Injury Of The Peripheral Cranial Nerves During Carotid Endarterectomy

Basil Theodotou, M.D., and M. S. Mahaley, Jr., M.D., Ph.D.

SUMMARY  The incidence of local nerve injury among 192 consecutive carotid endarterectomies in 162 patients between 1977–1983 was determined from review of the medical records. Two facial nerve, 5 hypoglossal nerve, and 2 vagus nerve injuries were discovered for a total incidence of 4.7%. Only the 2 facial nerve injuries failed to improve over 2 years. Followup ranged from 1 to 60 months in this group of patients. Careful attention to details of tissue dissection at surgery should lower the incidence of nerve injury during carotid endarterectomy.

MOST REPORTS CONCERNING carotid endarterectomy complications focus upon the most serious entities of stroke, death, and myocardial infarction. The incidence of cranial nerve palsy has been the primary focus of several previous studies.1,2,5 During a recent survey of carotid endarterectomies performed at North Carolina Memorial Hospital by the Division of Neurosurgery, attention was directed to the incidence of this complication.

Methods  The medical records of 162 consecutive patients undergoing carotid endarterectomies performed by the attending staff and residents of the Division of Neurosurgery at North Carolina Memorial Hospital between 1977–1983 were examined retrospectively. These 162 patients (57 female and 105 male), whose average age was 62.6 years, underwent 192 endarterectomies. The operative approach used, with minor variation, has been carefully described elsewhere.1 An intravascular shunt was used on 48.7% of the operations, its need determined by the observance of electrical slowing on intraoperative electroencephalogram or low internal carotid (“stump”) pressures or both following common carotid artery occlusion. The bifurcations of 9 carotid arteries were at the level of C4 or higher (4.6%). The occurrence and duration of dysfunction in cranial nerves was recorded during hospitalization and postoperative clinic visits. Cranial nerve dysfunction was defined as hoarseness or increased voice fatiguability (vagus nerve), tongue deviation on protrusion (hypoglossal nerve), and peri-oral facial weakness (facial nerve) lasting greater than 1 week.

Results  Of 192 endarterectomies reviewed, 9 occurrences of peripheral cranial nerve injury in 9 patients were found (4.6% incidence rate). This may underestimate the true incidence because of the retrospective nature of the study. Cranial nerve palsies included facial nerve in 2 cases, vagus nerve in 2 cases, and hypoglossal nerve in the remaining 5 cases, in 3 of whom an intraarterial shunt was used during the procedure. A high carotid bifurcation was present in 1 case each of facial and hypoglossal nerve dysfunction.

Clinical followup ranged from 1 to 60 months in all 9 patients. Hypoglossal nerve dysfunction had resolved in all 5 patients by 8 months. Both facial nerve injuries demonstrated persistent weakness 2 months and 2 years, respectively, after endarterectomy. Hoarseness resolved in 1 patient after 1 month; followup in the other case was inadequate to ascertain duration of dysfunction.

Discussion  The incidence of cranial nerve palsy in this series is low (see table 1). Hertzler, et al1 in a prospective study noted a 15.8% incidence in 240 operations. Thirty-five of 38 palsies resolved in 12 months. Massey, et al2 noted 2 of 5 persistent facial nerve and 4 of 13 persistent hypoglossal nerve dysfunctions persisting 1 year after endarterectomy in their series of 158 cases. Their overall complication rate was 16.4% and included 8 cases of vocal cord paralysis each of which recovered. In other studies, dysfunction of the hypoglossal nerve occurred in 5–17% of patients, and injury to the recurrent laryngeal nerve or the marginal mandibular branch of the facial nerve occurred in 1.5 to 2.3 percent.1,2,4,3

The marginal mandibular branch of the facial nerve, located between the platysma and deep cervical fascia after emerging from beneath the parotid gland, innervates the muscles of the lower lip and angle of the mouth. Positioning of the head away from the operative site may bring the branch lower into the superior neck, thus making the nerve more vulnerable to injury.3 Angling the superior portion of the incision posteriorly behind the ear helps to avoid facial nerve branch trauma during dissection. Drooping of the side of the mouth is usually only a cosmetic problem except when other additional or bilateral nerve palsies coexist. Careful postoperative examination may be needed to differentiate ipsilateral peripheral lower facial nerve palsy from a lower facial weakness caused by contralateral stroke, yet another potential complication during surgery on this group of patients.

