Upper Extremity Approaches for Carotid Stenting

The utility of transradial and transbrachial access for difficult arch anatomy.

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Carotid artery stenting (CAS) has been shown to be an effective treatment modality in patients with carotid artery occlusive disease.[1-4] However, patients with complex aortic arch anatomy and octogenarians may be considered high risk, with increased stroke risk during CAS.[5-8] Schneider et al identified severe aortoiliac disease, unfavorable aortic arch configuration (type II or III), bovine arch anatomy, and supra-aortic vessel take-off as conditions rendering CAS more difficult.[9]

CAS is typically performed via a transfemoral approach, which has a short learning curve and is advantageous in that the femoral artery can accommodate larger-diameter devices. Although infrequent, there are femoral artery access site complications.[10,11] In addition, manipulation through the aortic arch can lead to increased embolic potential despite placement of an embolic protection device (EPD). An MRI-based study revealed that 40% of patients had evidence of cerebral embolization during transfemoral CAS.[12] Sixty percent of the cerebral infarcts were outside the vascular territory of the treated lesion, suggesting that the emboli originated from the aortic arch. An approach that minimizes catheter manipulation in the aortic arch could possibly reduce the risks of CAS in patients with complex aortic arch anatomy.

Upper extremity approaches have previously been shown to be acceptable for coronary occlusive disease.[13-16] Multiple large-volume studies have shown that complications from radial approaches have been incredibly low, while others have noted the benefits of both radial and brachial approaches specifically for CAS.[13,14,17-26] One study showed that upper extremity approaches are also valuable for vertebral interventions.[27] In particular, excellent results have been achieved with right brachial approaches in patients with left internal carotid artery (ICA) lesions and bovine arch anatomy,[17] and with transradial access in patients undergoing CAS with bovine and type III aortic arch anatomy. This was demonstrated at one institution in which contralateral transradial approaches were utilized to treat patients requiring CAS.[21]

METHODS

Our group employs CAS for patients who are considered to be at anatomic high risk for carotid endarterectomy (CEA). Most commonly, these patients have recurrent carotid lesions, a history of neck irradiation, high cervical lesions, or previous neck surgery. Typically, patients who are at physiologic high risk are treated with CEA under cervical block and sedation (our practice defines physiologic high risk as recent myocardial infarction, New York Heart Association class III/V angina, congestive heart failure, or oxygen-dependent chronic obstructive pulmonary disease). Our group utilizes upper extremity approaches for patients requiring CAS in the setting of a bovine and/or a type III aortic arch.

All patients are treated with clopidogrel for at least 5 days before the procedure. Brachial or radial approaches are used based on the operator's experience, as well as a preprocedural Allen's test. A SMAK micropuncture access set (Merit Medical Systems, Inc., South Jordan, UT) is used for brachial artery access, whereas a Glidesheath nitinol micropuncture set (Terumo Interventional Systems, Somerset, NJ) is utilized for radial artery access. Patients undergoing radial artery access have both verapamil (0.075–0.15 mg/kg) and nitroglycerin (100–200 µg for

CASE 1

A 72-year-old man presented with amaurosis fugax. Carotid duplex ultrasound showed a > 80% left ICA stenosis. CT angiography (CTA) confirmed a critical left ICA stenosis and revealed that the patient had a bovine aortic arch (Figure 1). Given that it was a high cervical lesion, the patient was taken for CAS from a right brachial approach. A micropuncture kit was used for access to the brachial artery at the antecubital fossa. A C2 catheter and 0.035-inch Glidewire were used to select the left CCA, followed by passage of a 0.035-inch Rosen wire (Figure 2). A 6-F shuttle sheath was then placed in the middle of the CCA. After placement of an Emboshield Nav6 EPD, a 6- X 30-mm RX Acculink stent was placed across the lesion and postdilated accordingly (Figure 3). Hemostasis was achieved via manual compression. The patient had an excellent angiographic result and tolerated the procedure well.

Figure 1. A CTA revealing a bovine aortic arch.

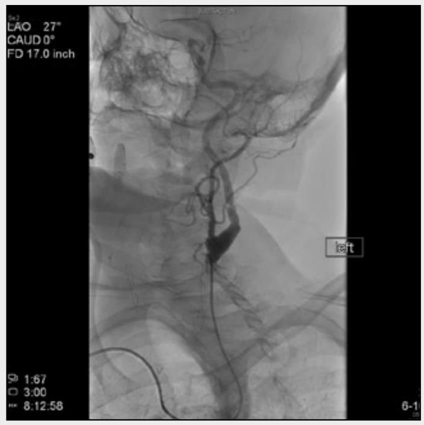

Figure 2. The left CCA was selected from a right brachial approach.

