Assessment of Voice, Eating, Reflux and Swallowing Impairment in Carotid Endarterectomy patients using Scores questionnaires

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Abstract:

Objective: The purpose of this prospective study was to identify and quantify Voice, Eating, Reflux and Swallowing Impairment using self-reporting questionnaires in patients after Carotid Endarterectomy (CEA).

Material-Methods: A prospective case cohort study was undertaken including patients that underwent CEA for asymptomatic carotid disease. The patients filled in the Voice Handicap Index (VHI), Eating Assessment Tool 10 (EAT-10), Reflux Symptom Index (RSI) and Swallowing Impairment Scores (SIS-6) questionnaires pre -, 48h-post- and one-month post-surgery. Under direct visualization, nerve injury was recorded during the steps of operation.

Results: Thirty patients were treated with CEA. Intra-operatively, hypoglossal ansa cervicalis was dissected in one patient (3.4%), while rami was dissected in 7 patients (24.1%). Regarding swallowing and voice questionnaires scores, at the preset time points, the peak was observed 48h after surgery [(pre-op vs 48h; VHI: 0.57 vs 9.1; p=0.027; EAT: 0.73 vs 4.94; p=0.037; RSI: 0.91 vs 7.73, p=0.007; SIS-6: 1.12 vs 5.47, p=0.0012], while values almost returned to baseline one month later [(pre-op vs 1 month; VHI: 0.57 vs 0.74; p=0,345/ns; EAT: 0.73 vs 1.14; p=0,496/ns; RSI: 0.91 vs 1.52, p=0.506/ns; SIS-6: 1.12 vs 1.07, p=0.906/ns].

Conclusion: Self-reported questionnaires can identify voice, eating, reflux and swallowing impairment that may be associated with cranial nerve injury. This impairment seems to be transient during the first post-operative month.

Keywords: *Carotid endarterectomy, Assessment of voice quality, Assessment of swallowing, Cranial nerve injury*

INTRODUCTION

Carotid endarterectomy (CEA) is considered as the standard treatment of choice for stroke prevention in patients with severe carotid stenosis in an average risk population[1]. However, CEA may cause early complications such as cranial nerve injuries (CNI) that may be particularly troublesome for certain patients (e.g. patients who sing or speak publicly for a living). CNI may potentially result in significant prolonged disability and may even require further surgery for palliation of symptoms and improvement of function. Postoperative CNI rates vary between 3% and 27%, depending on the observer, definition of CNI, and study design.[3] Prior studies mainly focused on anatomically proven lesions and surgeons' estimations, while the clinical relevance of CNI has not yet been thoroughly examined, in terms of patient's actual functionality after surgery. The most examined clinical consequence refers to the voice alteration.[4,5] Other potentially severe complications, such as swallowing/eating disturbances are far less studied and their true incidence and impact on patients' everyday life remains largely unknown.[6,7] The aim of this study was to identify and quantify Voice, Eating, Reflux and Swallowing Impairment using self-reporting questionnaires in patients after Carotid Endarterectomy (CEA).

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MATERIAL AND METHODS

A prospective case cohort study was undertaken including patients that were treated with traditional CEA and patch plasty for asymptomatic carotid disease.

Exclusion criteria were: 1) Any kind of previous operation in the neck, 2) proved voice or swallowing disorder preoperatively, 3) tumor of the neck, 4) history of radiation of the neck, 5) history of thyroidectomy

All patients underwent a CEA under general anaesthesia with an oblique (skin crease) cervical incision. Careful dissection was mandatory to avoid iatrogenic lesions of the hypoglossal, vagus and recurrent laryngeal nerve, causing dysphonia and hoarseness; unnecessary manipulation of the arteries should be avoided to prevent cerebral embolization. Heparin (5000 IU) was routinely administered before clamping and a longitudinal arteriotomy was performed from the distal common carotid to the internal carotid as far as the end of the plaque.

Patients were asked to fill in the following questionnaires assessing swallowing and voice function:

a) Eating Assessment Tool (EAT) -10 questionnaire: The EAT-10 may be utilized as a clinical instrument to document the initial dysphagia severity and monitor the treatment response in persons with a wide array of swallowing disorders. The normative data suggest that an EAT-10 score of 3 or higher (mean + 2 SD) is abnormal.[8]

b) Voice Handicap Index (VHI) questionnaire: The VHI has three content domains representing functional, physical, and emotional aspects of voice disorders. There are 10 items corresponding to each domain, each item being measured on a five-point Likert-type scale (from 0 - never to 4 - always). A high score is expected to correspond to a more severe voice disorder. The VHI is usually completed within 5 minutes. The overall median VHI score in the group of 67 Greek subjects with voice disorders was 32 (mean 37, SD 21.3), the range being from 4 to 97 out of a maximum possible score of 120.[9]

c) Reflux Symptom Index (RSI): Patients were instructed to fill out the 9-item RSI on a rating scale ranging from 0 to 5, where 0 means no problems and 5 means a severe problem. Patients were given clear instructions about how they will fill out the 2 questionnaires according to the above-mentioned rating scales.[10]

d) Swallowing Impairment Index (SIS-6) is one of the most commonly used questionnaires in the related literature that has been validated for diagnosis of swallowing impairment. It is a self-administered, 6-item assessment of symptoms related to dysphagia, which provides an analysis of the spectrum of symptoms reported by patients. SIS-6 scoring ranges from 0 (no swallowing alterations) to 24 (highest swallowing impairment).[11]

