Cranial nerve injuries and the retrojugular approach in carotid endarterectomy

WILLIAM D BEASLEY, CHRISTOPHER P GIBBONS

Department of Vascular Surgery, Morriston Hospital, Swansea, UK

ABSTRACT

INTRODUCTION This is a retrospective case series analysis to compare the incidence of cranial nerve injuries in carotid endarterectomy by the retrojugular and anteromedial approaches.

PATIENTS AND METHODS Data were extracted from a prospectively collected database. Ninety-one retrojugular carotid endarterectomies were compared with 145 anteromedial carotid endarterectomies. All were performed under local anaesthesia and used the eversion technique. Data were analysed using the chi-squared test.

RESULTS Nine (3.8%) cases were complicated by cranial nerve injuries. In four cases, multiple nerves were involved. In total, 13 (5.5%) cranial nerves were injured. The affected nerves were: two (0.8%) marginal mandibular, two (0.8%) laryngeal, three (1.2%) accessory and six (2.5%) hypoglossal. There was no statistically significant difference in total or specific cranial nerve injuries between the two surgical approaches.

CONCLUSIONS The risk of cranial nerve injuries was similar following either the retrojugular or anteromedial approach. Accessory nerve injuries were only seen in the retrojugular approach but this did not reach statistical significance.

KEYWORDS

Carotid endarterectomy – Cranial nerve injury

CORRESPONDENCE TO

William D Beasley, Department of Vascular Surgery, Morriston Hospital, Swansea NHS Trust, Swansea SA6 6NL, UK
E: williamdbeasley@hotmail.com

In the ‘standard’ approach to the carotid bifurcation used in carotid endarterectomy, the dissection proceeds anteriorly and medial to the internal jugular vein. The facial vein requires division, allowing the jugular vein to be retracted laterally to expose the carotid bifurcation (Fig. 1).

The retrojugular approach was originally described to allow dissection through unscarred tissue for re-do surgery or to provide better exposure of the distal internal carotid artery in high lesions.¹ Here, the dissection proceeds behind the internal jugular vein, which is retracted anteriorly and medially to expose the carotid bifurcation. This avoids the facial vein and the small anterior branches of the internal jugular vein at the upper end of the incision (Fig. 2).

Recent reports have stimulated a resurgence of interest in the retrojugular approach, showing it to be safe and possibly faster than the anteromedial approach.^{2,5} However, concerns have been raised with regard to cranial nerve injury with the retrojugular approach,^{4,5} in particular, whether the accessory nerve may be prone to injury.

The aim of this study was to investigate whether the incidence of cranial nerve injuries associated with the

retrojugular approach was different from that of the anteromedial approach.

Patients and Methods

Study design

Data were obtained from a prospectively maintained database containing details of 461 carotid endarterectomies performed by or under the supervision of a single surgeon (CPG) over a 16-year period and were analysed retrospectively to determine the incidence of cranial nerve injury.

Patients

A total of 236 (164 males; 72 females; median age, 69 years; range, 43–85 years) primary carotid endarterectomies performed under local anaesthetic using the eversion technique were identified from the database of which 145 were performed via the anteromedial approach and 91 by the retrojugular approach. The choice of approach depended mainly on the date of surgery as the preference of

the operating surgeon changed from the anteromedial to a retrojugular approach during the series. Shunting was employed selectively according to the development of intra-operative neurological deficit.

Cranial nerve assessment

All patients underwent clinical cranial nerve examination pre- and postoperatively before discharge and at follow-up. All suspected laryngeal nerve injuries were investigated using indirect laryngoscopy and all clinically detected cranial nerve injuries had targeted follow-up until resolved.

Statistical analysis

The frequency of cranial nerve injury was compared between groups using the χ^2 test (MedCalc® software). *P*-values < 0.05 were taken as significant and all χ^2 tests were with one degree of freedom.

Results

Major outcomes

There were no significant differences in mortality, transient or permanent cerebral events, myocardial infarction or haematoma formation between the two groups (Table 1).

