Frequency of transient ipsilateral vocal cord paralysis in patients undergoing carotid endarterectomy under local anesthesia

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Background: **Especially because of improvements in clinical neurologic monitoring, carotid endarterectomy done under local anesthesia has become the technique of choice in several centers. Temporary ipsilateral vocal nerve palsies due to local anesthetics have been described, however. Such complications are most important in situations where there is a pre-existing contralateral paralysis. We therefore examined the effect of local anesthesia on vocal cord function to better understand its possible consequences.**

Methods: **This prospective study included 28 patients undergoing carotid endarterectomy under local anesthesia. Vocal cord function was evaluated before, during, and after surgery (postoperative day 1) using flexible laryngoscopy. Anesthesia was performed by injecting 20 to 40 mL of a mixture of long-acting (ropivacaine) and short-acting (prilocaine) anesthetic.**

Results: **All patients had normal vocal cord function preoperatively. Twelve patients (43%) were found to have intraoperative ipsilateral vocal cord paralysis. It resolved in all cases ≤24 hours. There were no significant differences in operating time or volume or frequency of anesthetic administration in patients with temporary vocal cord paralysis compared with those without.**

Conclusion: **Local anesthesia led to temporary ipsilateral vocal cord paralysis in almost half of these patients. Because pre-existing paralysis is of a relevant frequency (up to 3%), a preoperative evaluation of vocal cord function before carotid endarterectomy under local anesthesia is recommended to avoid intraoperative bilateral paralysis. In patients with preoperative contralateral vocal cord paralysis, surgery under general anesthesia should be considered. (J Vasc Surg 2007;46:37-40.)**

Carotid endarterectomy (CEA) is a frequently performed operation.[1] Mainly because of improvements in clinical monitoring, CEA under local anesthesia has become the technique of choice in many hospitals.[2-6] As described in some case reports, however, local anesthesia can lead to transient ipsilateral vocal cord paralysis if the vagal nerve is affected.[7-9] In a patient with pre-existing contralateral paralysis, anesthetic-induced ipsilateral nerve dysfunction could lead to severe respiratory distress caused by bilateral median positioning of the paralysed cords.

Vocal cord paralysis occurs in up to 3% of patients.[10-16] Etiologies include inflammation, tumor, idiopathic, and postoperative.[10-16] The frequency of anesthetic-induced ipsilateral paralysis during CEA under local anesthesia is unknown because no systematic study has, to our knowledge, evaluated the effect of local anesthetics on vocal cord function. It is possible, however, that in some of the cases of conversion to general anesthesia (about 2% as described in literature), an anesthetic-related vocal cord paralysis was the underlying cause. We experienced such a situation with one of our own patients; therefore, the aim of this prospective study was to examine the effect of local anesthesia on vocal cord function during CEA.

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METHODS

This prospective study surveyed all consecutive patients who underwent CEA using local anesthesia between November 2005 and August 2006. Inclusion criteria were an indication for prophylactic CEA (according to the guidelines) and the patient's agreement to this surgical technique. Patients needing repeat surgical interventions (such as restenosis of the carotid artery) and patients with preexisting vocal cord paralysis were excluded.

Each patient was evaluated preoperatively by a neurologist, and a Duplex ultrasound examination of the carotids was performed by the surgeon. The function of the vocal cords was also evaluated by video flexible laryngoscopy.

For local anesthesia, we used a standardized mixture of long-acting (ropivacaine [Naropin, AstraZeneca, Wedel, Germany], 4-hour half-life) and short-acting (prilocaine, [Xylonest 1%, AstraZeneca], 1.5-hour half-life) anesthetics in a 1:1 ratio. The initial injection was 20 to 30 mL (about 0.3 mL/kg body weight). The surgeon administered the local anesthetic by infiltrating the punctum nervosum and the subcutaneous layers (Fig). A repeat injection of 2 to 3 mL was made only if requested by the patient for pain.

Fig. Technique of infiltration of local anesthesia at the punctum nervosum.

The operations were conducted by two experienced vascular surgeons. Surgical technique included thromboendarterectomy by eversion or with patch. Intraoperative shunting was used selectively according to clinical (vigilance) and neurologic monitoring (sensory-motor function of the contralateral upper extremity). Flexible laryngoscopy was repeated immediately after skin closure.

