The patient is a 60-year-old woman with little known medical history who presented with loss of control of her left arm, which gradually improved to mild weakness. Her neurological and medical evaluation revealed magnetic resonance imaging (MRI) findings of a stroke in the right internal capsule and insular cortex. She was additionally found by magnetic resonance angiography, computed tomographic angiography, and later angiography to have negligible bilateral internal carotid artery (ICA) stenoses but with the presence of calcified plaque, a severely calcified aortic arch involving all three arch vessels, and partially flow-limiting embolism to the distal right M1 segment (Figures 1 through 3). She was also found to have severe hypertension, atherosclerotic peripheral vascular disease, renal occlusive disease, three-vessel coronary arterial disease, and mesenteric occlusive disease with unintentional weight loss. Echocardiography revealed normal left ventricular ejection fraction and no evidence of intracardiac thrombus or valvular abnormality.

Initial medical treatment was instituted with clopidogrel, atorvastatin, low-molecular-weight heparin, and gradual blood pressure management. Three days later, the patient developed another clinical episode of loss of left arm control as well as left leg loss of control and dysarthria. MRI revealed new diffusion hits in the right cerebral hemisphere in the frontoparietal lobe (Figure 4). Given the repeated episodes of neurological events, it was decided to proceed with endovascular management. No viable options for surgical management existed, with the only surgical option involving arch reconstruction and coronary bypass grafting.

PROCEDURAL DETAILS
Endovascular evaluation entailed arch aortography with a 4-F tennis racquet catheter and angiography via the right brachial approach evaluating the right carotid system and not disturbing the finger-like innominate plaque that may have contained thrombus. The angiogram showed partially recanalized thrombus in the right M1 segment with normal flow in the right M2...
branches, a high-grade right vertebral origin stenosis and retrograde flow in the left vertebral artery, and plaque without stenosis in the right ICA (Figures 1 and 2).

Cerebral protection before any intervention was believed imperative in this case. Manipulation of the stenotic right vertebral artery, however, was not performed based on risk/benefit evaluation, but it was believed necessary to place a SpideRx device (ev3 Inc., Plymouth, MN) in the right ICA given the two recent embolic events into this artery, which was widely patent. The SpideRx was selected given the unique ability to deliver this filter over a coronary wire placed through potentially tortuous anatomy, such as the right common carotid from the right subclavian artery. After placing the SpideRx filter into the right ICA via the right brachial approach, the lesion was endovascularly repaired from the femoral approach.

A 7-F Shuttle sheath (Cook Medical, Bloomington, IN) was placed in the aortic arch, and a 4-F catheter was placed at the origin of the innominate artery, allowing for placement of a Tad II wire (Covidien, Mansfield, MA). The sheath tip was placed into the orifice of the innominate artery interrupting antegrade flow temporarily. The lesion was then completely covered and stented with an 8- X 38-mm iCast covered stent (Atrium Medical Corporation, Hudson, NH) that was postdilated in its distal aspect with a 10- X 40-mm Admiral balloon (Medtronic Invatec, Frauenfeld, Switzerland) (Figure 5). The patient tolerated the procedure without clinical or angiographic evidence of intracranial embolism. Recovery of the SpideRx filter revealed trapped chronic thrombotic and fibrinous debris. The patient remains clinically patent with stable duplex carotid evaluation for the past 24 months.

She subsequently underwent coronary bypass surgery after iCast revascularization of her left subclavian artery. She has additionally had renal, peripheral, and mesenteric endovascular interventions.

DISCUSSION
Several large series evaluating the safety of innominate and great vessel endovascular intervention without distal protection devices have existed in the literature essentially creating the standard of not using an embolic protection device (EPD) in arch great vessel intervention.1-5 This approach and the acceptance of arch vessel endovascular intervention as a lower-risk
procedure was demonstrated by Criado et al in their landmark article in 1996. It is worthwhile to note that the value of EPD use in carotid intervention has been debatable with the majority of United States operators believing as though EPDs are essential with significant statistical decline in stroke events compared to historical controls in the same centers. In European trials, including SPACE and the more recently published ICSS, EPDs were believed to have resulted in worse outcomes, with both trials evaluating symptomatic patients only. Symptomatic patients would seem to benefit greatest from EPD use because they are thought to have an unstable carotid lesion. In contradistinction, in the EVA-3S trial, the safety committee halted the study on endovascular intervention on symptomatic carotids because of a 3.9-fold higher stroke event risk in the nonprotection patients.

Earlier reports have documented a low risk of embolic events in occluded innominate and subclavian arteries. Mathias evaluated 46 patients with subclavian occlusions including five patients with right subclavian occlusions and reported no cerebral events. In Hüttl’s evaluation of 89 patients with innominate disease with five occlusions, only one cerebral embolic event occurred. This event occurred in a stenotic artery before balloon dilatation and likely represented an arch embolic event. All other cases were successful without embolization. In Sullivan’s review of great vessel intervention, only left common carotid intervention with combined endarterectomy resulted in stroke events, presumably secondary to platelet aggregation of the stent during clamping.

Because great vessel cases are not common or standard, each case and its associated risks must be evaluated individually. In cases of higher risk for embolization, such as common carotid, innominate, and right subclavian intervention, the risks and difficulty of placing an
Higher-risk endovascular cases are feasible and appropriate when all risks, benefits, and alternatives are explored for selected cases such as this.

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