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CRANIAL NERVE INJURIES ASSOCIATED WITH CAROTID ENDARTERECTOMY

A Prospective Study

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Abstract. To determine the incidence and nature of cranial nerve damage in connection with carotid artery surgery, 139 patients were studied before and after 162 operations. Nerve damage was detected in association with 19.8% of the operations. The hypoglossal nerve was most commonly affected. The injuries were of benign character and usually resolved within 4 to 6 weeks. Apart from damage to the great auricular nerve, all lesions resolved within 5 months. The incidence of nerve disturbance was greater than that found in a retrospective study from the same hospital. Gentleness of technique is important in carotid artery surgery, in order to avoid nerve damage.

Key words: Carotid artery surgery, complications, cranial nerve injuries.

Peripheral injuries to cranial nerves in connection with carotid endarterectomy have been less frequently studied than have central nervous complications and mortality. Few systematic studies have been published, and reported rates of peripheral nerve injuries range from 4.7% in a retrospective study (17) to 39% in a prospective study (7). To investigate the true incidence of nerve injury associated with carotid artery surgery, we conducted a prospective study in the period 1982–1984.

PATIENTS AND METHODS

The study comprised 162 carotid artery operations performed on 139 patients. The indication for surgery was transient ischemic attacks or amaurosis fugax in 104 cases, partial nonprogressive stroke in 40 and asymptomatic lesion of the carotid artery in 18 cases. Two of the operations were performed on the external carotid artery and the remainder on the internal carotid artery. An indwelling shunt was used in 18 operations, when the stump pressure was below 50 mmHg. Reoperation was performed because of acute occlusion in four patients and for postoperative bleeding in ten. The operations were carried out in general anesthesia and normocapnia.

The patients were examined preoperatively and one week postoperatively at the Department of Phoniatrics. Voice recordings were made on each occasion, in addition to laryngoscopy and stroboscopic light examination of the vocal cords. The following nerves were evaluated (Table I): hypoglossal, glossopharyngeal, recurrent and superior laryngeal nerve, and the cervical sympathetic trunk. Functional defects were followed up until recovery, except for injury to the great auricular nerve.

RESULTS

No disturbance of nerve function was found preoperatively. Postoperative dysfunction of one nerve was found in 27 of the 139 patients, while two nerves were affected in four cases and three nerves in one case. The disturbances appeared after 32 (19.8%) of the 162 operations. Among the 14 patients with reoperation, four (28%) had nerve disturbance, and such complications appeared after 3 of the 18 operations done with use of shunt.

Type and incidence of nerve injuries (Table I)

Hypoglossal nerve. This nerve was injured at 17 operations, causing deviation of the tongue towards the affected side. The function was restored within 6 weeks in all but four of the patients, and the longest time of recovery was 5 months.

Vagal nerve. Transient damage to the recurrent laryngeal nerve occurred in five patients, with hoarseness and paralysis of a vocal cord. All recovered in 2–5 months. No defect of the superior laryngeal nerve function was found.

Glossopharyngeal nerve. In a patient with bilateral operation, uvular deviation from the treated side occurred after each operation and lasted for 6–8 weeks. This patient also had reversible hypoglossal nerve dysfunction after each operation.

Table I. *Cranial nerve injuries after 162 carotid artery operations*

Nerve	Symptom	No. of cases
Hypoglossal	Deviation of tongue to affected side	17
Recurrent laryngeal	Vocal cord in paramedian position, hoarseness	5
Superior laryngeal	Phonasthenia, loss of high-pitched tones	0
Glossopharyngeal	Swallowing difficulties, uvular deviation from affected side	2
Facial	Ipsilateral paralysis of lower lip	1
Great auricular	Anesthesia of ear lobe and/or cheek	11
Cervical sympathetic	Horner's syndrome	2
Total		38

Facial nerve. Ipsilateral paralysis of the lower lip appeared postoperatively in one patient, but subsided within a week.

Great auricular nerve. Nine patients had anesthesia of an ear lobe postoperatively. In a tenth patient both an ear lobe and the upper part of the cheek were affected, and in another only the cheek was involved. The time to recovery was not ascertained.

Cervical sympathetic trunk. One patient had Horner's syndrome postoperatively, lasting 2 months, and one had attacks of ipsilateral ptosis with similar duration.

Additional complications detected at the Department of Phoniatrics were vocal cord hematoma in three cases and intubation granuloma in one case.