After surveillance on the intensive care unit for 24 hours, a third laryngoscopy (time frame, 24 to 28 hours postoperative) and a neurologic examination were performed. All laryngoscopies were performed by an independent examiner. Patients were discharged on postoperative day 4 to 6. The indicators prospectively recorded were results of preoperative, intraoperative, and postoperative laryngoscopy, location of the CEA (right/left), duration of operation, amount of local anesthetic, and gender.

Statistical significance for categoric variables was assessed using χ^2, and numeric variables were assessed by the Student *t* test. Data were analyzed using SSPS software (SPSS Inc, Chicago, Ill), with differences considered significant at the level of $P < .05$.

RESULTS

Between November 2005 and August 2006, 32 patients were included in this study. Two patients required conversion to general anesthesia: one presented a seizure due to inadvertent intravascular injection of anesthetic and the other due to uncontrollable agitation. These patients were excluded from the study. Two patients with preexisting asymptomatic vocal cord paralysis detected by preoperative laryngoscopy were also excluded from the study (according to our exclusion criteria). In one patient, preoperative evaluation of the vocal cord function showed asymptomatic ipsilateral vocal cord paralysis. Although he underwent the operation with local anesthesia, he was excluded from the study. In the other patient, asymptomatic contralateral vocal cord palsy was detected by preoperative laryngoscopy. This patient was operated on under general anesthesia. Thus, two (6.3%) of 32 patients in this series were discovered to have a vocal cord palsy, neither of which was known beforehand.

Table. Comparison of patients with and without temporary vocal cord paralysis

*Variable**	*Vocal cord paralysis*[†]	
	Temporary (n = 12)	*None (n = 16)*
Gender		
Male	8	11
Female	4	5
Location of CEA		
Right	7	7
Left	5	9
Mean duration of operation (min)	89.5 (75-110)	81 (65-100)
Mean volume of anesthetic (mL)[‡]	33 (20-40)	30 (20-40)
Repetitive application[§]	8	9
No of operations		
Surgeon 1	5	7
Surgeon 2	7	9

CEA, Carotid endarterectomy.
*Categoric data are presented as number, continuous data are presented as mean (range).
[†]All *P* values for these data were not significant.
[‡]The initial dose was 0.3 mg/kg body weight.
[§]Patient received more than one application of local anesthetic during the operation.

Accordingly, the total study group consisted of 28 patients. All underwent preoperative, intraoperative, and postoperative flexible laryngoscopy and 12 (43%) were found to have ipsilateral vocal cord paralysis intraoperatively (immediately after skin closure). A repeat examination after 24 hours showed normal cord function in all 12 patients. Accordingly, 16 patients did not show any vocal cord dysfunctions preoperatively, intraoperatively, and postoperatively. A temporary hypoglossal nerve paralysis also occurred in three cases (10%) and resolved <24 hours.

The mean time in surgery was 85 minutes (range, 65 to 110 minutes). The mean amount of local anesthetic used was 35 mL (range, 20 to 40 mL). In 17 cases (8 patients with temporary ipsilateral vocal cord paralysis), anesthetic injection was repeated.

Analysis of the recorded data showed that vocal cord paralysis did not correlate with the method or the duration of surgery, the gender, or with the location of the CEA. Furthermore, the amount of local anesthetic administered and the need for repetition of anesthetic administration did not influence the frequency of temporary vocal cord paralysis. However, a trend was noted to a higher frequency of cord paralysis in patients who needed repetitive administration of the anesthetic. Eight (47%) of 17 patients with repetition of anesthetic administration had temporary paralysis, whereas only four (36%) of 11 patients without repetition had temporary palsy. Probably owing to the limited number of patients, this difference did not reach statistical significance.

The recorded data showed results were similar for the two surgeons (Table).

Early occlusion developed in the internal carotid artery of one patient that required reintervention and revascularization was successful, without neurologic impairment. The postoperative course of the remaining patients was uneventful. All patients were discharged between postoperative days 4 and 6.

DISCUSSION

CEA under local anesthesia has become the standard in some institutions.[2-5] This is mainly because of the better clinical monitoring of neurologic function, and there is generally a high acceptance of the method by patients.[3-5] However, according to few case reports, local anesthesia can have side effects such as a temporary effect on the nerves.[7-9] We were motivated to do this study after one of our own patients presented with severe respiratory distress after the injection of local anesthetic. We noticed that the respiratory difficulty improved in a time frame consistent with decreasing anesthetic effect.

