# Endovascular Management of an Embolizing Innominate Artery Stenosis

Evaluation of distal protection devices and covered stents.

BY LARRY HORESH, MD

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

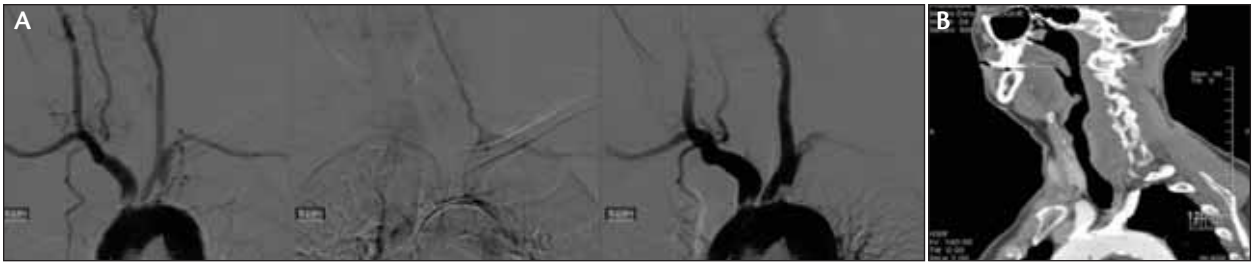


**Figure 1. Arch aortogram with magnified and delayed views showing severe flow-limiting calcifications of all arch vessels, high-grade stenosis of the right vertebral artery, and no significant internal carotid bulb stenosis and retrograde flow in the left vertebral artery (A). CT angiogram showing the dense arch calcification (B). Any potential thrombus is obscured by the dense calcifications.**

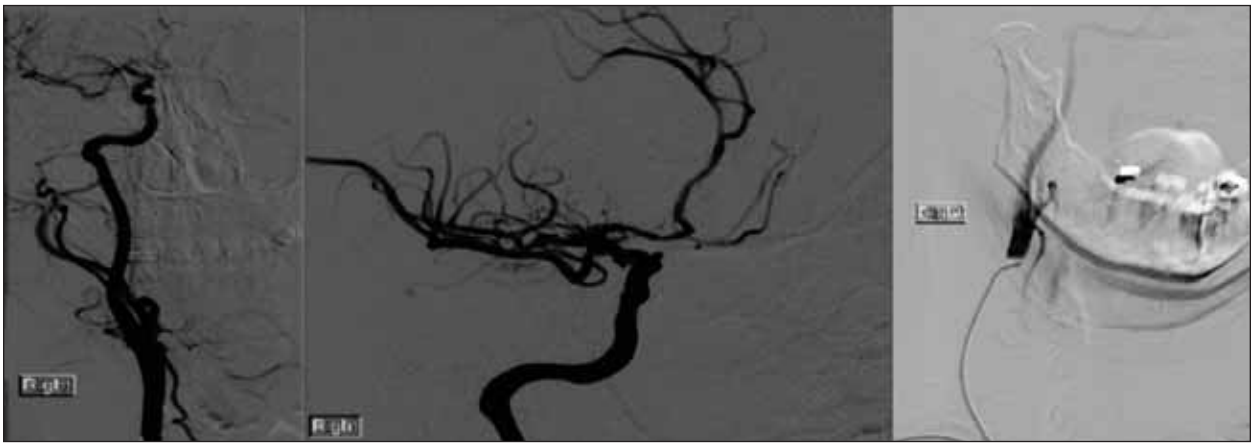

**Figure 2. Selective right ICA imaging from the right brachial approach showing no significant right internal carotid bulb stenosis and partially recanalized thrombus in the right middle cerebral artery distal to an early large inferior middle cerebral artery division artery.**

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.

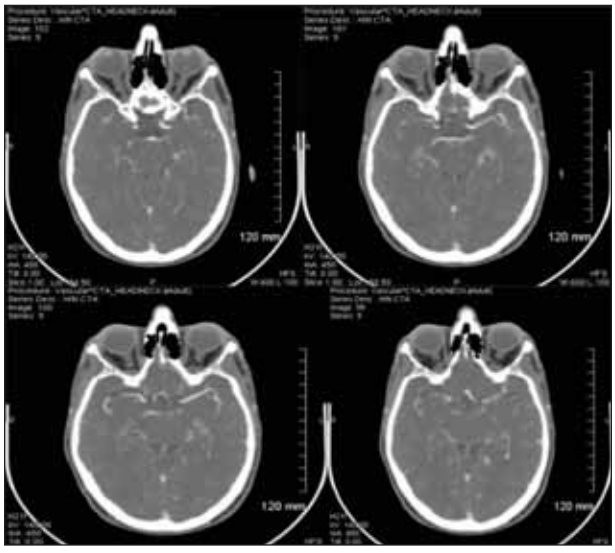

**Figure 3. Consecutive CT angiograms showing poor opacification of the right MCA branches consistent with an embolic/thrombotic event.**