Figure 3. Placement of the RX Acculink stent.

a 70-kg patient) given as boluses through the sheath as antispasmodics. Anticoagulation during the procedure is achieved upon access to the target vessel with unfractionated heparin with the goal to keep the activated clotting time > 350 seconds.

The target common carotid artery (CCA) is initially cannulated using standard techniques; usually a Cobra C2 (Terumo Interventional Systems), H1 (Cook Medical, Bloomington, IN), or a Berenstein (Boston Scientific Corporation, Natick, MA) catheter is employed. A 0.035-inch Glidewire (Terumo Interventional Systems) is then used to position the catheter into the CCA or external carotid artery, depending on the anatomy. The Glidewire is then removed and replaced with a 0.035-inch Rosen wire (Cook Medical). At that point, the 5-F sheath is exchanged out for a 6-F shuttle sheath (Cook Medical) and advanced over the wire once the target CCA or external carotid artery is engaged.

Carotid stenting is then performed using standard techniques. Either an Emboshield Nav6 (Abbott Vascular, Santa Clara, CA) or Angioguard RX (Cordis Corporation, Bridgewater, NJ) EPD is used. The stents typically utilized are Precise Pro RX (Cordis Corporation), RX Acculink (Abbott Vascular), or Xact (Abbott Vascular). After stenting, a 4- or 4.5-mm balloon is usually used for postdilatation. Once the procedure is completed, the heparin is actively reversed with protamine sulfate. Manual pressure is applied for brachial access, and a TR Band assisted compression device (Terumo Interventional Systems) is used for radial access.

DISCUSSION

CAS has been shown to be noninferior to CEA in regard to both efficacy and patient safety.[2,6,8] We have a conservative approach when using CAS, choosing only to proceed with this treatment modality in patients who are deemed to be at anatomical high risk (patients having recurrent carotid lesions, a history of neck irradiation, high cervical lesions, or prior neck surgery). We perform CEA under cervical block and sedation in patients who are at physiological high risk. We use two imaging modalities in patients being considered for CAS: duplex ultrasonography and CTA are used preoperatively for both confirmation and case-planning purposes. Previous studies have shown the utility of preoperative CTA for CAS as well.[17,19,22]

Transfemoral approaches have been shown to be very efficacious and are the preferred method if feasible.[2,6,8] However, transfemoral CAS may be difficult in patients with bovine and type III aortic arches.[9] Studies have shown that manipulation of the aortic arch may lead to increased risk of stroke in both cerebral hemispheres.[12]

In our experience, CAS from upper extremity approaches can be performed safely and is effective in

CASE 2

A 78-year-old woman presented after suffering a right hemispheric transient ischemic attack manifested by left upper extremity weakness. Previous surgeries included a right neck rotational flap for ocular carcinoma. Carotid duplex ultrasound showed a 70% stenosis. In addition, a type III aortic arch was identified by a transfemoral angiography (Figure 4), which was performed at an outside hospital by the referring physician. A Glidesheath nitinol micropuncture set was used to access the right radial artery. Nitroglycerin and verapamil were given intra-arterially. A Berenstein catheter was used to access the right external carotid artery, followed by passage of a Rosen wire (Figure 5). A shuttle sheath was placed, followed by an Emboshield Nav6 EPD (Figure 6). An Xact stent was then placed to treat the stenosis. A good angiographic and clinical result was achieved (Figure 7).

Figure 4. Transfemoral angiogram showing a type III aortic arch.

Figure 5. Placement of the Rosen wire into the right external carotid artery from a right radial approach.

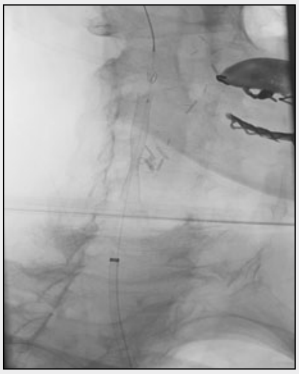

Figure 6. Placement of the Nav6 EPD from an ipsilateral radial approach.

Figure 7. A completion angiogram after right CAS from a right radial approach.

