Hybrid Procedures in the Treatment of Carotid Stenosis

A feasible technique applied to complex carotid plaque and anatomy.

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Indications for carotid intervention have long been established.[1,2] Most carotid atherosclerotic plaques develop near or at the carotid bifurcation, and carotid endarterectomy (CEA) remains the gold standard for addressing these lesions. With the improved safety of the procedure, carotid artery stenting (CAS) has become a viable alternative to CEA in a select group of patients.[3] Both treatment modalities have technical limitations. CEA exposure does not allow for treatment of the proximal common carotid artery (CCA) and skull base-level internal carotid artery (ICA) lesions, while angulated arch anatomy, tortuosity, or preocclusive lesions of the ICA reduce the technical feasibility of CAS. Hybrid approaches are increasingly used to address challenging carotid plaques. This article presents three cases that demonstrate expanded indications for carotid stenting as an adjunct to CEA.

CASE 1

Indication

A 45-year-old woman with ischemic cardiomyopathy and known bilateral carotid stenoses had progressed to a critical stenosis >95% on the left carotid artery. A CT angiogram (CTA) of the arch demonstrated a common take-off of the innominate and left common carotid arteries. The proximal third of the left ICA had a severe narrowing, transitioning to a mild stenosis in the middle third of the vessel.

Technique

A standard left CEA was performed. The plaque extended both distally and proximally. A distal clamp site was unable to be obtained, thus a number 4 Fogarty catheter (Edwards Lifesciences, Irvine, CA) was inserted for distal control. The plaque was removed well into the distal ICA as far as possible without mandibular subluxation. The arteriotomy was reconstructed with a Dacron patch. Given the extensive nature of the carotid plaque, an angiography was performed by accessing the lumen through the patch. The arteriogram demonstrated an intimal flap at the ICA endarterectomy endpoint (Figure 1A). Antegrade access

Figure 1. Angiography of the endarterectomized left carotid artery shows cephalad ICA intimal flap (A). Completion angiography shows no residual stenosis and a good distal endpoint (B).

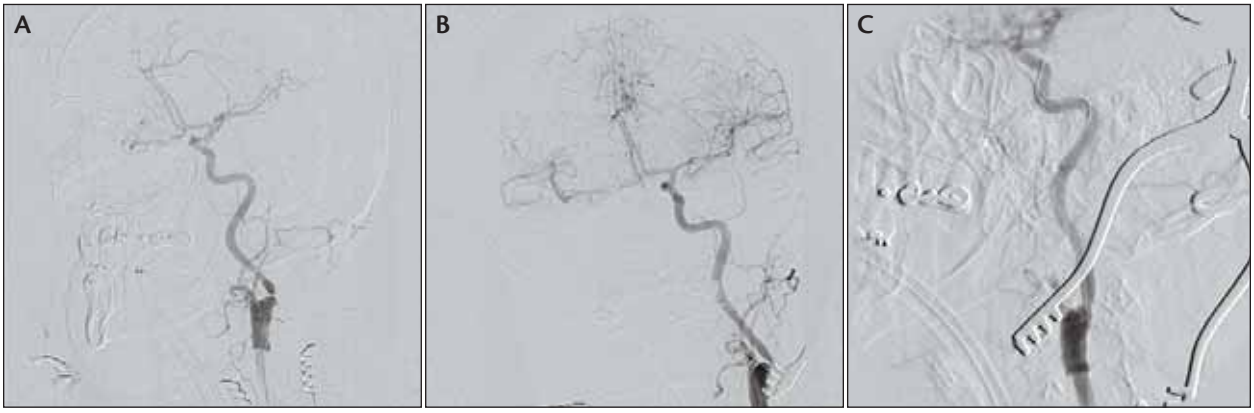

Figure 2. Postendarterectomy angiogram shows a kink at the ICA take-off (A). Despite the kink, bilateral cerebral filling is normal (B). Resolution of the vessel irregularity is seen on the completion angiogram (C).

was obtained through the patch. The flap was subsequently stented with a 5- X 15-mm Herculink stent (Abbott Vascular, Santa Clara, CA) distally. A completion angiogram showed no residual stenosis or flap (Figure 1B). The patient had uneventful postoperative recovery. She remains neurologically intact several months after the operation, and her left carotid artery is widely patent.

