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Ekberg, Olle; Bergqvist, David; Takolander, Rabbe; Uddman, Rolf; Kitzing, Peter

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Pharyngeal Function After Carotid Endarterectomy

Olle Ekberg,[1] David Bergqvist,[2] Rabbe Takolander,[2] Rolf Uddman,[3] and Peter Kitzing[3]

Departments of [1] Diagnostic Radiology, [2] Surgery, and [3] Otorhinolaryngology, University of Lund, General Hospital, Malmo, Sweden

Abstract. Neurologic deficiencies, with special reference to pharyngeal function, were studied prospectively in 12 patients before and after they underwent carotid endarterectomy. Pharyngeal function was monitored with cineradiography. Five patients developed pharyngeal dysfunction: defective closure of the laryngeal vestibule, epiglottic dysmotility, and pharyngeal constrictor paresis 1 week postoperatively. In 2 patients this dysfunction remained, while in 3 it had resolved 4 weeks after the operation. Pharyngeal dysfunction was more common in patients with preoperative minor stroke and a temporary perioperative carotid shunt and in patients with a long operation time. The registered transient pharyngeal dysfunction may be due to manipulation of the cervical structures including the vagus nerve and the pharynx or due to cerebrovascular damage during the operation. Our findings support careful monitoring of postoperative oral feeding in patients at risk.

Key words: Pharynx – Endarterectomy carotid – Radiology, pharyngeal – Cineradiography, pharyngeal – Cranial nerves

Carotid endarterectomy is an established method of preventing cerebral embolism in patients with arteriosclerotic plaques in the carotid bifurcation. The incidence of iatrogenic injury to adjacent cranial nerves during carotid endarterectomy varies but has been reported to be as high as 28% [1]. However, with an increasing surgical experience and refined technique, the morbidity has been reduced and the rate of major neurologic postoperative complications is now less than 5%.

In our hospital the incidence of cranial nerve damage in connection with carotid endarterectomy has been reported to be 20% [2]. This has been reversible in all cases [3]. Similar frequencies have been found in other series [1–8]. Although cranial nerve injury occurs frequently, clinical symptoms of pharyngeal dysfunction are often vague and may therefore be underestimated. An objective and sensitive method is necessary to study pharyngeal function and cineradiography during barium swallow is one such method [10].

The aim of this study was to monitor prospectively pharyngeal function before and after carotid endarterectomy to determine if pharyngeal function deteriorated after the surgical procedure.

Material and Methods

A total of 12 patients were included in this study: 8 men and 4 women aged between 43 and 64 years (median, 56). Indications for surgery were minor stroke (7 patients), amaurosis fugax (transient blindness; 4 patients), and transient ischemic attack (TIA) (1 patient). The clinicoradiologic data are summarized in Table 1.

Cineradiography was performed using a 35 mm technique and 50 frames/s film speed while patients swallowed thin liquid barium. All patients were examined in a sitting position with at least 2 lateral and 2 anteroposterior (AP) projections. The patients were asked to hold a "somewhat too large bolus" in the mouth and then swallow on command. The cineradiograms were assessed for the following pharyngeal functions: elevation of pharynx and larynx, closure of the laryngeal vestibule, tilting down of the epiglottis, closing of the nasopharynx, pharyngeal constrictor activity, and opening of the pharyngoesophageal segment. Cineradiograms were obtained preoperatively as well as 1 and 4 weeks postoperatively.

All operations were performed as an endarterectomy of the internal carotid artery. A temporary carotid shunt (Pruitt-Inahara) was used in 4 of the patients who had sustained a minor stroke.

Address reprint requests to: Olle Ekberg, M.D., Department of Radiology, Hospital of the University of Pennsylvania, 3400 Spruce Street, Philadelphia, PA 19104, USA

Table 1. Pre- and postoperative findings in 12 patients undergoing carotid endarterectomy

Patient no.	Sex/age	Preoperative neurologic findings and indications for operation	Preoperative pharyngeal function	Operation time (min)	Clamping of carotid artery (min)	Postoperative neurologic deficit	Pharyngeal function 1 week postoperatively	Pharyngeal function 4 weeks postoperatively
1	M/49	TIA	Normal	69	18	Hypoglossus paresis	Penetration	Normal
2	F/55	AF	Normal	92	23	0	Penetration	Penetration
3	F/62	AF	Normal	90	48	0	Normal	Normal
4	M/62	AF	Normal	88	37	0	Normal	Normal
5	F/40	AF	Normal	68	18	Facial paresis	Normal	Normal
6	M/67	Minor stroke	Normal	89	19	0	Normal	Normal
7	M/46	Weakness in one hand; minor stroke	Normal	125	41	0	Normal	Normal
8	M/49	Deficient sensitivity in one hand; minor stroke	Normal	140	5 sh	0	Penetration constrictor paresis	Penetration constrictor paresis
9	F/67	Weakness in one hand; minor stroke	Normal	83	4 sh	Status quo ante	Normal	Normal
10	M/67	Weakness in one hand; minor stroke	Normal	110	6 sh	Status quo ante	Epiglottic dysmotility	Normal
11	M/62	Weakness in one hand; minor stroke	Normal	97	6 sh	Hypoglossus paresis	Penetration; epiglottic dysmotility	Normal
12	M/52	Weakness in one arm and leg; minor stroke	Normal	70	14	Normal	Normal	Normal

Penetration refers to defective closure of the laryngeal vestibule. AF, amaurosis fugax; TIA, transient ischemic attack; sh, temporary carotid shunt.

