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Original Research Article

The Role of Endoscope Assisted Intra-Operative Identification of External Branch of Superior Laryngeal Nerve in the Outcome of Voice Following Thyroid Surgery

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ABSTRACT

Aims: (I) To identify the External Branch of Superior Laryngeal Nerve (EBSLN), along with Recurrent Laryngeal Nerve (RLN), during thyroid surgery by adopting endoscopic magnification along with routine dissection methods. (II) To determine the significance of intra-operative identification of EBSLN for preservation of quality of voice following Thyroid surgery.
Methodology: A prospective institutional comparative study was carried out for 2 years from August 2014 to July 2016 with a sample size of 40 patients, who were admitted for Thyroid surgery. The sample size was divided into two equal groups of 20 patients each. In Group A, Thyroid surgery was conducted by employing conventional dissection techniques, where EBSLN was not identified. In Group B, special care was taken to preserve the EBSLN with the aid of endoscopic magnification. The patients were clinically evaluated for any changes in voice, particularly related to injury to the EBSLN; by assessing for hoarseness of voice, easy fatigability, inability/difficulty to produce high pitch voice; three days and one month following surgery. Furthermore, patients underwent indirect and flexible videolaryngoscopy, and voice recording. The results were statistically evaluated.
Results: Employment of endoscopic magnification along with routine dissection techniques, helped in the preservation of EBSLN in Group B patients. Cernea Type 1 variation was the most common (69%). The voice outcome assessment in Group B patients was found to be superior to that in Group A.
Conclusion: There seems to be an important role of preservation of EBSLN along with RLN during thyroid surgery for conserving a superior quality of voice. Endoscopic magnification aids in identification of EBSLN and its variants.

Key words: EBSLN, RLN, identification, endoscope, voice, thyroid surgery

INTRODUCTION

Thyroidectomy is a commonly conducted surgical procedure for the treatment of benign and malignant thyroid nodules. The intricate anatomic structures for phonation, which lie in proximity to the thyroid gland, are vulnerable to injury during thyroid surgery. The identification and preservation of the laryngeal nerves can help in voice conservation. However, unlike RLN, it is not a routine practice to identify and preserve EBSLN. The EBSLN carries the only motor fibers to the cricothyroid muscle, which functions to tilt the thyroid cartilage relative to the cricoid cartilage, thereby increasing the distance between the anterior commissure and the posterior commissure of the larynx. This increased the length and tension of the vocal fold. Injury to the EBSLN results in changes in

voice quality, voice projection, and the production of high pitched sounds. [1,2] Clinically, a patient with EBSLN palsy may have a hoarse or weak voice. Voice symptoms may be more noticeable with professional speakers, especially singers. The famous opera singer Amelita Galli-Curci suffered damage to the EBSLN after thyroid surgery. This nerve has since become known as the "nerve of Galli-Curci." Various classification systems have been used to describe the course of the EBSLN. We have used the Cernea classification in this study- Type 1 Crosses Superior Thyroid Artery (STA) > 1 cm above upper pole of thyroid; Type 2a Crosses STA < 1 cm above upper pole of thyroid; Type 2b Crosses STA under cover of upper pole of thyroid. [3,4] The use of Intraoperative Nerve Monitoring (IONM), magnifying glasses, as well as video-endoscopic thyroid surgery has been explored for preservation of EBSLN. [5,6,15,17] In our study, we have advocated a simple modification of the conventional thyroid surgery for easy identification of the EBSLN.

MATERIALS AND METHODS

Two years of institutional prospective comparative study was carried out. Out of 68 patients, admitted for Thyroid surgery, 40 patients, who satisfied the inclusion and exclusion criteria, were randomly divided into 2 equal groups, A and B.

In Group A, Thyroid surgery was conducted by routine dissection techniques, where no extra effort was made to identify EBSLN. In Group B, along with the conventional dissection techniques, EBSLN was identified and preserved with the help of endoscopic magnification during dissection of the superior pole ("HYBRID TECHNIQUE").

