Identification of the External Branch of the Superior Laryngeal Nerve During Thyroidectomy

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Objectives: To determine the feasibility of identification of the external branch of the superior laryngeal nerve (EBSLN) during routine thyroidectomy and to describe the EBSLN position according to the Cernea classification system.

Design: Prospective case series.

Setting: Academic tertiary care center.

Patients: One hundred twelve consecutive patients undergoing hemithyroidectomy or total thyroidectomy by the senior author between August 15 and December 31, 2007.

Interventions: None.

Main Outcome Measure: Proportion of EBSLNs identified. Secondary outcome measures included EBSLN position according to Cernea classification and correlation with patient and gland characteristics.

Results: Three of 178 EBSLNs (1.7%) could not be identified using the routine technique. The EBSLN was found in the highest-risk position (Cernea type 2b, crossing the superior vascular pedicle below the upper border of the gland) in 48.3% of cases, and in the lowest-risk position (Cernea type 1, crossing more than 1 cm above the upper border) in 7.3%. Specimens larger in weight and in dimension were correlated with type 2b nerves.

Conclusions: The EBSLN can be routinely identified during thyroidectomy. Moreover, many EBSLNs are in position to be at high risk of injury during ligation of the superior vascular pedicle.


Studies have shown that subjective voice disturbance after thyroidectomy is very common, even without injury to the recurrent laryngeal nerves. One possible cause for postoperative dysphonia is injury to the external branch of the superior laryngeal nerve (EBSLN). The EBSLN supplies the cricothyroid muscle, which acts to lengthen the vocal folds during phonation. The external branch courses deep to the superior thyroid artery and vein from superolateral to inferomedial and inserts at the cricothyroid muscle medial to the superior pole of the thyroid gland. The nerve is vulnerable to injury during thyroidectomy as the surgeon dissects and ligates the superior thyroid vascular pedicle. Injury to the superior laryngeal nerve leads to objective alterations in voice quality, even in nonsingers. Cernea et al reported that an experienced thyroid surgeon had a lower incidence of postoperative cricothyroid muscle dysfunction in cases in which the nerve was searched for and identified than in cases in which no search was performed.

Anatomic studies have sought to delineate the course of the nerve near the superior pole and to identify patterns. Cernea et al created a 3-way system according to the level at which the nerve crosses behind the artery: type 1 nerves cross more than 1 cm above the upper border of the thyroid gland; type 2a nerves cross within 1 cm of the upper border of the thyroid; and type 2b nerves cross below the upper border of the gland. Their study showed that 37% of cadaveric nerves were found in a position as to be vulnerable during thyroidectomy; a more recent clinical study using the same classification system found 64% of nerves to be at risk. Interestingly, Hurtado-Lopez et al found that increasing thyroid nodule size did not predict postoperative cricothyroid dysfunction, although Cernea et al found an increased incidence of high-risk nerves in patients with very large goiters. In this study, we report our experience of EBSLN identification in a series of consecutive thyroidectomies.
METHODS

The Research Ethics Board of Mount Sinai Hospital approved this study. We retrospectively reviewed the medical charts of 112 consecutive patients who underwent thyroidectomy performed by the senior author (J.L.F.) at our tertiary care center between August 15 and December 31, 2007.

We used a standardized approach for each superior pole. The sternothyroid muscle was retracted laterally and the sternothyroid muscle was divided at its midpoint. The gland was retracted inferolaterally while the sternothyroid muscle was bluntly dissected upward, after which the avascular space between the larynx and the superior thyroid pole was opened bluntly. During this dissection, the lateral surface of the cricothyroid muscle was exposed and the EBSLN was identified. Its course was traced laterally to the point where it crossed the superior thyroid vessels. No sharp dissection or electrocautery was used at the superior pole prior to identification of this point. We did not use a nerve stimulator or other laryngeal nerve monitor. We then proceeded to dissect the remainders of the attachments of the thyroid gland.

For each patient, we recorded the laterality of the procedure and whether relevant nerves were identified and their Cernea classifications. We also noted the dimensions and weight of the thyroidectomy specimen and the patient’s body mass index. Risk factors were analyzed by χ² test. Statistical analysis was performed with EpInfo software (Centers for Disease Control and Prevention, Atlanta, Georgia).

RESULTS

We studied 112 patients in whom 178 superior poles were dissected. There were 91 right sides and 87 left sides. Using the standard procedure, 175 nerves were identified (98.3%). Two of the remaining 3 nerves were located, but only after the division of the superior vascular pedicle; the third was in a patient with an atrophic right thyroid lobe in whom no superior pole was present. The positions of the 175 identified nerves are shown in the Table.

The 2 patients in whom we were unable to find the EBSLN with our standard dissection had firm nodules or inflamed thyroid parenchyma, which prevented lateral retraction of the superior pole and thus prohibited our usual blunt dissection technique.

