Cerebral Protection During Retrograde Carotid Artery Stenting for Proximal Carotid Artery Stenosis
—Technical Note—

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Abstract

Carotid artery stenting for carotid bifurcation stenosis usually uses the transfemoral approach. However, in patients with proximal common carotid artery (CCA) stenosis, the guiding catheter is difficult to introduce into the narrow origin of the CCA without risking cerebral embolization before activation of the protection device. A technique of cerebral protection by internal carotid artery (ICA) clamping with or without simultaneous external carotid artery (ECA) clamping was used to treat patients with proximal CCA stenosis by the retrograde direct carotid approach. The carotid bifurcation was surgically exposed and retrograde catheterization was performed to approach the stenosis. The ICA was clamped during angioplasty and stenting to avoid cerebral embolization. The ECA was clamped simultaneously if any extracranial-intracranial anastomosis was present. None of five patients treated with this technique experienced ischemic complications attributable to this technique.

Key words: cerebral protection, common carotid artery stenosis, retrograde approach, stent

Introduction

Isolated proximal common carotid artery (CCA) stenosis without concomitant carotid bifurcation stenosis is relatively rare. Combined carotid endarterectomy and retrograde angioplasty or carotid artery stenting to treat mixed carotid bifurcation and proximal CCA stenosis has been reported, but carotid artery stenting for isolated proximal CCA stenosis has not been well described. We previously reported a case treated by the retrograde direct carotid approach. Since then we have successfully treated additional four cases by this technique. Therefore, we believe this technique is feasible and safe for isolated CCA stenosis.

Here we describe our technique of cerebral protection by internal carotid artery (ICA) clamping with or without simultaneous external carotid artery (ECA) clamping during carotid artery stenting for isolated proximal CCA stenosis. This method involves a cervical skin incision and retrograde direct carotid artery puncture.

Technique

Five (2.5%) of 202 patients with isolated proximal CCA stenosis underwent carotid artery stenting procedures by retrograde direct carotid artery puncture using a cervical skin incision at our institute between February 1999 and April 2006. The characteristics of these patients are summarized in Table 1. Three patients were symptomatic and two were asymptomatic. All patients received aspirin (100 mg/day) and ticlopidine (200 mg/day) for at least 3 days before undergoing the procedure. All treatments were performed under general anesthesia.

A 4F sheath was placed percutaneously in the femoral artery and a 4F diagnostic catheter was placed near the ostium of the affected CCA for intraoperative angiography. A 5-cm longitudinal skin incision was made anterior to the sternocleidomastoid muscle, and the distal CCA and the carotid bifurcation were exposed similarly to standard carotid endarterectomy. The distal CCA, ICA, and ECA were exposed and encircled with vessel tape. If bradycardia or hypotension occurred during carotid sinus manipulation, about 1 ml of 1% lidocaine was injected into the adventitia of the
Table 1 Characteristics of five patients treated by retrograde carotid angioplasty and stenting

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Symptom</th>
<th>Side of lesion</th>
<th>Stenosis (%)</th>
<th>Comorbidities</th>
<th>ICA occlusion time (min)</th>
<th>Complication</th>
<th>Follow up (mos)</th>
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<tr>
<td>1</td>
<td>49, F</td>
<td>infarction</td>
<td>lt</td>
<td>95</td>
<td>HT, DM</td>
<td>19</td>
<td>—</td>
<td>35</td>
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<tr>
<td>2</td>
<td>73, M</td>
<td>TIA</td>
<td>rt</td>
<td>90</td>
<td>HT, DM, HC</td>
<td>18</td>
<td>—</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>60, F</td>
<td>infarction</td>
<td>lt</td>
<td>90</td>
<td>HT, HC</td>
<td>20</td>
<td>—</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>69, F</td>
<td>asymptomatic</td>
<td>lt</td>
<td>85</td>
<td>HT</td>
<td>16</td>
<td>—</td>
<td>9</td>
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<tr>
<td>5</td>
<td>53, F</td>
<td>asymptomatic</td>
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<td>90</td>
<td>aortitis</td>
<td>18</td>
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Fig. 1 Intraoperative photograph showing retrograde cannulation of a 7F sheath into the common carotid artery. The asterisk identifies the clamped internal carotid artery.

carotid bifurcation to block the baroreceptor mechanism. An 18-gauge needle was introduced retrogradely into the CCA near the carotid bifurcation and a 5.5 cm-long 7F Britetip sheath (Cordis, Miami Lakes, Fla., U.S.A.) was carefully placed at the distal portion of the stenosis under fluoroscopic guidance (Fig. 1). A 6-0 polypropylene (Prolene*; Ethicon, Inc., Piscataway, N.J., U.S.A.) Z-stitch was placed around the entrance of the sheath to facilitate rapid hemostasis of the puncture site. Heparin (4000 U) was administered by intravenous bolus after placement of the sheath into the CCA.