CASE 2

Indication

A 64-year-old woman with a stable small abdominal aortic aneurysm was found to have incidental carotid disease. Her right ICA was completely occluded, and a severe asymptomatic stenosis >90% was noted in the left ICA.

Technique

A standard left CEA was performed. The patient was shunted using an Argyle shunt (Covidien, Mansfield, MA) due to transient electroencephalogram (EEG) waveform slowing after the initial clamping. The ICA was tortuous, but successful CEA was performed without kinking. The patient had good distal ICA pulse at the end of the case.

Upon recovery from general anesthesia, the patient's neurological exam was notable for moderate aphasia and failure to move her right arm. The patient was emergently re-explored. There was a good palpable pulse in the ICA distal to the patch. However, a transpatch angiogram demonstrated a small filling defect at the distal aspect of the patch, corresponding to a small surface kink in the patch (Figure 2A). Given her previous EEG slowing and the new neurological changes, rather than reclamp the patient's carotid to surgically reconstruct the kink, an endovascular approach was used to allow continued perfusion. The proximal left CCA was then exposed by dividing the omohyoid muscle. The vessel was cannulated, and a 6-F sheath was introduced in an antegrade manner. A repeat angiogram again showed a small kink and filling defect in the distal aspect of the patch closure; however, cerebral filling was excellent (Figure 2B). A 6- to 8-mm X 30-mm nitinol Acculink stent (Abbott Vascular) was deployed spanning the distance from the CCA to the ICA.

On the completion angiogram, the patch kink had resolved, and the cerebral flow was excellent (Figure 2C). The sheath was removed, and the CCA was repaired. The patient had strong palpable pulses in the left CCA and ICA. Upon recovery from anesthesia, the patient was neurologically intact with normal right arm control and complete resolution of the aphasia. She had an unremarkable postoperative course. The patient remains asymptomatic, and there is no evidence of recurrent carotid plaque on the ultrasound after 1 year of close follow-up.

CASE 3

Indication

A 73-year-old woman presented with four episodes of amaurosis fugax in the right eye. A magnetic resonance angiogram and CTA, obtained at an outside hospital, showed severe bilateral ostial carotid disease and bilateral bifurcation stenoses >95%. Because the right side was symptomatic, we proceeded to intervene on that side.

Technique

A thoracic aortogram demonstrated that the left CCA was completely occluded without reconstitution distally (Figure 3A). The origin of the right CCA was severely narrowed with a >95% stenosis (Figure 3B). A critical stenosis >95% was also noted at the origin of the right ICA. A standard right CEA was performed. Before the patch placement, a 6-F sheath was introduced into the right CCA in a retrograde manner over a wire. An angiogram confirmed a critical stenosis at the CCA origin (Figure 3C). This lesion was crossed using a .035-inch Glidewire (Terumo Interventional