There were 23 obese patients (body mass index [calculated as weight in kilograms divided by height in meters squared] >30), with 37 nerves dissected. The odds ratio (OR) for finding a type 2b nerve was 1.34 (95% confidence interval [CI], 0.65-2.76; P = .43). Among these dissections, 2 type 1 nerves were identified. There were 66 total thyroidectomies. In this group, in 37 patients (56%), the right and left EBSLNs were found in the same position. Of the 71 nerves found in the Cernea type 2b position, 68 of the contralateral nerves were found in either the type 2a or 2b position.

We studied the relationship between EBSLN position and the size of the thyroidectomy specimen. For 4 patients, specimen mass was not recorded. For the remaining 108 specimens, the median mass was 21.5 g. There were 25 nerves dissected in specimens larger than 50 g, of which 18 were in the type 2b position (OR, 3.24; 95% CI, 1.28-8.24; P = .006). We sought to determine if the dimensions of the thyroid gland were predictive of finding the EBSLN in a high-risk position. Fifty-two lobes larger than 5.5 cm in the superior-inferior dimension were found; type 2b EBSLNs were discovered in 62% of cases (OR, 2.13; 95% CI, 1.10-4.13; P = .02). There were 19 lobes larger than 3.5 cm in the anteroposterior dimension; 79% of these were associated with type 2b EBSLNs (OR, 4.65; 95% CI, 1.48-14.63; P = .005).

The EBSLN is commonly associated intimately with the superior thyroid pole, as we confirm in this study. Our data demonstrate that the technique of ligation of the superior polar vessels flush with the thyroid gland would still result in a high risk of injury in almost half of the superior poles. We conclude that, just as in the case of the recurrent laryngeal nerve, every superior polar dissection should include a search for the EBSLN.

Our results confirm the high proportion of patients in whom the EBSLN is found after only limited dissection. Mishra et al described not encountering the EBSLN in only 8 of 78 superior poles. Friedman et al reported finding the EBSLN, using a different technique, in 83% of 1057 superior poles.

The proportion of EBSLNs found to be in the type 2b position was 48%, which is higher than reported previously. Cernea et al found 20% of 30 cadaveric nerves in the type 2b position, whereas Ozlugedik et al found 18% of 40 cadaveric nerves in the type 2b position. Surgical series by Mishra et al and Bellantone et al identified only 10% in the type 2b position. One possible explanation is the manner in which the superior pole is exposed. The cadaveric dissections of the superior pole may result in a perspective of the nerve that varies from that obtained by surgical exposure, especially the technique used in the present series of dissecting from inferior to superior underneath the divided sternothyroid muscle. It is difficult to explain the differences between our results and those of Mishra et al, neither study incorporated the use of a nerve stimulator or monitor to confirm the identity of the nerve.

We have identified factors associated with the finding of type 2 nerves, including the weight of the thyroidectomy specimen and the dimensions of the lobe. Specimens were weighed in their entirety, so we were unable to evaluate a correlation between lobe weight and nerve position, which may have been stronger than that between gland weight and nerve position. There were insufficient lobectomy specimens larger than 50 g to calculate a robust OR. The correlation between large lobe dimension and inferiorly positioned EBSLN is likely not surprising to thyroid.

<table>
<thead>
<tr>
<th>Cernea Class</th>
<th>No. (%) of Superior Poles</th>
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<tbody>
<tr>
<td>1</td>
<td>13 (7.3)</td>
</tr>
<tr>
<td>2a</td>
<td>76 (42.7)</td>
</tr>
<tr>
<td>2b</td>
<td>86 (48.3)</td>
</tr>
</tbody>
</table>

a See introductory paragraphs for definitions of the Cernea classes.

COMMENT

The EBSLN was performed with EpiInfo software (Centers for Disease Control and Prevention, Atlanta, Georgia).
surgeons; these data combined with preoperative imaging would allow prediction of nerve position. Although it seems a reasonable proposition, there is as yet no conclusive evidence that routine nerve identification would prevent postoperative dysphonia. In addition to nerve injury, dysphonia could result from dysfunction of the cricothyroid muscle, alterations of endolaryngeal soft tissues, or infrahyoid strap muscle dysfunction, although there is evidence that the latter does not contribute significantly. A complicating factor is the difficulty of assessing EBSLN and cricothyroid muscle function. Hurtado-Lopez etal7 reported a lower rate of EBSLN dysfunction, as measured by electromyography, when the nerve was specifically identified. What remains is a study of subjective and objective voice outcomes with correlation to nerve position.

In conclusion, during thyroidectomy, the EBSLN is easily found in most cases. Furthermore, almost half of the nerves in our series were in position to be injured during ligation of the superior thyroid vessels. We conclude that the EBSLN should be identified routinely during thyroidectomy.

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Author Contributions: Drs Pagedar and Freeman had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Freeman. Acquisition of data: Pagedar. Analysis and interpretation of data: Pagedar and Freeman. Drafting of the manuscript: Pagedar. Critical revision of the manuscript for important intellectual content: Freeman. Statistical analysis: Pagedar.

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REFERENCES