An Alternative Technique for Complex Aortic Arch Access

Multiple guidewires provide stability for advancement of guide catheters, stent deployment, and filter recovery in cases when tortuosity and complex anatomy make conventional approaches difficult.

MATERIALS AND METHODS

In the last year, from a single institution, we retrospectively reviewed our last 44 patients, which involved 50 stented cervical carotid arteries. Demographics of the patient population included an average age of 72 with a high incidence of octogenarians (16 patients, 36%). Nineteen (43%) patients were female, 14 (32%) patients were symptomatic, and all were high risk. Cardiopulmonary disease was the most common risk factor followed by recent restenosed carotid endarterectomy (CEA) (Table 1).

We have encountered many patients with difficult aortic arch anatomies or complex anatomical factors that made many of the cases complicated. Although 21 (47%) patients had a type I arch, many had tortuous innominate arteries and CCAs, difficult and complex internal carotid artery (ICA) lesions, and complicated secondary bends in the distal ICA. Thirteen (30%) patients had type II arches, and 10 (27%) patients had type III arches (Table 2).

All patients had undergone either a diagnostic angiography or carotid CTA before the procedure in addition to a screening Doppler ultrasound. All patients received oral clopidogrel 75 mg at least 5 days before the procedure in addition to aspirin. A neurology consultation took place before and after procedure was completed.

Standard retrograde access was achieved with an 8-F sheath. Two modified telescope techniques were used with the 8-F guide catheter. The majority of cases,
which involved type I cases or other simple tortuosity and secondary bends, had a telescope technique with a coaxial diagnostic catheter. A 6.5-F JB1 catheter (Cook Medical, Bloomington, IN) over a .035-inch Wholey wire (Covidien, Hazelwood, MO) or with a 0.35-inch regular or stiff Glidewire (Terumo Interventional Systems, Somerset, NJ) was advanced to the origin of the innominate artery or left CCA.

Under road map guidance, the ECA or the distal common artery (proximal to the bulb) was selected by the guidewire, and the guide catheter and diagnostic catheter were used to coaxially advance the guide catheter safely into the CCA. The diagnostic catheter and .035-inch wire were then removed. With the 8-F guide catheter in the CCA, we often advance an accessory wire—a .014-inch wire with support, such as a BMW (Abbott Vascular), or a hydrophilic wire, such as a PT2 (Boston Scientific Corporation, Natick, MA)—into the ECA. Care was taken with the use of hydrophilic wires to ensure the risk of dissection or perforation of the ECA branches.

Because many of the .014-inch wires had a similar color as the filter wires, we placed a towel or gauze through the proximal end of the wire. With the accessory .014-inch wire in the ECA, we performed conventional filter wire passage and deployment in the ICA, followed by stenting, balloon dilatation, and filter recovery. In most cases, the accessory wire was left in the ECA until after the filter was removed. We used the Abbott Vascular (formerly Guidant) Accunet 5.5- or 6-mm filter and the Acculink tapered or straight 30- or 40-mm stents for nearly all of the cases.

In a subset of patients with severe tortuosity, such as level III aortic aches with a deep-set takeoff from the innominate or left CCAs, as well as those with severe redundancy of CCAs and ICAs, we employed a modified technique with several wires (Figure 1). With the coaxial 6.5-F diagnostic catheter in the 8-F guide catheter, both were advanced to the origin of the ICA or left CCA. After removal of the wire and diagnostic catheter, road map injection revealed the carotid bifurcation. Frequently, we first advanced a .014-inch PT2 into the ECA followed by a second .014- or .035-inch
Glidewire into the ECA for added support. This allowed the telescoping technique of the 8-F guide catheter into the CCA. With the guide established in the CCA, one .014-inch wire was left in the ECA for support during the case. As before, a filter wire was used to cross the lesion. If needed, the lesion was predilated, and then stenting and postdilation were performed. Only after the distal protection device was recovered would the wire in the ECA be retrieved. Completion cervical and cerebral angiograms were then obtained.