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

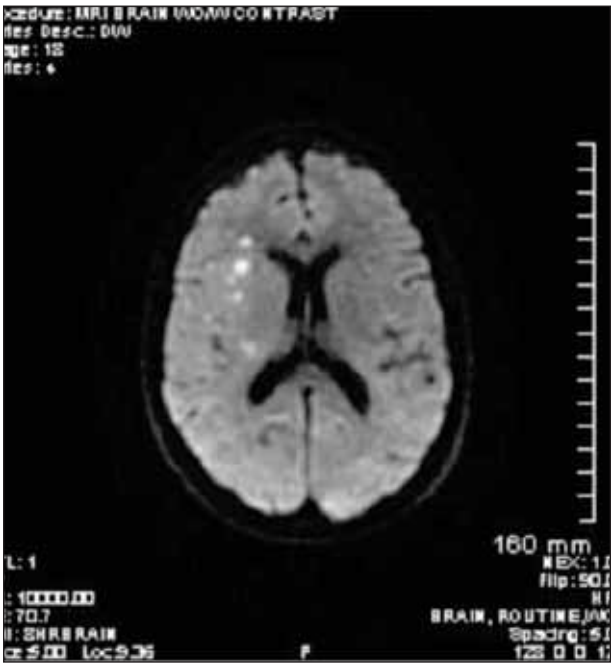


**Figure 4. MRI diffusion sequence showing the new infarcts in the right hemisphere centrum semiovale (frontoparietal lobe).**

procedure was demonstrated by Criado et al in their landmark article in 1996.[6] Other literature has cited spontaneous embolization events from innominate intervention, which certainly raises the possibility of embolization with intervention.[7,8] It is most likely that there have not been enough great vessel cases analyzed for firm recommendations. A large number of cases would be required to show this risk reduction. It is likely that a substantial number of events occur in the arch before treating the diseased arch vessel.[9]

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.[10-12] In European trials, including SPACE[13] and the more recently published ICSS,[14] 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.[15]

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.[16] In Hüttl's evaluation of 89 patients with innominate disease with five occlusions, only one cerebral embolic event occurred.[9] 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.[5]

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

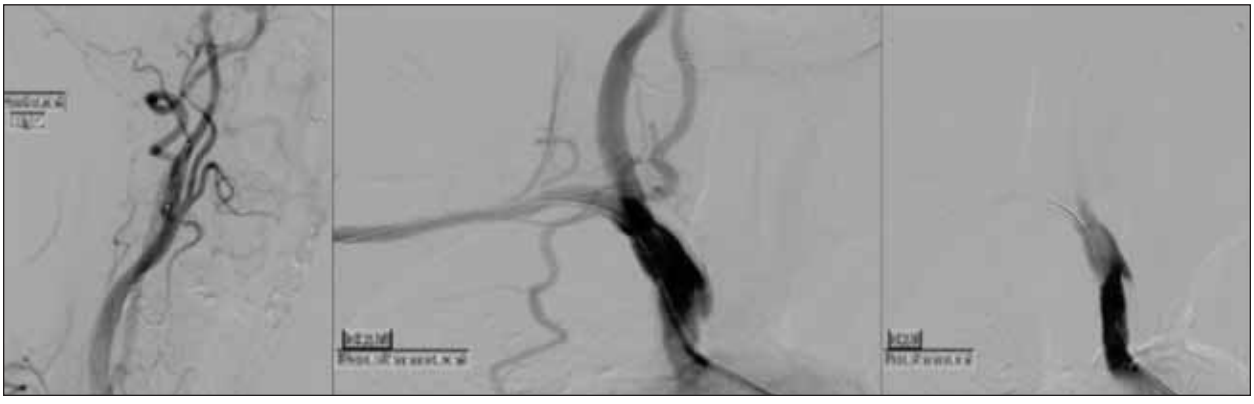

**Figure 5. Endovascular intervention images showing initial SpideRx wire in the right ICA via brachial approach, subsequent engagement of the innominate lesion with the sheath advanced partially across the lesion interrupting flow and final placement of an 8- X 38-mm iCast polytetrafluoroethylene-covered stent. The stent after covering the lesion was molded gradually and gently with a 10-mm X 4-cm Admiral balloon.**

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EPD should be evaluated and compared to surgical alternatives. It is noteworthy that even in vertebral artery lesions that have been previously believed to be safe to dilate without embolic protection, some investigators have demonstrated transcranial Doppler embolic events. Qureshi et al found distal embolism after vertebral artery stenting with ischemic complications and reported a 58% incidence of embolic signals with vertebral artery percutaneous transluminal angioplasty.[17]

There are now mounting cases in the literature that have demonstrated the feasibility and utility of EPD use in great vessel cases. Stiefel et al used dual EPDs in recanalization of an occluded innominate stent.[18] Although they did not report any debris in the EPD, they showed the feasibility and technique of EPD use in these cases.

The role of covered stents in preventing distal embolization is theoretical and debatable. In the saphenous vein graft coronary data, the first generation of covered stents resulted in a higher distal embolization rate presumably secondary to the larger size of the covered stents and greater frequency of predilatation causing distal embolization.[19] The significantly lower frequency of embolization with primary stenting without predilatation was demonstrated by Amor et al in their evaluation of subclavian artery lesions.[20]

The iCast stent is unique in that the profile is similar to uncovered stents secondary to the ultrathin polytetrafluoroethylene. In this case, the use of embolic protection and a covered stent to trap embolic debris was believed to be the best combination. The iCast stent has been used successfully to trap thrombus in a renal ostial stenosis containing thrombus.[21]

## CONCLUSION

With the advent of a newer generation of EPDs, the feasibility and utility of EPD use in multiple arch cerebrovascular interventions can now be accomplished and should likely become a first choice in higher-risk cerebrovascular arch interventions. Surgical distal protection of the carotid arteries is also a viable choice and should be implored whenever endovascular means are not feasible. The use of lower-profile covered stents in select cases to trap thrombus has demonstrated utility. 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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