After ICA clamping, angiography was performed using the side arm of the 7F sheath to assess the extracranial-intracranial anastomosis. If collateral pathways were present from the ECA to the ICA, the ECA was clamped proximal to the ostium of the occipital artery to flush debris into the superior thyroid artery. Using road-mapping, a 0.014-inch 200 cm long guidewire was advanced through the stenosis into the descending aortic arch. The stenosis was predilated with a balloon of 4–6 mm diameter in accordance with the vessel diameter. The balloon was inflated for 30 seconds at a pressure of 6–8 atm. A Wallstent (Boston Scientific Corp., Natik, Mass., U.S.A.) was applied, which was sized according to an estimation of the CCA diameter. Postdilation was not performed if the residual stenosis was less than 20%. In all cases, the shaft of the balloon catheter was 90 cm long and the stent system was 75 cm long. Angiography was performed to confirm that the lesion had been treated satisfactorily. The CCA and ECA were then clamped and the 7F sheath removed. Upon release of the ICA clamp, debris was flushed out through the puncture site, which was then repaired with the previously placed Z-stitch. The skin was closed with 4-0 vicryl and nylon sutures. After completion of the carotid artery stenting procedure, heparinization was not reversed but allowed to disappear spontaneously.

All procedures were carried out successfully (Fig. 2). The average overall ICA occlusion time was 18.2 minutes (Table 1). None of the patients developed new ischemic symptoms, complications attributable to the technique including neck hematoma and nerve injury, or new hyperintense areas on...
Cerebral Protection in CCA Stenting

Discussion

The transfemoral approach may not be feasible for carotid artery stenting for proximal CCA stenosis, because introduction of a large-caliber guiding catheter into the narrow origin of the CCA is technically difficult and carries the risk of cerebral embolization before activation of the protection device.\(^4,5,7\) In addition, the distance between the lesion and the aortic arch is too short to obtain sufficient stability and support of the guiding sheath, and there is a risk for stent migration into the aorta.\(^2,7\) The optimal distance between the aortic arch and CCA stenosis is difficult to determine, so the transfemoral approach should be avoided. We performed the retrograde direct carotid approach in cases with instability of the catheter placed proximal to the stenosis during preoperative diagnostic angiography. This approach provides stability of the guiding sheath, requires less time for catheter positioning, and shortens the access route to the lesion.

The 5-cm skin incision is relatively large, but is necessary for adequate exposure of the ICA, ECA, and CCA. Exposing these arteries allows clamping of the ICA to prevent embolism migration and allows flushing of debris into the ECA territory. The presence of collateral pathways to the ICA, such as the internal maxillary, ophthalmic, middle meningeal, and occipital arteries, carries the risk of cerebral embolism when debris is flushed to the ECA, so these dangerous collateral pathways should be carefully evaluated after ICA clamping. In the presence of such anastomoses, the ECA should be clamped proximal to the ostium of the occipital artery and debris should be flushed into the superior thyroid artery.

Another advantage of this technique is definite and quick hemostasis of the puncture site by suturing. We believe that our technique of cerebral protection is safe and effective in carotid artery stenting with cervical skin incision and retrograde direct carotid artery puncture to treat patients with isolated proximal CCA stenosis.

References


Commentary

This is certainly a very useful technique that adds to the armamentarium of endovascular interventionalists in cooperation with neurosurgeons and obviously increases the safety for their patients. The fact that only 2.5 percent of all patients treated for carotid artery stenosis have been selected by the authors demonstrates how strictly we handle the indication for this combined procedure with cerebral protection by temporary internal carotid artery clamping. Its success in five patients suffering from isolated proximal carotid artery stenosis may encourage others to use the same method likewise in strictly selected cases.

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The authors describe an interesting approach to stenting of the proximal CCA retrogradely from the carotid bifurcation, avoiding both the difficulty of a proximal approach and the risk of distal embolization. Five patients were treated successfully without ischemic or other complications. As noted, this was only a small proportion of a large group of 202 patients with isolated proximal CCA stenosis — the cases were selected when prior diagnostic angiography had shown instability of the catheter proximal to the stenosis, with a risk of proximal migration of the stent or of embolization of debris. Presumably it had proved possible to treat the other 197 by a standard transfemoral approach.

Although an open approach is necessary for this procedure, the technique appears safe in expert hands, and should prove useful for this small but significant group of patients with isolated severe proximal common carotid stenosis.

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This is a technical case report on the cerebral protection during retrograde carotid artery stenting for proximal carotid artery stenosis. The authors performed the retrograde direct carotid approach in patients with instability of the catheter placed proximal to the stenosis on the diagnostic angiography. Clamping of the ICA followed by clamping of the ECA proximal to the ostium of the occipital artery in the presence of dangerous anastomosis between the ECA and ICA was reliable protection for cerebral embolization. Although it needs a cervical skin incision and retrograde direct carotid artery puncture, I think their technique is feasible and safe for isolated CCA stenosis.

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