Later, a pre-existing asymptomatic contralateral vocal cord paralysis from remote thyroid surgery was discovered. The patient had never had any related clinical signs or symptoms such as breathing or voice disturbances. Only in retrospect did we realize that the patient's acute intraoperative problems came from a temporary bilateral vocal cord paralysis due to our local unilateral anesthetic (temporary ipsilateral paralysis due to the local anesthetic, pre-existing contralateral paralysis). Sustained median positioning of both vocal cords from bilateral paralysis can rapidly lead to serious respiratory distress, possibly requiring endotracheal intubation.[8,9]

The effects of local anesthetics on nerve function that we observed have been previously described in some case reports.[7-9,17] In fact, at least two case reports describe similar occurrences of temporary vocal cord palsy during CEA.[8,9] The etiologies hypothesized by these authors included inadvertent direct infiltration of a nerve, excessive diffusion of the local anesthetic, and repetitive applications of anesthetic. Interestingly enough, these observations have not led to any practical changes in carotid surgery; however, the literature describes conversion rates of up to 2%.[18,19]

The most common reasons provided for converting to general anesthesia were patient agitation and poor compliance. It is possible, though, that some of these complications were related to the phenomenon here described. If so, these complications might have been prevented with vocal cord evaluation. To our knowledge, however, no study on this problem has been published yet. Accordingly, there is no experience on the mechanism responsible for the development of a temporary paralysis. The frequency of vocal cord palsies was higher in our patients who needed repetitive administration of the anesthetic, which is usually injected into or close to the carotid sheath. However, this did not reach statistical significance probably owing to the limited number of patients in this study.

Thyroid-surgery dependent lesions of the recurrent nerve occur in 0.7 to 2.8%.[11,20] Other etiologies causing paralysis of the recurrent nerve have been described, including trauma, inflammation, postsurgical, tumor,[12-15] and idiopathic causes.[16] The overall frequency of pre-existing recurrent laryngeal nerve paralysis is as high as 3%. Because CEA is mainly performed in elderly patients, there is an increased likelihood of a pre-existing vocal cord paralysis due to one of these mentioned causes. In our series of patients who where admitted for carotid stenosis, the prevalence of vocal cord paralysis was 6.3% (2/32). Even if it is only contralateral paralysis, which is important for local anesthesia in carotid surgery, at least 1.5% of all patients may then still bear an approximate 40% to 50% risk (according to our findings) of developing bilateral vocal cord paralysis (resulting from preexisting contralateral paralysis and temporary ipsilateral paralysis) during surgery using local anesthesia. We consider this a relevant risk. As a consequence, we choose to use general anesthesia for patients in our institution with contralateral cord impairment.

CONCLUSION

We use (as other surgeons do[19] and as we have described) a technique of local anesthesia that is easy to perform and well accepted by the patients. The two surgeons in our study both had similar results concerning the vocal cord function. One reason for temporary vocal cord impairment might be that the amount of anesthetic administered (20 to 40 mL) is large enough to potentially affect the vagal nerve and its branches by diffusion. One could consider using only very small amounts of local anesthetic to minimize diffusion-related nerve dysfunction by performing ultrasound-guided plexus infiltration, but this is a more complex and time-consuming method and is also not without associated risks to functional nerve impairment.

Preoperative evaluation of vocal cord function is safe and easy. It is generally done before thyroid surgery by an otolaryngologist. Even though our sample group was small, we think that our results are convincing. We therefore recommend preoperative vocal cord evaluation before elective carotid surgery in which local anesthesia will be used.

Apart from this recommendation, there is one further aspect that we think is of interest. Literature describes the carotid surgery complications of vagal nerve and nerve branches injury to be 2% to 4%. Reoperations are associated with vagal nerve injury rates as high as 12%,[21-24] which is even higher than in thyroid surgery.[20] It is interesting that there is not more discussion about such results, whereas this is one of the main topics in thyroid surgery and has led to standardization and guidelines. Further studies and discussions regarding vocal cord evaluation, as in thyroid surgery,[20,25] should allow it to become a routine aspect of carotid surgery in the future.

AUTHOR CONTRIBUTIONS

Conception and design: FT, MB
Analysis and interpretation: FT, MB
Data collection: FT, JU, EJ, MB
Writing the article: FT, MB

Critical revision of the article: MB, HD, JU
Final approval of the article: MB
Statistical analysis: FT, MB
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Overall responsibility: FT

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