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Original Research Article

Identification of external branch of superior laryngeal nerve in relation to upper pole of thyroid gland in thyroid surgery

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ABSTRACT

Background: One of the most common procedures carried out by otorhinolaryngologists is thyroidectomy. A challenging aspect of thyroid surgery is the prevention of damage to the external branch of the superior laryngeal nerve (EBSLN). The objective of this study is to assess the rate of identification and different anatomical variations of the EBSLN in relation to the upper pole of the thyroid gland during thyroidectomy operation.
Methods: This is a prospective observational study conducted in the Department of Otorhinolaryngology, Silchar Medical College and Hospital, Silchar, Assam involving 25 patients who underwent thyroidectomy between January 2023, and December 2023. The study included patients aged 20 years and older who fulfilled the specified inclusion and exclusion criteria. The traditional open thyroidectomy technique was used for each procedure, using a standard Kocher's skin incision. We categorised the anatomical course of the EBSLN in relation to upper pole of the thyroid gland.
Results: In this study, out of the 29 EBSLN, 24 (82.35%) nerves were successfully identified, whereas 5 (17.64%) nerves could not be identified. Out of 24 EBSLN, we found 20 (68.97%) nerves crossing superior thyroid vessels above the upper pole of the thyroid gland and 4 (13.79%) nerves crossing underneath the upper pole of the thyroid gland.
Conclusions: We should direct our dissection more carefully in the region above the upper pole of the thyroid, as the majority of EBSLN crosses the superior thyroid vessels above the upper pole of the thyroid gland. We should also avoid extensive dissection in search of EBSLN, keeping in mind that some nerve branches that cross the superior thyroid vessels under the cover of the upper pole of the thyroid gland put patients at greater risk for injury during thyroidectomy.

Keywords: External branch of superior laryngeal nerve, Superior thyroid vessels, Thyroidectomy

INTRODUCTION

One of the most common procedures carried out by otorhinolaryngologists is thyroidectomy. Thyroid surgery is most often performed due to nodules or malignancies on the gland. Nodules can either be benign or malignant.[1] To prevent postoperative voice deterioration, thyroid surgery must preserve the "recurrent laryngeal nerve (RLN)" and the "external branch of the superior laryngeal nerve (EBSLN)." [2]

The superior laryngeal nerve is a branch of the vagus nerve. It usually starts at the nodose ganglion close to the jugular foramen at C2 level, about 4 cm cranial to the carotid artery bifurcation, and then descends posteriorly to the carotid sheath and crosses medially towards the larynx.[3,4] The superior laryngeal nerve (SLN) divides into internal and external branches at various distances from its origin, usually at the level of the superior cornu of the hyoid bone.[4] Because it crosses near the superior thyroid vessels (STV) in the possible avascular area known as Reeve's space, the EBSLN is vulnerable to injury during

"sternothyroid-laryngeal triangle" (Joll's triangle) dissection.

A challenging aspect of thyroid surgery is the prevention of damage to the EBSLN. The reported rates of EBSLN damage vary from 0 to 58%, depending on the specific procedures used for postoperative evaluation.[5-8] The EBSLN provides innervation to the "cricothyroid muscle (CTM)," which is responsible for increasing the tension of the vocal folds on the same side during pitch elevation. The main clinical symptoms consist of vocal fatigue and a reduction in vocal frequency range, particularly when trying to raise pitch.[9] These symptoms may significantly impact the quality of life, especially for those who rely on their voice for professional purposes. Even for those who are not singers, the damage might lead to a significant alteration in the quality of their voice.[10] Despite its importance, the EBSLN has not gotten much attention, leading "Delbridge" to label it as the "neglected nerve in thyroid surgery."[11]

Precise anatomical identification during dissection may aid in avoiding injury to the EBSLN during thyroid surgery.[4] The objective of this study was to assess the rate of identification and different anatomical variations of the EBSLN in relation to the upper pole of the thyroid gland during thyroidectomy operation.