CASE 3

A 75-year-old man presented with critical, recurrent left ICA stenosis 8 years after previous left CEA. Carotid duplex ultrasound measured a peak systolic velocity in the left ICA at 470 cm/s. CTA confirmed a critical left ICA stenosis and an 80% ostial left CCA stenosis with a type III aortic arch (Figure 8). He had a left common carotid-to-subclavian bypass graft several years ago for a symptomatic left subclavian artery occlusion. The patient was taken for combined left CCA and left ICA stenting via a left brachial approach. After left brachial access and sheath placement was performed using the previously described techniques, a Nav6 EPD was placed into the distal left ICA (Figure 9). The ostial lesion was considered critical because it was > 80% and represented the in-flow for both the left ICA and the left carotid subclavian bypass. The ostial left common carotid lesion was addressed first and treated with a balloon-expandable stent (Figure 10). The EPD was left deployed, and an Xact stent was deployed to treat the recurrent left ICA disease (Figure 11).

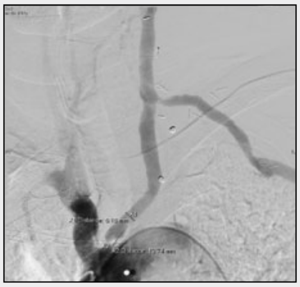

Figure 8. An angiogram depicting left ostial CCA stenosis with a type III aortic arch.

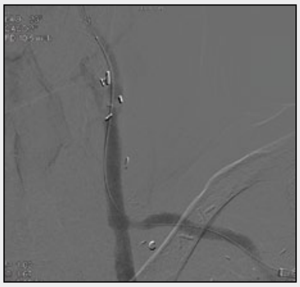

Figure 9. Placement of the left ICA Nav6 EPD from a left brachial approach across a previous left carotid-to-subclavian bypass.

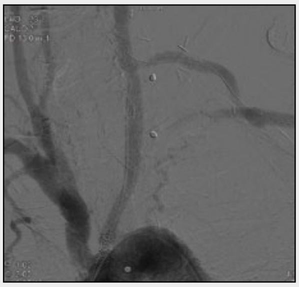

Figure 10. Balloon-expandable stenting of the left ostial CCA stenosis from a left brachial approach.

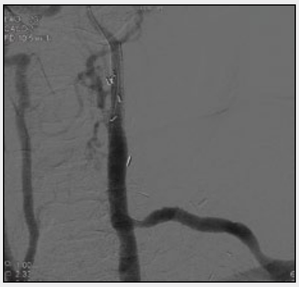

Figure 11. Left carotid bifurcation stenting from a left brachial approach across a previously performed left carotid-to-subclavian bypass.

treating both left- and right-sided carotid lesions in those patients with type III or bovine arch anatomy. These approaches are patient selective and considered only after a careful review of all imaging studies to determine suitability. We were fortunate that our patient with a left ICA lesion, an ostial CCA lesion, and a type III arch had a previous left carotid subclavian bypass graft, enabling left brachial access to the left ostial CCA. Alternative approaches for endovascular treatment in patients with a left ICA stenosis and a type III arch include direct cervical puncture or left CCA cutdown.

Our experience over the past 7 years has shown that utilizing upper extremity approaches for CAS is effective and safe. During this period, we have had no access site complications in our 17 CAS patients. We have found brachial and radial approaches to be helpful, although our preference is for radial access in patients whose anatomy is suitable. In our experience with both diagnostic and therapeutic angiograms, radial approaches have less complications than brachial approaches. In particular, we have seen less access vessel thrombosis and less hematoma formation when accessing the radial artery compared to the brachial artery. Dual blood supply to the hand and a complete palmar arch is always confirmed prior to radial access. A transradial approach with postprocedure placement of a TR Band for hemostasis allows for quicker ambulation, and complications with the site are minimal. The upper extremity approach minimizes arch manipulation and has the advantage of decreased access site complications.

Others have found it beneficial to approach CAS from a contralateral radial access.[21] We reserve the left radial access to treat left-sided lesions in patients with previous debranching procedures (eg, left common-to-subclavian bypasses, as this allows access to the ipsilateral ICA). We believe that by not crossing all three great vessels and having the least amount of arch manipulation possible, there should be decreased embolic events. In particular, we have found the right upper extremity approach to be beneficial in patients with right ICA or right CCA ostial lesions and a type III arch. We also employ a right upper extremity approach for left CCA and ICA lesions in the setting of a bovine arch. In the setting of a bovine arch, left-sided lesions should be preferentially treated from the right upper extremity, as this limits arch manipulation and the inherent embolic risks. ■

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