Clinical and laryngoscopic voice assessment was carried out 1 day preoperatively and at 3rd day and 1st month postoperatively. The results were statistically evaluated [chi sq test, Fischer exact test, Man-U Whitney test; $p<0.05$(S)]

INCLUSION CRITERIA

Age: 15 – 55 years, Non-toxic colloid goitre restricted to one lobe, Preoperative voice assessment to be within normal limits

EXCLUSION CRITERIA

Malignancy, Toxic goiter, Patients not giving consent, Unfit (physically, mentally), Mute

SURGICAL TECHNIQUE

Group A: Inferior to superior pole thyroid dissection with preservation of RLN, with no attempt to identify EBSLN.

Group B: During dissection of the inferior and superior pole, magnification by video-endoscopy (4mm 0 degree rigid endoscope) was additionally used to identify and preserve both the laryngeal nerves.

Cernea classification was used for identifying EBSLN types.

VOICE ASSESSMENT

Questionnaire:

("*Was any change of voice noted by either patient, close attendant?* Yes/No") [7]

MPT (Maximum Phonation Time): Patient asked to say sustained vowel *'aa'* continuously for as long as possible; longest of 3 performance was considered; abnormal <10 sec [8]

GRBAS score (Grading of Hoarseness, Roughness, Breathiness, Asthenia, Strain) : 0 to 15 0: Normal; 1: Mild; 2: Moderate; 3: Severe

Change in pitch and loudness range [8]

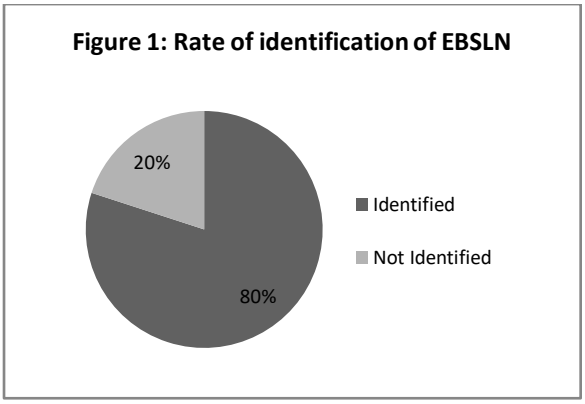
LARYNGOSCOPY

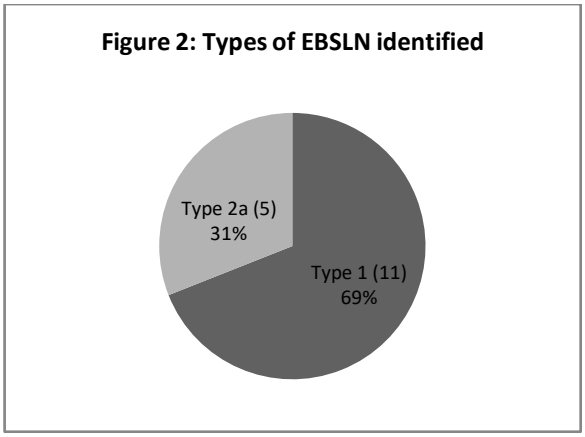
Flexible fibreoptic videolaryngoscopy was used. Patient was asked to utter sustained *vowels.* Positive laryngoscopy findings (due to probable nerve injury) were noted by the following:

Glottic asymmetry, Vocal Cord bowing, Inadequate Vocal Cord approximation, Vocal Cord displacement inferiorly

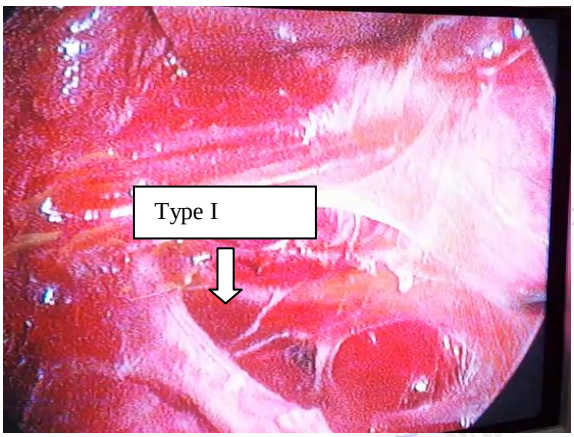
RESULTS

Rate of identification of RLN was 100% in both the study groups, EBSLN was identified in 80% of patients in Group B.