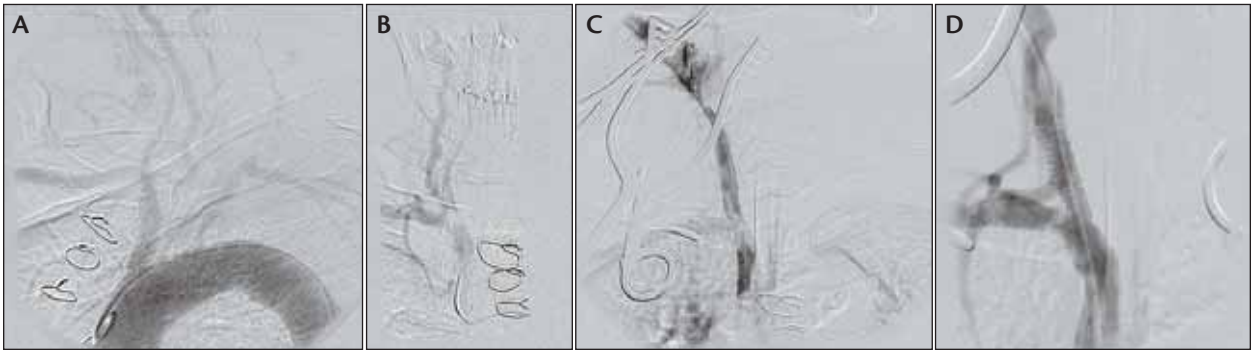

Figure 3. Arch angiography shows complete occlusion of the left CCA (A) and severe ostial stenosis of the right CCA (B). Retrograde angiogram confirms a severe stenosis of the proximal CCA (C). Completion angiogram demonstrates excellent proximal CCA flow and a patent right subclavian artery (D).

Systems, Somerset, NJ). Distal control of the carotid artery was achieved by clamping the vessel, and the lesion was predilated with a 5- X 20-mm balloon. A 7- X 27-mm Express stent (Boston Scientific Corporation, Natick, MA) was then deployed across the lesion. A completion angiogram showed no residual stenosis, and the right subclavian artery origin was intact after the procedure (Figure 3D). The carotid was then repaired with a Dacron patch. The patient was neurologically intact at the completion of the procedure, and she remains asymptomatic with a widely patent vessel after 6 months of follow-up.

DISCUSSION

CEA was first developed in 1954, and it has remained the gold standard for stroke prevention.[4] In experienced hands, CEA has a low risk of perioperative stroke; however, cardiopulmonary complications are not insignificant, particularly in high-risk patients. Percutaneous carotid treatment aims at reducing these complications. With the evolution of catheter technology, as well as the introduction of cerebral protection devices, CAS is gaining acceptance as an alternative treatment for carotid disease in a subset of patients.[3] However, open and endovascular techniques do not always have to be competing therapeutic modalities. Our experiences in other areas of vascular and endovascular surgery prove that incorporating both strategies can simplify an operative plan and reduce morbidity and mortality associated with a more involved operation. For instance, aortic debranching in the arch and abdomen has shown promise in the treatment of complex thoracoabdominal aortic aneurysms.[5-7] Furthermore, iliac and lower extremity angioplasty and stenting are often combined with open revascularization of the femoral artery.[8]

Recently, Tameo et al reported successful use of CAS to treat a difficult cephalad endarterectomy endpoint.[8] In our report, we describe a hybrid technique of CEA and CAS for three different problems: proximal CCA stenosis, carotid tortuosity, and the challenging distal ICA. Traditionally, very invasive approaches were used to treat these problems. Common carotid take-off could only be approached through a median sternotomy incision, occasionally requiring cardiopulmonary bypass. A tortuous carotid system was approached with a resection or plication of the vessels,[9,10] while access to the distal ICA plaque mandated a mandibular subluxation.[11] These techniques are associated with longer operative times and increased blood loss during the procedure, resulting in an overall greater morbidity and mortality for the patient. Instead, in our patients, we performed a standard CEA and then incorporated carotid angioplasty and stenting to target patient-specific CCA or ICA lesions using already-established carotid access. Excellent angiographic and clinical outcomes were achieved in all patients.

CONCLUSION

Combined or hybrid carotid procedures can offer an easier solution to a sometimes difficult technical problem. With CAS, we were able to treat a nonending distal plaque, severe carotid tortuosity, and a proximal CCA lesion. Thus, carotid angioplasty and stenting offers a valuable tool that should be considered during the preoperative planning for carotid endarterectomy, as well as at times of unanticipated intraoperative technical challenges. ■

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