The clinical functional status was assessed at three set time points (pre-surgery, 48 h post -surgery and at one month after surgery). An ENT doctor performed the indirect laryngoscopy, while patients were further assessed with validated questionnaires for two major functions: voice and swallowing. We aimed at the detailed recording of the surgery steps and for that purpose patients were categorized according to diathermy use (monopolar or dipolar), nerve exposure (identification/dissection) or the overt nerve damage/dissection under direct visualization. Injury to the following cranial nerves were distinguished: facial nerve (VII), facial droop; glossopharyngeal nerve (IX), swallowing difficulty unless other diagnosis confirmed; vagus nerve (X), hoarseness unless laryngoscopy normal; hypoglossal nerve (XII), any tongue deviation or discoordination.

STATISTICS

Continuous data were reported as a mean ± standard deviation. Categorical data were expressed as absolute numbers and percent prevalence (%) in the study cohort. Statistical significance between the groups for continuous variables used the independent t-test for normally distributed data or the Mann-Whitney U test for nonparametric data. The Fisher exact test was used for categorical variables, as appropriate. Descriptive and inferential statistics was performed. Non parametric Spearmans Rho was used to assess correlation among ansa dissection and questionnaires scores; Repeated measures analysis was applied to study questionnaires score variation at various time points. Statistical significance was set at p=0.05. SPSS 22.0 and Sigma plot 12.5 were used.

RESULTS

In terms of intra-operative manipulations, carotid artery exposure below hypoglossal nerve was undertaken in 22 patients (73%), while above hypoglossal nerve exposure was undertaken in 8 cases (27%). Hypoglossal loop was performed in 12 patients (41.3%), while vagus exposure took place in one patient (3.3%). In terms of intra-operative muscle injuries, digastric muscle dissection was required in 6 cases (20.0%). In terms of nerve dissection identification, hypoglossal ansa cervicalis was divided in one patient (3.3%), while rami was dissected in 7 patients (23.3%) (Table 1). No intermediate or severe wound haematoma was identified post-operatively.

Techniques	N (%)	Total
Preparation below hypoglossal nerve	22 (73.0%)	30
Preparation below and above hypoglossal nerve	8 (27%)	30
Hypoglossal loop	12 (40.0%)	30
Vagus preparation	1 (3.3%)	30
Muscle injuries		
Partial digastric divided	6 (20.0%)	30
Nerve injuries		
Hypoglossal ansa cervicalis division	1 (3.3%)	30
Hypoglossal rami divided	7 (23.3%)	30

Table 1. Techniques and CNIs

Regarding swallowing and voice questionnaires scores, at the pre-set time points, the peak was observed 48h after surgery, while values improved and in some cases almost returned to baseline one month later. All scores returned to baseline one month after surgery, while 48h post-op score was 5-20 times higher than baseline. All four assessment tools scores had a similar pattern through time and differences between baseline values and peak values were statistically significant. Mean (except VHI) values at 48h time point were indicative of severe problem, according to suggested cut-of scores.[8,12,13] (Table 2 & Fig.1)

	Pre-op	48h post-op	P Pre-op vs. 48h post-op	1month post-op	P Pre-op vs. 1month post-op
EAT	0.73±2.91	4.94±9.07	0.037	1.14±1.80	0.496
SIS-6	1.12±3.00	5.47±6.25	0.001	1.07±2.36	0.906
RSI	0.91±1.91	7.73±10.22	0.007	1.52±3.1	0.506
VHI	0.57±1.23	9.10±9.47	0.027	0.74±2.35	0.345

Table 2. Prospective questionnaire scoring

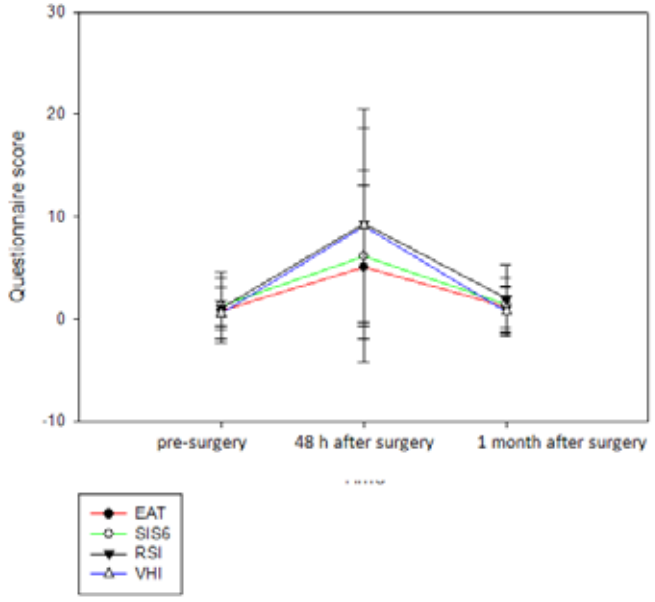

Figure 1. Prospective CN functionality (clinical assessment)