Type 1 EBSLN was predominant (69%), followed by Type 2a (31%).



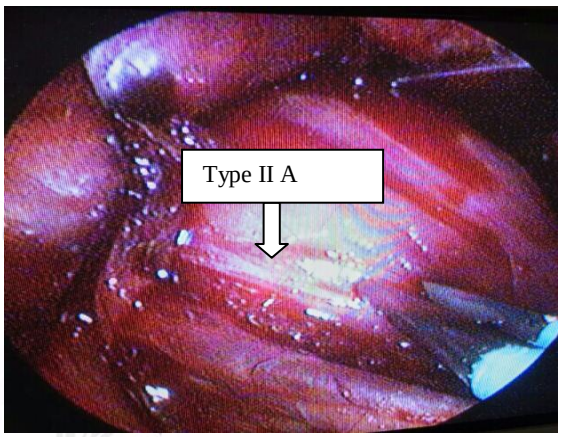


Figure 3: Intraoperative picture showing endoscopic magnification of EBSLN type I
Figure 4: Intraoperative picture showing endoscopic magnification of EBSLN type II A

Mean duration of surgery was 50.57 ± 5.19 minutes in Group A; 54 ± 6.55 minutes in Group B (p=0.06). At 3rd postoperative day, voice change was noted in 17/20 patients in Group A; 15/20 patients in Group B (p=0.694). At 1 month postoperative period, 8/20 patients had voice change in Group A; 3/20 patients in Group B (p=0.15).

Table I&II: GRBAS scores distribution at 3rd day and 1 month postoperative period

3rd day	0-3	4-8	9-15
Group A	6	10	4
Group B	10	8	2
P=0.888			

1 month	0-3	4-8	9-15
Group A	9	9	2
Group B	19	1	0
P=0.0025			

When comparing the Maximum Phonation Time (MPT), at 3rd day postoperative period, >10% decrease from preoperative MPT values was found in 14/20 patients in Group A, 5/20 patients in Group B (p=0.01); at 1 month postoperative period, it was found in 10/20 patients in Group A, 1/20 patients in Group B (p=0.0033).

Table III & IV: MPT> 10% from preoperative MPT at 3rd day and 1 month postoperatively

3rd day	MPT> 10%	MPT <10%
Group A	14	6
Group B	5	15
P = 0.01		

1 month	MPT> 10%	MPT <10%
Group A	10	10
Group B	1	19
P = 0.0033		

Table V & VI: Change in Loudness range

At 3rd day postoperative period, it was found in 9/20 patients in Group A, 6/20 patients in Group B (p=0.5144); at 1 month postoperative period, it was found in 3/20 patients in Group A, 1/20 patients in Group B (p=0.604).

3rd day	Change in Loudness	No Change in Loudness
Group A	9	11
Group B	6	14
P = 0.5144		

1 Month	Change in Loudness	No Change in Loudness
Group A	3	17
Group B	1	19
P = 0.604		

Table VII & VIII: Change in Pitch range

At 3rd day postoperative period, it was found in 17/20 patients in Group A, 15/20 patients in Group B (p=0.694); at 1 month postoperative period, it was found in 10/20 patients in Group A, 2/20 patients in Group B (p=0.013).

3rd day	Change in Pitch	No Change in Pitch
Group A	17	3
Group B	15	5
P = 0.694		

1 month	Change in Loudness	No Change in Loudness
Group A	10	10
Group B	2	18
P = 0.013		

Table IX & X: Positive postoperative laryngoscopy findings,

At 3rd day postoperative period, it was found in 12/20 patients in Group A, 10/20 patients in Group B (p=0.751); at 1 month postoperative period, it was found in 6/20 patients in Group A, 2/20 patients in Group B (p=0.235).