RESULTS

Using either of the two techniques described, we were successful in carotid stent placement in 44 patients (50 vessels). In the 43 of the 50 cases, the coaxial guiding catheter technique with the accessory wire in the CCA or ECA worked safely to allow coaxial advancement of the guide catheter safely into the CCA. The accessory .014-inch wire in the ECA was used in 39 of these 43 cases; in 4 cases, the ECA or distal CCA was diseased, and this accessory wire could not be used. The accessory wire was then removed without incident after filter recovery. During the use of the Xact Carotid Stent (Abbott Vascular), the accessory wire had to be removed due to the inability to inject contrast during stent placement. In two cases, a .014-inch buddy wire had to be advanced past the ICA stenosis to allow for advancement of the filter; the buddy wires were then removed before stent advancement.

In seven of the 50 cases, patients had markedly difficult aortic arch access (Table 3). One patient presented with Leriche syndrome (abdominal aortic occlusion) requiring a brachial approach. A medium-length (55 cm) 6-F Pinnacle Destination sheath (Terumo Interventional Systems) was placed (Figure 2) into the brachial artery. However, because of redundant and tortuous innominate and right CCA, two wires were left in the ECA, and the sheath could only be advanced to the origin of the right CCA. Two .014-inch wires were left in place in the ECA, and a filter, balloons, and a stent were then used. Contrast could not be injected through the 6-F sheath in this case while the stent was being deployed.

In the remaining six cases in the subset of difficult arch anatomy, we successfully used the multiple guidewires in the ECA to allow advancement of the guide catheter into the CCA.

There was one minor stroke in the group of the 44 patients either immediately after or within 30 days after the procedure. One patient who had an ECA larger than his ICA experienced a probable embolic event to the facial or lingual artery, relating some numbness to the upper lip immediately after the procedure until the next morning, when it mostly resolved. All of the patients except two have been followed, and there has been only one patient with angiographic stenosis 30% to 50% as documented by ultrasound and CTA. There have been no neurologic sequelae during the 6- to 12-month follow-up period.

DISCUSSION

When we first started performing carotid stenting in the 1990s, we traditionally used diagnostic catheters to select the ECA with torquable .035-inch guidewires to allow the placement of stiff .035-inch wires; these stiff wires then allowed the advancement of guide catheters or long sheaths into the CCA. However, as shown in this series, alternative methods may be useful to incorporate into practice, or the operator should at least be familiar with these should they be needed.

Yadav et al introduced the use of a telescope technique using a long diagnostic catheter within the guide

### TABLE 3. SUBGROUP FACTORS

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age</th>
<th>Risk Factors</th>
<th>Arch</th>
<th>Other Factors</th>
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<tbody>
<tr>
<td>1</td>
<td>72</td>
<td>Symptomatic, Leriche syndrome, CEA, CHF</td>
<td>I</td>
<td>Tandem lesions, complex</td>
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<td>2</td>
<td>68</td>
<td>III</td>
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<td>Secondary bend</td>
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<td>III</td>
<td>II</td>
<td>Tortuous innominate/CCA</td>
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catheter to gain access into the CCA. There were several benefits in using this technique. First, a .035-inch wire never crossed into the bulb and into the ECA, which may reduce embolic events. Second, fewer exchanges were required, saving time, decreasing blood loss, and avoiding the use of the heavy .035-inch wire across the origin of the great vessels. In 43 of our 50 cases with minimal or moderate anatomical complexity, we found this modified technique quick and efficient. The 6.5-F catheter loaded coaxially within the guide catheter was easy to manipulate to help select the CCA with a torquable wire and allowed the guide catheter to be easily advanced in a telescope fashion.

It cannot be emphasized enough how important it is to minimize manipulation within the aortic arch. Pinero et al in their MRI diffusion study of postembolic events found 17.9% of the total 32.1% embolic events to have occurred in contralateral middle cerebral artery and posterior fossa. Similarly, du Mesnil de Rochemont et al found that new punctate diffusion-weighted imaging lesions with a median diameter of 2 mm were detected in 14 of 50 cases in the territory of the stented ICA and in seven of 50 cases in other vascular territories. Also, in the CAPTURE study, 22% of the total neurologic events occurred in the contralateral circulation. These high rates of events in the contralateral circulation are particularly alarming; they are due in part to aggressive manipulation of catheters and sheaths in the aortic arch and the great vessels.