METHODS

This is a prospective observational study conducted in the Department of Otorhinolaryngology, Silchar Medical College and Hospital, Silchar, Assam. The study involved 25 patients who underwent thyroidectomy between January 2023, and December 2023. The study included patients aged 20 years and older who fulfilled the specified inclusion and exclusion criteria. The patients included in our research met the criterion of having nodular or cystic thyroid swellings of either benign or malignant type that necessitated a thyroidectomy operation. The study excluded patients under the age of 20, those with a history of previous thyroid or neck surgery, those who had received neck radiation, those with anaplastic carcinoma of the thyroid, pregnant and lactating patients, patients with bleeding disorders, anaemia, poor tolerance to anaesthesia, or uncontrolled medical conditions. Informed consent was obtained from all the participants. A detailed history and thorough clinical examinations were done. Ethical clearance was obtained from the Institutional Ethics Committee.

General anaesthesia was administered to all patients during surgery. The traditional open thyroidectomy technique was used for each procedure, using a standard "Kocher's" skin incision. The strap muscles were dissected and pulled aside, while the subplatysmal flap was raised both above and below. The sternothyroid muscle was retracted laterally and upwards. By applying lateral and downward force to the thyroid, a space was created between the thyroid gland and the inferior constrictor muscle. The superior thyroid vessels in the "Joll's triangle" were tied off near the glandular tissue. Throughout the procedure, we made efforts to visually locate the EBSLN after fully mobilising the upper pole. We categorised the anatomical course of the EBSLN in relation to the upper pole of the thyroid gland. In cases where the EBSLN could not be identified, it was marked as "could not be identified.".

RESULTS

The study included 25 thyroidectomy cases. 23 (92%) were females, whereas 2 (8%) were males (Table 1).

Table 1: Gender distribution.

Gender	Number	Percentage
Female	23	92
Male	2	8
Total	25	100

The predominant diagnosis was colloid goitre, accounting for 76% of cases, followed by multinodular goitre (12%), papillary thyroid cancer (8%), and follicular neoplasm (4%) (Table 2).

Table 2: Diagnosis.

Diagnosis	Number	Percentage
Colloid goitre	19	76
Multinodular goitre	3	12
Papillary thyroid carcinoma	2	8
Follicular neoplasm	1	4

Out of the total cases, 21 (84%) had hemithyroidectomies, 2 (8%) underwent near total thyroidectomies, and another 2 (8%) underwent total thyroidectomies (Table 3).

Table 3: Operative procedures.

Procedure		Number	Percentage
Hemithyroidectomy		21	84
Hemithyroidectomy	**Right**	13	52
	Left	8	32
Near total thyroidectomy		2	8
Total thyroidectomy		2	8

We attempted to identify 29 EBSLN who were at risk during thyroid surgery. There were a total of 17 branches on the right side and 12 branches on the left side. Among the 29 nerves examined, 24 EBSLN (82.35%) were successfully identified, whereas 5 EBSLN (17.64%) could not be identified. Out of 24 EBSLN, we found 20 (68.97%) nerves crossing above the upper pole of thyroid gland and 4 (13.79%) nerves crossing under cover of the upper pole of the thyroid gland (Table 4).

Table 4: Identification of EBSLN.

Anatomical variations	Right	Left	Total	Percentage
Crossing above upper pole of thyroid	11	9	20	68.97
Crossing under cover of upper pole of thyroid	2	2	4	13.79

DISCUSSION

The fundamental basis of all surgical treatments, including those involving the head and neck, is the identification and preservation of vital anatomical components to avoid any harm to them.[12] Thyroidectomy surgery presents two distinct surgical challenges: hypocalcaemia resulting from parathyroid damage and injury to the RLN and the EBSLN. These concerns are in addition to the typical postoperative complications such as wound infection and bleeding. During the dissection and ligation of the superior thyroid vessels, it is possible for up to 58% of patients to damage the EBSLN. The injury may be challenging to identify due to the presence of various and subtle postoperative symptoms and laryngoscopic findings.[5-8]

While considering the consequences of thyroid surgery, it is critical to emphasize the importance of preventing damage to the EBSLN. The paralysis of the EBSLN may have a severe impact on those whose profession relies largely on using the whole vocal range. In 1935, the renowned opera singer Amelita Galli-Curci suffered damage to her EBSLN during thyroid surgery.[13] The nerve injury might result in paralysis of the cricothyroid muscle on the same side. During the examination, the physician may see signs of bowing and inferior displacement of the affected vocal cord.[14]