Cranial nerve injuries

Of 145 patients undergoing carotid endarterectomy by the anteromedial approach, three patients (2.1%) suffered a total of five cranial nerve injuries (Table 2). In contrast, six of 91 patients (6.6%) undergoing carotid endarterectomy by the retrojugular route suffered a total of eight cranial nerve injuries. This difference, however, was not significant (*P* = 0.16). All cranial nerve injuries were temporary. Accessory nerve injuries were only seen in the retrojugular group but this did not reach statistical significance.

Discussion

The incidence of cranial nerve injuries in this study is comparable with those in previous reports of 5.1–27%, with the majority of injuries temporary.^{6–10} A permanent cranial nerve injury incidence of 0.5% has been reported from the European Carotid Surgery Trial (ECST).¹⁰ The nerves most at risk of injury during carotid endarterectomy are the marginal mandibular branch of the facial (Vth) nerve, the laryngeal branches of the vagus (Xth) nerve and the hypoglossal (XIIth) nerve due to their close anatomical relationships to the carotid bifurcation. Most cranial nerve injuries probably result from stretching, retraction or clamping but they may also arise from the injudicious use of

Table 1 Major complications in patients undergoing carotid endarterectomy by the anteromedial or retrojugular approach

Complication	Anteromedial (n = 145)	Retrojugular (n = 91)	P-value
Death	1 (0.7%)	0	0.81
Myocardial infarction	0	1 (1.1%)	0.81
Permanent central neurological deficit	1 (0.7%)	0	0.81
Transient central neurological deficit	4 (2.8%)	2 (2.2%)	0.87
Haematoma	6 (4.2%)	1 (1.1%)	0.34

Table 2 Cranial nerve injuries in patients undergoing carotid endarterectomy by the anteromedial or retrojugular approach

Cranial nerve injury	Anteromedial (n = 145)	Retrojugular (n = 91)	P-value
Marginal mandibular (VII)	1 (0.7%)	1 (1.1%)	0.69
Laryngeal (X)	1 (0.7%)	1 (1.1%)	0.69
Accessory (XI)	0	3 (3.3%)	0.11
Hypoglossal (XII)	3 (2.1%)	3 (3.3%)	0.87
Total	5 (3.5%)	8 (8.8%)	0.14

diathermy or ligation for haemostasis. The hypoglossal nerve is the most commonly injured cranial nerve during carotid endarterectomy and is jeopardised by retraction at the top of the wound to improve access to high lesions. The marginal mandibular branch of the facial nerve is the next most frequently injured, usually due to mandibular retraction and is also at risk during cranial extension of the skin incision. The superior and recurrent laryngeal nerves are also at risk during control of the superior thyroid artery, dissection behind and clamping of the carotid artery.

Accessory nerve injury is a rare complication of carotid endarterectomy,^{11–15} with an incidence of 0.9% reported in the ECST.¹⁰ One possible mechanism of injury is lateral retraction of the sternocleidomastoid, thereby stretching the accessory nerve which pierces, and is adherent to, the muscle. The dissection in the retrojugular approach is more posterior and closer to the accessory nerve, rendering it at greater risk of injury. Although accessory nerve injuries were only seen in the retrojugular group in this study, this was not statistically significant. It would seem likely that this represents a type 2 error and a much larger sample would be required to reach statistical significance. Awareness of the potential for accessory nerve injury and knowledge of the mechanisms of injury should minimise risk. The few small studies published so far would also sup-

port the safety of the retrojugular technique^{2,5,14} claiming it to be faster and to have a superior exposure than the medial approach, particularly at the upper end of the internal carotid, with which we agree.

Cranial nerve injury is reported in all series of carotid endarterectomies but it is notable that the vast majority are temporary. Whilst carotid artery stenting avoids this complication, it has yet to be proven to be equivalent or better than carotid endarterectomy in randomised studies.¹⁵

Conclusions

The retrojugular technique does not appear to increase the risk of cranial nerve injury during carotid endarterectomy. However, in this relatively small study, accessory nerve injury was only seen in carotid endarterectomy performed by the retrojugular approach. A much larger series would be required to determine whether accessory nerve injury was a significant complication of the retrojugular route.

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