The risk for aortic arch-related embolic events has been especially true for octogenarians, who have been found to have more of a complex aortic arch. Setacci et al found that of the 144 elderly patients in their study, 46% had type III arches compared to 23% in the general study, and that the elderly had a high incidence of complex plaque morphology.

If the lesion and the CCA appear too difficult to gain safe access, then these patients should be referred to vascular surgery for a CEA. In the seven complex carotid cases we encountered, we chose a modified technique, with the guide catheter parked at the ostium, allowing the selection of the ECA with a .014- or .035-inch guidewire with the subsequent advancement of the guiding catheter. Risks associated with this technique involve advancing a guide catheter into the CCA without a dilatator or 6-F catheter to protect the distal tip from "snow plowing" the vessel intima. The two wires should help to keep the guide catheter's edge off of the wall, but the risk of disruption persists. Also, there is a risk of dislodging embolic debris during manipulations of the guidewires near the bifurcation.

Of the seven cases with complex anatomy, all were high-surgical-risk patients. One of the patients had aortic occlusion requiring a right brachial approach. The other six were patients with deep-set type II (three patients) or type III (three patients) aortic arch with tortuous common carotid arteries. One of the patients had a left carotid artery with bovine anatomy. Three of the patients were over age 80, and three were symptomatic.
It is beyond the scope of this article to assess the use of 8-F guide catheters versus the newer 6- or 7-F carotid sheaths (Shuttle Select, Cook Medical). We have used both and have found merits with each system. However, with complex anatomy, we have found benefit with the guide catheters in allowing the operator the ability to torque the guide catheter to gain access across tight and tortuous lesions, as well as the ability to recover filters more safely in patients who received open-cell stents and who cannot bend or rotate their necks.

There have been previous articles regarding the use of dual wires for intracranial neurointervention, as well as the use of buddy wires to gain access through ICA lesions. There has also been discussion of the dual-wire technique in ostial CCA lesions in recent meetings by Joye et al, but little publication.

We employed the accessory .014-inch wire in the ECA in most of the 50 cases without sequelae. We believe the accessory wire in the ECA was beneficial for the procedure. The accessory wire provided support for the delivery and deployment of the stent, as well as for recovery of the filter. Although difficult to quantify, we believe the accessory wire had provided more accurate deployment of the self-expandable stent in comparison of previous stent cases in which a single wire was used. Risk with the accessory wire in the ECA would include...
vessel perforation or dissection, as well as a disastrous deployment of a stent into the ECA.

This article has several major limitations in being a retrospective analysis of consecutive patients, as well as being from primarily a single institution with only 44 patients. However, it suggests an alternative telescope technique with the use of a guide catheter instead of customary sheath for routine access. This article also reveals another issue that may be of importance in the future: We may be able to park our guide catheter or sheath at the origin of the CCA without having to advance into the distal region and risk disrupting the plaque existing near the ostium. From there, with the stability of wires in the ECA, we could proceed with the stent placement under cerebral protection. However, factors that prevent this advancement include the length of the systems compared to the sheath and guide catheters. With sheaths measuring 100 to 110 cm and the stents measuring 135 cm, there is little extra length when starting at the base of the carotid artery. Secondly, the stability of embolic filters to support stent delivery and their own recoveries can be precarious at times.

**CONCLUSION**

We presented two unique methods to gain access into the CCA. The first is a modified telescope technique with a guiding and coaxial diagnostic catheter. The second was the use of a guiding catheter placed at the origin of tortuous, deep-set, and otherwise complicated innominate or left carotid arteries; by using one or two guidewires in a patent ECA, we can gain enough support to help advance our guide catheter into a more stable position. Although this analysis is limited by the small number of patients in the series, the two techniques described provide alternatives to gain and maintain safe access during carotid stenting. One .014-inch wire was left in the ECA during filter advancement, stent deployment, and filter removal.

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