

ORIGINAL ARTICLE

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Stepwise approach to preserve the external branch of superior laryngeal nerve during thyroidectomy

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Abstract

Background: Most of the surgeons tend to avoid exposing and identification the external branch of the superior laryngeal nerve (EBSLN) during thyroidectomy. In this study, our aim is to assess sequential steps to ligate superior thyroid vessels safely away from the External branch of superior laryngeal nerve (EBSLN).

Methods: This prospective case series study was conducted on 60 patients going for either total or hemi thyroidectomy in a tertiary teaching hospital between January 2016 and June 2019. During thyroidectomy, firstly we skeletonized the upper pole of the thyroid gland by its capsular dissection followed by anterolateral down retraction of the superior pole. Then, entry and opening of the cricothyroid space and lastly clamping and ligating superior thyroid pedicle close to the upper pole away from EBSLN.

Results: This study included 60 cases; 19 total thyroidectomy and 41 hemi thyroidectomy with 79 superior thyroid vessels ligation and EBSLN at risk. In all patients, no evidence of superior laryngeal nerve (SLN) palsy or bleeding was detected. Postoperative video laryngoendoscopy showed apparently normal mobility, length, level, and position of the vocal folds with symmetry of the larynx. The patients' voice showed no changes from preoperative evaluation in all studied patients at 3 months postoperative evaluation. No patients complained of any changes in their voice or voice activities.

Conclusion: The described stepwise approach for preservation of the EBSLN serves to completely remove the superior pole of the thyroid gland and ligate superior thyroid vascular pedicle without risk of SLN injury.

Keywords: Thyroidectomy, Thyroid gland, Superior laryngeal nerve, Vocal cords, Voice, Approach

Background

Recurrent laryngeal nerve (RLN) identification during thyroidectomy is considered nowadays the best way in order to avoid its injury [1]. On the other side, most of the surgeons tend to avoid exposing and identification the external branch of the superior laryngeal nerve (EBSLN) during thyroidectomy [2–4]. EBSLN provide the only motor nerve supply to the cricothyroid muscles

that is responsible for the vocal fold tension and voice pitch; important challenge in professional voice user.

In capsular dissection technique for thyroidectomy, dissection runs between the surgical capsule (false capsule) of the gland and its true capsule. The surgical capsule originates from the pretracheal fascia enveloping the thyroid gland, superior thyroid vessels, superior parathyroid gland, inferior, and middle thyroid veins; then, it goes medially and inserted in the posterolateral part of the trachea [5] and does not envelop EBSLN.

Superior laryngeal nerve (SLN) is one of vagus nerve branches. At the hyoid bone level, it divides into external and internal branches, close to superior thyroid artery

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(STA). The internal branch (sensory and autonomic) supplies laryngeal mucosa superior to true vocal folds and it accompanies the superior laryngeal artery (SLA) to penetrate thyrohyoid membrane so it is away from thyroidectomy surgery [6].

EBSLN (motor) descends behind the larynx (superior thyroid vessels) on the inferior constrictor muscle then terminates in the cricothyroid muscle. Cricothyroid muscle supplied by EBSLN tenses the vocal folds thus increasing the pitch of the voice [6].

Inspire of operative techniques have been described to minimize its injury, EBSLN injury are still demonstrated post thyroidectomy in 5% [7] to 30% [8] of patients and detailed well described step wise sequential approach is still required to preserve this overlooked nerve.

In this work, we used the retraction of the skeletonized superior pole as a method to safely ligate superior thyroid vessels away from EBSLN as a reliable approach to minimize its injury.

Methods

This prospective case series study was conducted on 60 patients diagnosed as goiter and scheduled for either hemi or total thyroidectomy in a tertiary teaching hospital between January 2016 and June 2019.

Exclusion criteria included revision cases, previous neck irradiation, previous laryngeal, thyroid or neck surgery, and patients with any preoperative vocal cord mobility disorders.

Preoperative work-up comprised clinical examination, neck ultrasound and assay of thyroid hormonal profile. Fine-needle aspiration cytology (FNAC) was done for either solitary nodule or dominant nodule in case of multinodular goiter. Pre- and postoperative video laryngoscopy was done to all patients via rigid oral 70° or 90° telescope connected to a camera by speech evaluators blinded to the technique. Mobility of the vocal fold, bowing, symmetry and regularity of the mucosal wave, glottic shink, and the degree of glottis closure were evaluated and recorded. Follow-up for at least 6 months has been done for all patients.

The operative technique is as follows:

A lower neck incision has been done over a skin crease with elevation of the subplatysmal flaps. The strap muscles were separated in the midline, dissected off the thyroid gland, and retracted laterally exposing the gland. The sternothyroid muscle can be partially divided if exposure of the cricothyroid space and the upper pole was limited by the close proximity of the muscle insertion into the thyroid cartilage with care to preserve the ansa cervicalis at its lateral border. Approach to the thyroid gland began with dissection through the non-vascular plane medial

to the carotid vessel along the length of the exposure and the middle thyroid vein should be ligated once seen.

