD explant from a patient with significant aortic atherosclerosis and a recent history of stroke. Atheroma burden in the ascending aorta and aortic arch is a well-established risk factor for cerebral embolization during cardiac and aortic procedures. Stroke risk may be as high as 31% in patients with documented ascending aortic atherosclerosis undergoing cardiac procedures requiring aortic clamping or cannulation. According to the Protected Carotid Artery Stenting in Patients at High Risk for Carotid Endarterectomy (PROTECT) trial evaluating the safety of this EPD, supra-aortic catheterization carries a procedure-related major stroke risk of 0.5%. Compared with our case, filter placement during carotid artery stenting requires a much shorter deployment time. However, with systemic heparinization and removal of the filters before protamine administration, bilateral carotid filter placement was considered relatively safe. Our decision was ultimately based on this patient’s significant risk of a recurrent stroke, which was thought to far outweigh the risk related to EPD placement.

This case is also important in that it represents successful collaboration among interventional cardiologists and cardiac surgery specialists in a Heart Team Model. Although difficult to standardize to general cardiac or aortic surgery, in special circumstances such as this, we think this to be a technically feasible option that may be considered for stroke prevention in high-risk patients. Our outcome may encourage consideration of the use of carotid artery filter devices in surgical and interventional procedures in which aortic manipulation is anticipated in the setting of severe aortic atherosclerosis.

**Disclosures**

None.

**References**


**Key Word:** Carotid arteries
Figure. A, Left coronary artery angiogram demonstrating near-complete occlusion (arrow) of the trifurcating left main coronary artery. B, Right coronary artery (RCA) angiogram demonstrating complete occlusion of the RCA (arrow). C, Intra-operative transesophageal echo images showing extensive ascending aortic atherosclerosis (arrows). D, Noncontrast head computed tomography demonstrating hypodensities in the right frontal lobe and the left cerebellar hemisphere (arrows). E, Left carotid artery angiogram showing an atherostenotic lesion at the origin of the internal carotid artery (arrow). F, Right carotid artery angiogram showing ulcerating plaque at the origin of the internal carotid artery (arrow). G, Bilateral internal carotid artery filter placement (arrows). H, Carotid filters after retrieval (top) and at ×50 magnification (bottom) with captured atheromatous plaque (bottom left arrow) and thrombotic material (bottom right arrow).
Bilateral Embolic Protection Devices for High-Risk Cardiac Surgery in a Patient With Recent Embolic Stroke

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