In those 8 patients with the dissection of the rami or the ansa cervicalis no significant associations were found between questionnaires scores, either regarding voice or swallowing. (Spearman's Corelation Rho for ansa dissection and 48 post-op: VHI: rho=0.065, p=0.768; EAT-10: rho = -0.256, p=0.561; SIS-6: rho=-0.166, p=0.449; RSI: rho=0.49, p=0.826).

DISCUSSION

The findings of the present study indicate self-reported questionnaires may identify transient functional impairment that may be associated to cranial nerves injury after CEA affecting voice, swallowing, reflux and eating. A transient voice and swallowing alteration might be indeed underestimated, since patients are often able to compensate deficits resulting in a "normal" voice and questionnaire scoring might be within normal range. Currently, there are no formal protocols including objective functional impairment measurement at set time points that may be associated to CNI, thus, it is possible that subtle nerve lesions may have been missed. According to literature, most postoperative nerve lesions seem transient, although permeant damage and consequent serious impact on patient's life cannot be excluded[12]. This study demonstrated that cranial nerves are vulnerable to injury in almost 43% of the cases (cumulative muscle and nerve injuries), however, the true post-operative impact on nerve functionality is non-significant, since all parameters return to baseline values at the end of the first post-operative month. Along these lines, previous epidemiological studies reporting low incidence of CNI, such as the VSGNE study (5.6%) such as the New York Carotid Artery Surgery study (NYCAS, 5.5%),[14] the European Carotid Surgery Trial (ECST, 5.1%),[5] and the North American Symptomatic Carotid Endarterectomy Trial (8.6%).[15] Recurrent laryngeal nerve dysfunction causing vocal fold paralysis is a well-recognised cause of voice disturbance. The discordance of voice dysfunction and nerve injury might imply that disturbance of the extralaryngeal skeleton is partially responsible: the digastric muscle's division itself might cause a change in vocal fold motility, and thus postoperative hoarseness.[4]

It has been well documented that cranial and cervical nerve damage are related to local trauma to the nerve by means of retraction, stretching, clamping and transection. However, most of the clinical injuries occur from nerve damage during retraction.[16]

Hypoglossal nerve dysfunction can present with subclinical symptoms manifested only by deviation of the tongue to the ipsilateral side of injury. Severe injury can result in profound tongue clumsiness, tongue biting, dysarthria, and symptomatic mastication and deglutition.[14] Injury to this nerve can result in symptoms ranging from mild dysphagia to severe recurrent aspiration, respiratory failure, and malnutrition. Injury results in uncoordinated swallowing and ablation of the gag reflex. Clinical manifestations of vagal injury range from mild symptoms of hoarseness and loss of effective cough mechanism, to upper pharyngeal dysphagia with aspiration, to life-threatening airway obstruction from bilateral recurrent laryngeal nerve injury. Injuries can involve the recurrent laryngeal nerve, superior laryngeal nerve, and the vagus trunk. Damage to the glossopharyngeal nerve can result in uvula deviation and dysphagia with a potential risk of aspiration.[16]

Clinical assessment is of great importance as sometimes functional impairment that may be associated CN dysfunction (eg in the case of superior laryngeal nerve; SLN dysfunction) is hard to accurately establish, because the diagnosis can be hard to make, even when direct laryngoscopy examination is used .[17] Thus, CNIs may be underdiagnosed in many cases. The worst score on the questionnaires was observed 48 hours after the surgery. Patients might be in stress if they are not reassured that this is a rather transient functional impairment condition and that recovery is expected within 1 month.

In the present study, voice and swallowing were assessed with various tools and by different experts to avoid assessment bias, while nerve injure severity and the applied techniques were not associated with outcome. The above along with the fact that almost (but RSI score) variables, regardless of the magnitude of their peak, returned to baseline values 1 month after the surgery.

Apparent limitation of this study was the small sample. Another potential limitation was that we did not include patients that were treated under local anesthesia as a comparable group in order to minimize the possibility that the results of the tests were not been affected by other conditions such

endotracheal intubation of the general anaesthesia. Larger samples in future studies might allow significant associations between questionnaire scores and techniques/kind of injuries to emerge. Longer follow up may also be of interest to evaluate if there is any impact on these patients during the long term period.

CONCLUSION

Self-reported questionnaires can identify voice, eating, reflux and swallowing impairment that may be associated with cranial nerve injury. This impairment seems to be transient during the first post-operative month.

No conflict of interest.

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