The stepwise approach includes (1) free the superior pole completely of the overlying strap muscles with superolateral retraction of the muscles then dissect the upper pole to be covered only by its capsule. (2) The superior pole was then grasped by tissue forceps, pulled then retracted in an anterior, inferior and lateral direction so the lateral cricothyroid space was opened. The EBSLN runs across the superomedial part of this space even in its lowest course variant. (3) The cricothyroid space was entered from medial to lateral by a fine mosquito in its lower half close to the retracted superior pole that away from expected SLN location. Then, the superior blood vessels were ligated then divided in close proximity to the upper pole capsule. At that point, lobectomy was completed. In case total thyroidectomy was planned, the other lobe was separated using the same technique (Figs. 1 and 2).

Signs of EBSLN injury include down displacement and/or bowing of the involved vocal fold, rotation of the

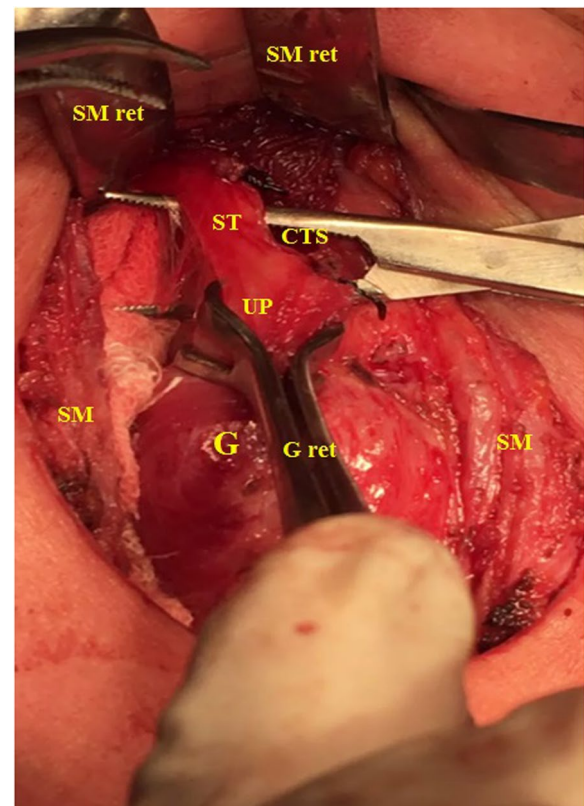


Fig. 1 The upper pole (UP) of the thyroid gland (G) was freed from the covering strap muscles (SM) and UP was retracted by tissue forceps (G ret) inferiorly and anterolateral so the lateral cricothyroid space (CTS) was opened to dissect superior thyroid vessels (ST)

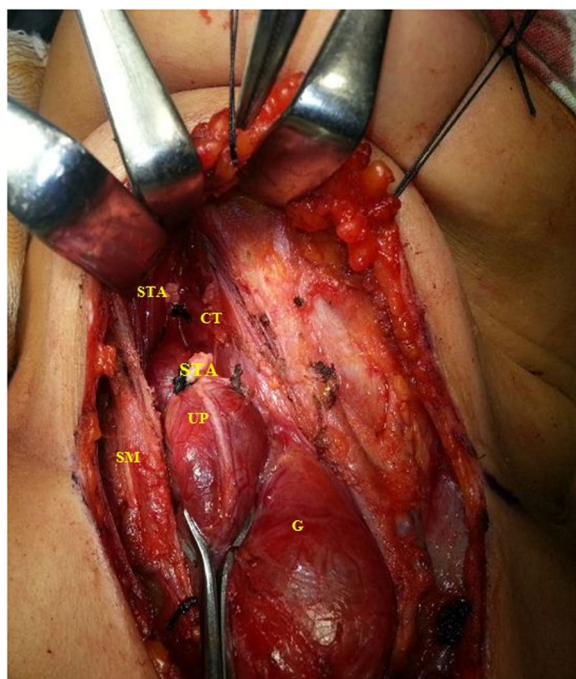


Fig. 2 The superior thyroid pedicle (ST) was ligated and cut close to upper pole (UP) of thyroid gland (G) that was retracted exposing the cricothyroid muscles (CT)

posterior glottis with tilting of the larynx to the affected side.

Voice was assessed before the operation then at 1 week, 3 months, and 6 months postoperatively via the voice assessment protocol [9, 10] and Voice Problem Self-Assessment Scale (VPSS) [10, 11].

Results

This study included 60 cases; 19 (31.7%) total thyroidectomy and 41 (68.3%) hemi thyroidectomy (79 lobectomies) with 79 superior thyroid vessels ligation and EBSLN at risk.

Seventeen cases (28.3%) proved pathologically to be malignant, while other 43 (71.7%) cases confirmed to be benign. Patients were 8 (13.3%) males and 52 (86.7%) females, and age range was 20 to 57 years (mean; 32.6 ± 10.2). All patients were non-smokers except two male (3.3%) (Table 1).