The patients were examined pre- and postoperatively for evaluation of cranial nerve function including hypoglossal, glossopharyngeal, recurrent and superior laryngeal nerve, and cervical sympathetic trunk. Differences in frequencies were tested by chi-square test with Yate's corrections.

Results

All 12 patients had normal preoperative pharyngeal function. After undergoing carotid endarterectomy, seven patients had normal function at both 1 and 4 weeks. One week postoperatively five patients had developed pharyngeal dysfunction: defective closure of the laryngeal vestibule (penetration) (4 patients), middle pharyngeal constrictor paresis (one patient), and epiglottic dysmotility (two patients). Three of these 5 patients regained normal pharyngeal function 4 weeks postoperatively, while 2 patients continued to have pharyngeal dysfunction. Elevation of the pharynx and larynx as well as opening of the pharyngoesophageal segment was normal in all patients. In addition, 2 patients developed postoperative dysfunction of the hypoglossal nerve and one of the facial nerve. Only 1 of 7 patients with normal postoperative pharyngeal function had cranial nerve damage (facial nerve). Laryngeal symptoms (recurrent laryngeal nerve involvement) were not seen. None of the 7 patients had symptoms from the glossopharyngeal or hypoglossal nerve.

Pharyngeal dysfunction occurred in 4 of 8 men and in 1 of 4 women. Dysfunction did not correlate with the age of the patients nor with the side on which surgery was performed. Three of 7 patients with preoperative minor stroke developed pharyngeal dysfunction, as did 2 of the 5 with amaurosis fugax and/or TIA.

The duration of the operation varied between

68 and 148 min (median, 89.5). Patients who developed pharyngeal dysfunction had an operation time between 68 and 140 min (median, 97). The clamping time in these was 18 and 23 min (median, 21) while 3 patients were operated on with shunts. This difference was, however, not significant. In patients who did not develop pharyngeal dysfunction, the operation time was shorter: between 68 and 125 min (median, 88). The clamping time in 6 patients varied between 19 and 48 min (median, 28) and 1 patient had a shunt. This means that the operation time was longer (102 compared to 88) among those who developed pharyngeal dysfunction, although the clamping time was shorter. However, 3 of 4 patients operated on with shunt developed pharyngeal dysfunction. This difference was, however, not significant.

Discussion

Earlier studies of cranial nerve complications of carotid endarterectomy have focused on damage to the following nerves: hypoglossal, glossopharyngeal, recurrent laryngeal, superior laryngeal, facial, great auricular, and cervical sympathetic trunk [1–9]. Nerve fibers to the pharynx derive from the main vagus trunk just inferior to the nodose ganglion. This is far above the level where the endarterectomy is performed. Changes in pharyngeal function during swallowing after carotid endarterectomy seem not to have been studied previously. Deglutition is controlled from several locations in the central nervous system (CNS), although the major control is from the "swallowing center" in the brainstem. Normal pharyngeal function also depends on local circumstances in the neck. The vagus and glossopharyngeal nerves are the motor nerves of the pharynx. The main vagus trunk is located posteriorly, close to the common and internal carotid artery.

None of our patients had any coughing, choking, or dysphagia before the operation. It is well known that chronic swallowing symptoms and pharyngeal dysfunction, as monitored by cineradiography during barium swallow, sometimes do not correlate. This has been ascribed to a tendency for these patients to compensate for loss of the swallowing function to an extent that dysphagia is not experienced [11]. However, it is less likely that our patients, who supposedly had acute dysfunction, could recruit such compensation.

Our finding of pharyngeal dysfunction in five patients (42%) is higher than the frequency of impairment of other cranial nerve functions. However, only 2 patients had abnormal pharyngeal function 4 weeks after surgery. It is possible that these patients' conditions also would have normalized if they had been evaluated for a longer period of time.

Patients who were operated on with shunts were those who suffered most from pharyngeal dysfunction. The use of a shunt usually means somewhat more extensive dissection and traction, especially in a proximal direction. All these patients also had minor stroke as an indication for surgery. The pharyngeal dysfunction therefore may be caused by extensive dissection trauma in combination with impaired cerebral function. At least in the patients with reversible dysfunction, the main cause seems to be local. The patients in this series did not routinely undergo postoperative computed tomographic (CT) scan, since it has been shown that silent postoperative brain infarcts do not necessarily occur in the "appropriate" hemisphere [12].

The traditional view that swallowing is a bilateral and brainstem-mediated activity was recently challenged by Robbins and Levine, who studied patients with isolated clinical and CT evidence of unilateral ischemic stroke involving the cerebral cortex [13]. They found a distinct pattern of swallowing dysfunction with left cortical lesions leading to impaired oral stage (pretransport), whereas right cortical lesions led to pharyngeal (transport) impairment. We did not register any such differences in pharyngeal dysfunction related to the side of the endarterectomy in our series. Our patients did not undergo CT or magnetic resonance imaging studies (MR). If the swallowing dysfunction in our patients was due to perioperative stroke, it is likely that MR would have revealed the lesion. This hypothesis warrants further studies for clarification.

The pharyngeal dysfunction in the present study was of a relatively benign nature and resolved in 3 of the 5 patients within 4 weeks. Obviously these patients are at risk, although the extent of this risk is not known. Local dissection should be as atraumatic as possible to avoid severe sequelae such as choking due to defective closure of the laryngeal vestibule. Patients who develop swallowing symptoms after carotid endarterectomy should be carefully monitored, and eating after the operation should be supervised by trained personnel. If a patient is to undergo a contralateral elective carotid endarterectomy, it seems important to check the function of the cranial nerves as well as the pharyngeal function, especially in patients who have sustained a minor stroke.

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