Injury to the hypoglossal nerve was the most common in our series and those of others. After leaving the hypoglossal canal, this nerve is in a position parallel and posterior to the posterior belly of the digastric muscle. It then sweeps medially, crossing the external carotid artery to innervate the ipsilateral musculature of the tongue. A high position (C4 level) of the carotid bifurcation increases encounters with the hypoglossal nerve making proper retraction procedures necessary.1 Improper retraction or mobilization of the nerve results

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TABLE 1  Reports of Cranial Nerve Palsy Following Endarterectomy

<table>
<thead>
<tr>
<th>Author</th>
<th>Number of Endarterectomies</th>
<th>Number of Palsies</th>
<th>Number of Palsies by Cranial Nerve ( ) = Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massey, et al²</td>
<td>158</td>
<td>26 (16.4%)</td>
<td>Vagus (8) Hypoglossal (13) Facial (5)</td>
</tr>
<tr>
<td>Hertzer, et al¹</td>
<td>240</td>
<td>38 (15.8%)</td>
<td>Vagus (19 *) Hypoglossal (13) (9) (6 *)</td>
</tr>
<tr>
<td>Matsumoto, et al⁷</td>
<td>130</td>
<td>16 (12.3%)</td>
<td>Vagus (3) Hypoglossal (11) (11) (2)</td>
</tr>
<tr>
<td>Ranson, et al⁵</td>
<td>214</td>
<td>17 (7.9%)</td>
<td>Vagus (3 *) Hypoglossal (11 *) (3 *)</td>
</tr>
<tr>
<td>Theodotou and Mahaley</td>
<td>192</td>
<td>9 (4.6%)</td>
<td>Vagus (2) Hypoglossal (5) Facial (2)</td>
</tr>
</tbody>
</table>

*Not reported.

in ipsilateral deviation of the tongue which often contributes to dysarthria in the stroke patient. When surgical exposure necessitates more extensive mobilization of the hypoglossal nerve, sectioning of the descending hypoglossal branch to the ansa cervicalis and omohyoid, sternothyroid, and sternohyoid muscles can be performed with little morbidity. Likewise, the small sternocleidomastoid artery can restrict upward dissection but may be ligated and divided. Cephalad and medial retraction of the nerve with dull self retaining retractors placed with the blades parallel to the wound is recommended. Longitudinal retraction with self-retaining blades at both ends of the wound accounted for hypoglossal dysfunction in one of our patients.

Injury to either the vagus nerve or its branch, the recurrent laryngeal nerve, causes ipsilateral vocal cord paralysis with resultant hoarseness and easy voice fatigue. The vagus nerve is usually located posterior to the carotid artery. The nerve must be dissected free of the common carotid artery before vessel clamping.

One must also be aware of the anomalous lateral position occasionally seen. After branching from the vagus, the recurrent laryngeal nerve travels superiorly from the chest in the tracheoesophageal groove where it enters the larynx. Improper placement of retractor blades forcing the trachea and esophagus mediadly may place tension on the nerve. Bilateral injury with the risk of airway obstruction is at least one argument against bilateral single stage endarterectomies. The superior laryngeal nerve branches from the vagus near the superior thyroid artery, travels medially and innervates the cricothyroid muscle. This branch of the vagus nerve is subject to injury during dissection to control the thyroid artery, and dysfunction results in a weak voice and inability to tighten the vocal cords. Asking the patient to imitate a sustained upper register “e” will identify such injuries. Careful dissection of the thyroid artery should avoid the injury.

Intimate knowledge of local anatomy and careful surgical technique will lessen peripheral cranial nerve injury during carotid endarterectomy (fig. 1). Facial nerve injuries appear to be least likely to recover, hypoglossal nerve injuries the most frequent, and multiple injuries the most debilitating.

Acknowledgments
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References

FIGURE 1. The relationship of peripheral cranial nerves VII, X, XII to the carotid artery and its branches in the neck.
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