DISCUSSION

The overall incidence of injuries to peripheral nerves in this prospective study was 19.8%, as compared with 12% in a retrospective study (unpublished) at the same hospital. Furthermore, of the five injuries to the recurrent laryngeal nerve in our series, only three were suspected by the ward surgeon. One of the 17 hypoglossal defects likewise was unnoticed by the surgeon. These and similar data from other clinics (9, 13) indicate that injuries to peripheral nerves in connection with carotid surgery are more common than was previously recognized. The only means of establishing the true incidence is to study a consecutive case series prospectively, with emphasis on a specialized phoniatric investigation. The peripheral nerve injuries have also been shown to be of benign nature, very seldom causing permanent deficit.

Several nerves may be damaged in carotid artery surgery. The hypoglossal nerve (19, 20) normally crosses anterior to and immediately above the carotid bifurcation, with the descending hypoglossal branch given off at the external carotid artery constituting the upper part of the ansa cervicalis. The descending hypoglossal branch occasionally has to be divided in order to mobilize the hypoglossal nerve. For optimal access, this division should be performed as near to the hypoglossal nerve as possible. It may be done without consequences. Because of the close connection between the hypoglossal nerve and the carotid bifurcation, this is the nerve most commonly affected in carotid surgery. In the present study the function of the hypoglossal nerve was disturbed in 10.5% of the operations. Other authors have given figures ranging from 4.7 to 20% (3, 5, 6, 7, 9, 13–18). Damage usually is caused by traction or pressure from hematoma, and recovery as a rule is complete within 6 weeks. Bilateral damage (2, 11) is a serious complication, which must be avoided. Symptoms of injury are deviation of the tongue to the affected side and difficulties in mastication and articulation.

The vagal nerve runs from the base of the skull between the internal jugular vein and the internal carotid artery on the dorsal aspect. As its position sometimes is anomalous, this nerve may be mistaken for the descending hypoglossal nerve. Fibers constituting the recurrent laryngeal nerve lie medially and can be damaged during operation or by pressure from hematoma. The incidence of vagal nerve damage in our series was 3.1%, and other authors have reported 0.5 to 24.6% (5, 7, 9, 13–16, 18, 21). Restitution of function usually is complete within 6 months, after which time further improvement is rarely seen (1). As bilateral damage can result in fatal airway obstruction (10), bilateral op-

eration should not be done in a single session. In sequential surgery, the state of the cranial nerves should be checked before the second operation. The superior laryngeal nerve (8) divides at the carotid bifurcation into an internal and an external branch. The external branch passes under and close to the superior thyroid artery towards the lower larynx. It can be damaged while passing a sling under the thyroid artery, resulting in vocal fatigue and loss of high-pitched tones due to malfunction of the cricothyroid muscle (4, 8). Other authors reported incidence of such damage ranging from 1.4 to 2.1% (3, 9), but there was no case in our series, although four patients had transient symptoms such as inability to sing, difficulty with high-pitched voice tones, inability to close the glottis completely and low-pitched, hoarse voice. Earlier authors (9) pointed out that some injuries to the vagal nerve and its branches are asymptomatic and their detection requires careful search. Laryngeal stroboscopy is a prerequisite for correct evaluation of vocal fold palsy (12).

The lowermost part of the facial nerve supplies the lip with motor fibers and can be damaged by traction or compression in holding of the upper medial margin of the skin incision. Injury rates in the literature range from 0.8 to 5.0% (3, 9, 13–16, 18), compared with 0.6% in the present series. The great auricular nerve emerges from behind the sternocleidomastoid muscle under the platysma towards the ear, and innervates the ear lobe and the skin of the upper part of the mandible. Injuries are commonly due to transection. In our series there was malfunction of this nerve after 6.8% of the operations, i.e. a somewhat lower incidence than in other reports, 7.5 to 16.5% (5, 13, 14).

The cervical sympathetic trunk, being located under a thin layer of fascia in a plane deep below the vagus nerve, is not ordinarily visualized during carotid endarterectomy. In our series there was one case of Horner's syndrome and one with more atypical manifestation, i.e. attacks of ptosis. This complication was found in 2.8% of cases in an earlier study (18).

Peripheral nerve damage can undoubtedly be minimized by gentleness in dissection. To avoid unnecessary dissection, the course should curve around the anterior margin of the sternomastoid muscle and proceed right down to the internal jugular vein, dissecting in an almost nonvascularized plane. The transversely crossing venous trunk (the faciolingual trunk) is identified and cut between ligatures. Beneath this structure the carotid artery is easily identified, usually at the lowermost portion of the bifurcation. The surrounding tissue should be carefully dissected away from the carotid vessels and the superior thyroid artery before these vessels are encircled with vessel loops.

The patient's head should not be turned too much away from the side of operation, since this will present the surgeon with distorted anatomy and expose the motor branch of the facial nerve to danger. All handling of the tissues must be gentle, and the hypoglossal nerve should never be deliberately stretched. Conscious avoidance of nerve disturbance may lead to improved results.

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