Among all patients, there was no evidence of RLN palsy, SLN palsy, or bleeding during follow-up. Video laryngoendoscopy showed apparently normal mobility, length, level, and position of the vocal cords with symmetry of the larynx with no signs of EBSLN injury in any case. Also, there were no obvious abnormalities in mucosal wave or vocal fold movement limitation either before surgery or during follow-up.

Table 1 Epidemiological data for the patients

Thyroidectomy		Number	Percent
Surgery	Total thyroidectomy	19	31.7%
	Hemi thyroidectomy	41	68.3%
Thyroid disease	Benign	43	71.7%
	Malignant	17	28.3%
Surgery			
Sex	Males	8	13.3%
	Females	52	87.7%
Age	Range	20 to 57 years	
	Mean	32.6 ± 10.2	
Smoking	Non-smokers	58 (96.7%)	
	Smokers	2 (3.3%)	

Study of the patients' voice showed no changes from preoperative evaluation in all studied patients at 3 and 6 months postoperative evaluation. No patient complained of any changes in his/her voice or voice activities.

Discussion

The SLN (one of vagus nerve branches) has external and internal branches. During thyroidectomy, The internal branch (the sensory branch) is not at risk because it enters the larynx via the thyrohyoid membrane far away from surgical field. On the other hand, the EBSLN innervates the cricothyroid muscle, which is involved in the vocal folds elongation. It has an intimate close anatomical relation with the superior thyroid pedicle. Therefore, it is more liable to be injured during thyroidectomy [4, 12].

In case of EBSLN trauma, voice abnormalities such as voice weakness and hoarseness with poor vocal volume may occur causing notable significant important impact on the professional voice users and public speakers and even may change their life. So, EBSLN preservation during thyroidectomy is an important challenge in such patients particularly in total thyroidectomy with bilateral surgical risk.

Even though some studies addressed EBSLN preservation, we here tried to put reliable surgical sequential steps in stepwise approach to reduce the risk of EBSLN injury during thyroidectomy.

The EBSLN descends dorsal to the carotid sheath crossing medially toward the larynx. The EBSLN is usually located superficial to the inferior constrictor muscle and dorsal to the superior thyroid artery during its descend and travels medially innervating the cricothyroid muscle on the anterolateral aspect of the lower part of the cricoid cartilage [4].

The EBSLN course was described in many classification systems such as Friedman et al. classifications [4],

and Kierner et al. [13]. However, Cernea et al. [14] classification is the most commonly used in which injury of EBSLN has a higher incidence with grade IIa and IIb where the nerve lies closely to or on the upper edge of the superior pole of the gland.

An important note is that all classifications used for EBSLN course description while the upper pole of thyroid gland in its anatomical location without retraction. Thus it is clear that down retraction of the skeletonized upper pole to > 1 cm will take the vascular pedicle away from cricothyroid muscle and so away from its supplying nerve (EBSLN) in all directions. It is important to completely skeletonize the upper pole to exert traction on the gland upper pole and its attached vessels only avoiding any traction on the nearby nerve. That is why, in current study, the described stepwise sequential approach for superior thyroid vessels ligation could preserve EBSLN in all cases in an easy reliable methods without need for extra tools such as neuromonitoring that is not always available and not free of risk.

The cricothyroid space is a non-vascular space commonly dissected to find and ligate the superior pole vessels. The superior pole is at a level above the cricopharyngeus and cricothyroid. Retraction of the skeletonized superior pole (covered only by the glandular capsule) downward will take gland with the attached superior thyroid pedicle downward so become away from the superior laryngeal nerve so ligation of the vessels become safe as regards EBSLN.

Separation of the skeletonized upper thyroid pole including dissection, ligation, and division of the superior thyroid vessels insures complete removal of the upper pole without cutting through it. In addition described approach aids in subsequent gland delivery and will reveal the area where surgeon can begin dissection of the surgical thyroid gland capsule in the way of capsular dissection to complete lobectomy.

EBSLN received poor attention in the thyroidectomy literature as compared with RLN. EBSLN has received limited citations in which it was not well described with lack of thorough analysis. So, EBSLN has been referred to as the neglected nerve in thyroid surgery [6]. Therefore, we believe the current sequential stepwise description of EBSLN preservation significantly describes and clarifies this important task during thyroidectomy.

Conclusion

The described stepwise approach for EBSLN preservation during thyroidectomy serves to completely remove the upper pole of the thyroid gland and ligate superior thyroid vascular pedicle without risk of SLN injury.

Acknowledgements

Not applicable

Authors' contributions

MWE suggested and developed research idea, performed the surgical work, wrote the methodology, and revised manuscript. TMA collected the data, reviewed the literature, revised the manuscript, and prepared the figures. AOK reviewed literature, assisted in the data interpretation statistical analysis, and wrote and revised the manuscript. All authors have read and approved the final manuscript.

Funding

None.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The institutional review board of Faculty of Medicine, Zagazig University has approved the research methodology (IRB: 1766/14-12-14). The study was conducted according to the declaration of Helsinki on Biomedical Research Involving Human Subjects. Consent to participate in the study was provided by all participants.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Received: 21 December 2021 Accepted: 25 March 2022

Published online: 15 April 2022

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