3rd day	Positive postoperative flexible laryngoscopy findings	Negative postoperative flexible laryngoscopy findings
Group A	12	8
Group B	10	10
P = 0.751		

1 month	Positive postoperative flexible laryngoscopy findings	Negative postoperative flexible laryngoscopy findings
Group A	6	14
Group B	2	18
P = 0.235		

DISCUSSION

Damage to the EBSLN, associated with impairment of cricothyroid muscle motility, leads to alteration of the high tones production ability, the voice and frequency. This nerve is surgically relevant because of its proximity to the superior thyroid pole and vessels and must be carefully approached in order to avoid iatrogenic injury. [9] In only about 15% of the cases, the EBSLN is protected from surgical manipulation via a location far from the superior pole vessels. Iatrogenic injuries can be avoided via an accurate anatomic localization during surgical dissection. [4,10] Unfortunately, the identification of this nerve is not done routinely. [6] However, there is an increasing trend to explore new technologies for EBSLN localization. Magnifying glasses are available to identify and preserve the laryngeal nerves, hence reducing the morbidity. [11]

Notably, Berti et al. reported a 65% EBSLN detection rate in video-assisted thyroidectomy with the aid of an optical magnification endoscope based visualization guidance. In this way, IONM has been proposed as an adjunct to the standard technique of intraoperative detection of the laryngeal nerves. [12,13] In our study, along with the routine dissection techniques, the identification and preservation of EBSLN was facilitated with the help of endoscopic magnification during dissection of the superior thyroid pole, a "Hybrid technique". The result showed a superior voice outcome in comparison to the control group where EBSLN was not identified. We have compared our results with other studies where EBSLN was preserved during thyroid surgery.

With the "Hybrid technique" in the current study, 80% of EBSLN was identified, in comparison to Barczynski et al (84%) and Bin et al's (75.6%) IONM

studies; and Dedivitis et al's Endoscopic Thyroid Surgery (83.3%). Berti et al. reported a 65% EBSLN detection rate in video-assisted thyroidectomy with the aid of an optical magnification endoscope based visualization guidance. [9,12] Cernea Type 1 EBSLN was the most commonly encountered (69%) in our study, which was supported by studies by Barczynski *et al (*47.6%) and Bellantone *et al (*58.6%). [14,9] Duration of surgery was comparable in both the groups. Current study showed statistically significant MPT, GRBAS score, pitch range evaluation, indicating post-operative conservation of the pitch, strength and projection of voice in the Group B in comparison to the control Group A. Such favorable voice outcome due to EBSLN preservation was supported also by IONM study by Barczynski et al and Endoscopic Thyroid surgery by Lombardi et al. However, conflicting view was observed in the study by Bellantone *et al*, where they concluded that though nerve stimulator aided in nerve identification, meticulous placement of superior pole ligature close to the gland showed similar voice outcome. [7,14,16]

There were certain limitations in our study, namely; a small sample size, limited inclusion criteria, unavailability of superior methods of vocal cord assessment like videostroboscopy and high speed cinematography.

CONCLUSION

The identification and preservation of EBSLN, along with RLN during thyroid surgery, undoubtedly yields a better voice outcome. Hence, possible attempts should be made to facilitate the same. Intraoperative nerve monitoring, video assisted Endoscopic Thyroidectomy and magnifying glasses are the recent tools which have helped in identification of EBSLN along with RLN. In our study, we have attempted to combine the routine thyroid dissection method with endoscopic magnification during dissection of the superior pole to help in identification of EBSLN, which we called "Hybrid Technique". This technique, requiring no extra skill or armamentarium, has yielded favorable results. It does not claim to be superior to the other available tools for identification of EBSLN, but can be easily used as an adjunctive step during conventional thyroid surgery. Despite the favorable outcome in the current study, further long term studies with a larger sample size, broader inclusion criteria and better monitoring techniques can be undertaken to come to a unanimous conclusion.

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