Two anatomic studies on cadavers found connecting nerves between the EBSLN and the RLN, using particular staining to determine nerve distributions and patterns throughout the larynx.[15,16] These results suggest that the EBSLN could provide significant innervation to muscles other than the cricothyroid, therefore supporting the evidence for the significance of the nerve. Various studies have reported significant variation in the rates of identification and injury, with identification rates ranging from 33% to 93% and injury rates between 0% and 58%.[6-9] The inconsistency of surgical procedures adopted by various clinicians may contribute to the difference in outcomes.

The proper detection of the EBSLN requires meticulous dissection in the region of the upper pole of the thyroid. In most situations, the nerve can be recognised regardless of the pathology or extent of the lesion, and malignancy seldom interferes with nerve identification. “Joll's triangle” is a useful marker for identifying EBSLN. It is formed laterally by the upper pole of the thyroid gland and vessels, superiorly by the attachment of the strap muscles and deep investing layer of fascia to the thyroid, and medially by the midline. Its floor is cricothyroid, and its content is EBSLN.[17] Before ligating the arteries, the nerve must be definitely identified since it passes through this relatively avascular zone.

In our study, out of the 29 EBSLN, 24 (82.35%) nerves were successfully identified, whereas 5 (17.64%) nerves could not be identified. In our study, nerve branches crossing the STV above the upper pole of the thyroid gland were the predominant branching pattern, accounting for 68.97% of cases. These EBSLN branching patterns are classified under Cernea types 1 and 2a. According to the Cernea classification, there are three variations in EBSLN's anatomical course.[14] In type 1, EBSLN crosses STV more than 1 cm above the upper pole of the thyroid gland, in type 2a, EBSLN crosses the STV within 1 cm above the upper pole of the thyroid gland, and in type 2b, EBSLN crosses the STV under the cover of the upper pole of the thyroid gland. This finding is consistent with the reported identification rate of 55% (type 2a) by Glover et al and 73.3% (type 2a) by Athvale et al.[19,20] We observed 4 (13.79%) EBSLN that cross the STV underneath the upper pole of the thyroid gland. In a similar study done in Eastern populations, Aina et al reported 56% type 2a, 17.30% type 1, and 26.7% type 2b.[21] Mishra et al reported 53.54% type 2a, 28.20% type 1, and 8% type 2b.[22] The reason for the nonidentification of the nerve may be due to the location of EBSLN underneath the thyroid's upper pole (Cernea type 2b), which makes the nerve vulnerable to damage during dissection. The second possibility of non-identification of EBSLN could be its damage during upper pole dissection owing to its intimate anatomical association with the superior thyroid arteries.[18]

CONCLUSION

During thyroid operations, surgeons should focus on preserving the external branches of the superior laryngeal nerve. The procedure may be accomplished by using a combination strategy, including the lateralisation of the superior pole and meticulous dissection in the avascular cricothyroid space. We should direct our dissection more carefully in the region above the upper pole of the thyroid, as the majority of EBSLN crosses the superior thyroid vessels above the upper pole of the thyroid gland. We should also avoid extensive dissection in search of EBSLN, keeping in mind that some nerve branches that cross the superior thyroid vessels under the cover of the upper pole of the thyroid gland put patients at greater risk for injury during thyroidectomy.

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REFERENCES

1. Joshi RR, Rijal AS, Shrestha KK, Dhungana A, Maharjan S. Identification and preservation of external branch of the superior laryngeal nerve during thyroid surgeries at NMCTH. J Coll Medi Sciences-Nepal. 2017;13(3):306-10.
2. Uludag M, Aygun N, Kartal K, Citgez B, Besler E, Yetkin G, et al. Contribution of intraoperative neural monitoring to preservation of the external branch of the superior laryngeal nerve: a randomized prospective clinical trial. Langenbeck's Arch Surg. 2017;402:965-76.
3. Barczyński M, Randolph GW, Cernea CR, Dralle H, Dionigi G, Alesina PF, et al. External branch of the superior laryngeal nerve monitoring during thyroid and parathyroid surgery: International Neural Monitoring Study Group standards guideline statement. Laryngoscope. 2013;123:S1-4.
4. Kochilas X, Bibas A, Xenellis J, Anagnostopoulou S. Surgical anatomy of the external branch of the superior laryngeal nerve and its clinical significance in head and neck surgery. Clin Anat: J Ame Assoc Clin Anatom Brit Asso Clin Anat. 2008;21(2):99-105.
5. Morton R, Whitfield P, Al-Ali S. Anatomical and surgical considerations of the external branch of the superior laryngeal nerve: a systematic review. Clin Otolaryngol. 2006;31(5):368-74.
6. Soylu L, Ozbas S, Uslu HY, Kocak S. The evaluation of the causes of subjective voice disturbances after thyroid surgery. Am J Surg. 2007;194(3):317-22.
7. Kark AE, Kissin MW, Auerbach R, Meikle M. Voice changes after thyroidectomy: role of the external laryngeal nerve. Br Med J (Clin Res Ed). 1984;289(6456):1412-5.
8. Aluffi P, Policarpo M, Cherovac C, Olina M, Dosdegani R, Pia F. Post-thyroidectomy superior laryngeal nerve injury. Euro Arch Oto-Rhino-Laryngol. 2001;258:451-4.
9. Friedman M, LoSavio P, Ibrahim H. Superior laryngeal nerve identification and preservation in thyroidectomy. Arch Otolaryngol–Head Neck Surg. 2002;128(3):296-303.
10. Eckley CA, Sataloff RT, Hawkshaw M, Spiegel JR, Mandel S. Voice range in superior laryngealnerve paresis and paralysis. J Voice. 1998;12(3):340-8.
11. Delbridge L. The 'neglected'nerve in thyroid surgery: the case for routine identification of the external laryngeal nerve. ANZ J Surg. 2001;71(4):199-.
12. Kerian K. Comparing the morbidity of external laryngeal nerve injury in thyroid surgery with and without identifying the nerve using intraoperative neuromonitoring. Med J Malaysia. 2012;67(3):289.
13. Eisele DW, Goldstone AC. Electrophysiologic identification and preservation of the superior laryngeal nerve during thyroid surgery. Laryngosc. 1991;101(3):313-5.
14. Teitelbaum BJ, Wenig BL. Superior laryngeal nerve injury from thyroid surgery. Head Neck. 1995;17(1):36-40.
15. Wu BL, Sanders I, Mu L, Biller HF. The human communicating nerve: an extension of the external superior laryngeal nerve that innervates the vocal cord. Arch Otolaryngol–Head Neck Surg. 1994;120(12):1321-8.
16. Sanders I, Wu BL, Mu L, Li Y, Biller HF. The innervation of the human larynx. Arch Otolaryngol–Head Neck Surg. 1993;119(9):934-9.
17. Gray H. Anatomy of the Human Body. Philadelphia: Lea &Febiger; 1918:910-913.
18. Cernea CR, Ferraz AR, Furlani J, Monteiro S, Nishio S, Hojaij FC, et al. Identification of the external branch of the superior laryngeal nerve during thyroidectomy. Amer J Surg. 1992;164(6):634-9..
19. Glover AR, Norlén O, Gundara JS, Morris M, Sidhu SB. Use of the nerve integrity monitor during thyroid surgery aids identification of the external branch of the superior laryngeal nerve. Ann Surg Oncol. 2015;22:1768-73.
20. Athvale PK, Bokare BD, Ekhar VR. Identification and Preservation of External branch of superior laryngeal nerve in Thyroidectomy. Int J Phonosurg Laryngol. 2013;3(2):39-41.
21. Aina EN, Hisham AN. External laryngeal nerve in thyroid surgery: recognition and surgical implications. ANZ J Surg. 2001;71(4):212-4.
22. Mishra AK, Temadari H, Singh N, Mishra SK, Agarwal A. The external laryngeal nerve in thyroid surgery: the 'no more neglected' nerve. Ind J Med Sci. 2007;61(1):3-8.

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