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Original Article

Relationship between Recurrent Laryngeal Nerve Diameter and Body Mass Index for Preoperative Prediction of Nerve Size in Thyroidectomy

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ABSTRACT

Objective: To study the correlation between recurrent laryngeal nerve diameter and Body Mass Index for preoperative prediction of nerve size in thyroidectomy.
Study Design: Cross-sectional study.
Place and Duration of Study: ENT Department, Combined Military Hospital, Rawalpindi Pakistan, from Jul 2021 to Jul 2022.
Methodology: Patients of either gender aged above 25 and below 80 years who had undergone open thyroidectomies, had malignancies and revision surgery with normal cords were included. Body Mass Index was measured preoperatively, and recurrent laryngeal nerve diameter was measured per operatively after meticulous dissection. RLN was exposed by tracking the inferior thyroid artery and traced along its total course. RLN diameter was measured using Castroviejo caliper. Postoperative examination was performed by an Otolaryngologist with the help of an Anesthesiologist for the assessment of vocal cord functions.
Results: Sixty individuals were included in the study. The male-to female ratio was 1:3, the mean age was 45.00±12.22 years, mean height and BMI was 164.55±5.02 cm and 26.59±2.16 kg/m2 respectively. Mean diameter of right and left recurrent laryngeal nerve was 1.46+0.20 mm and 1.71±0.20 mm. Pearson correlation showed a positive and statistically significant relationship between BMI and RLN diameter (r=0.748 right RLN, r=0.812 left RLN, *p*=0.001). Male candidates had thicker recurrent laryngeal nerve diameters than females on either side.
Conclusion: Body Mass Index has a strong positive correlation with diameter of the recurrent laryngeal nerve and can be used as preoperative tool to measure the size of recurrent RLN in thyroid surgeries.

Keywords: Body Mass Index, Recurrent Laryngeal Nerve, Thyroidectomy.

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INTRODUCTION

Recurrent Laryngeal Nerve (RLN) damage is a grave and unacceptably catastrophic complications of thyroid and parathyroid surgery. Besides being a cause of medico legal issues for specialists, concurrent paralysis of bilateral RLN may lead to airway difficulty and can be fatal[1]. Many treatment modalities have been described for the surgical management of thyroid diseases, including nodule excision, bilateral subtotal thyroidectomy, near-total thyroidectomy, and total thyroidectomy, during which nerve injury may occur. One reason for a high rate of nerve injury is attributed to a difference of size and course of RLN[2]. Exact knowledge of variations and the exact course of the RLN is paramount to refrain from any nerve damage during thyroidectomy procedures. Due to diseases and presence of structures immediately surrounding this nerve in the thorax, the left recurrent laryngeal nerve (RLN) is more susceptible to becoming compressed or damaged, resulting in vocal cord palsy. The left recurrent laryngeal nerve follows a more elongated course and bends in reverse at the ligament arteriosus of the aortic arch, while the right RLN is much shorter in course [3,4].

A thin recurrent laryngeal nerve diameter has been perceived as a negative prognostic factor for RLN palsy after thyroid surgery[5]. Injury of the nerve is thought because of extending of the nerve or transmission of heat intensity from electrocautery[6]. In addition, thin nerves are considered to be more vulnerable to damage by compression and traction even during routine manipulation. Therefore, it is important to assess size of nerve to avoid RLN palsy.[7]

The impact of Body Mass Index (BMI0 on surgical outcomes is currently a topic of increasing study. Studies have hypothesized, based on common anatomical pattern, that the RLN diameter might be

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related to patient body size[7]. However, we found a dearth of similar studies in our region, which forms the rationale for our study.

METHODOLOGY

The cross-sectional study was conducted at the Otolaryngology Department of Combined Military Hospital (CMH), Rawalpindi Pakistan, from July 2021 to July 2022, after approval from Hospital Ethical Committee (Serial No 233). Sample size was calculated using Open EPI calculator taking 4% prevalence of recurrent laryngeal nerve injury during thyroidectomies[5].

Inclusion Criteria: Patients of either gender aged between 25 and 80 years who had undergone open thyroidectomies between July 2021 and July 2022, those with suspected malignancy and revision surgery with normal cord movements were included.

Exclusion Criteria: Patients having abnormal vocal cord movements and hoarseness of voice were excluded from the study.

Written informed consent from patients prior to data collection. Non-probability consecutive sampling was used. All cases were operated under general anesthesia by the consultants having experience in thyroid surgery.

After the thyroid gland was removed, the RLN was identified across the inferior thyroid artery and tracked both proximally and distally up to its entry into the larynx.

Castroviejo caliper was used to calculate the thickest available RLN diameter, which was usually observed almost 2 cm before the nerve entered the larynx (Figure).

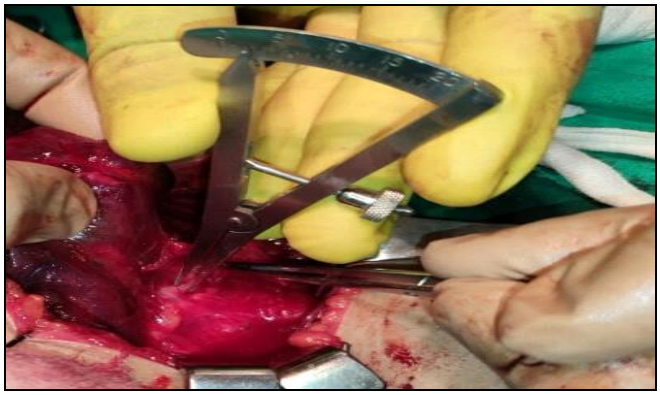

Figure: Measurement of Recurrent Laryngeal Nerve Thickness during Surgery

The parameters gathered included patient sex, nerve thickness, body weight, BMI and surgical procedure performed—whether ipsilateral or bilateral.

Statistical Package for Social Sciences (SPSS) version 23 was used for data entry and analysis. Mean±SD was calculated for continuous variables. Frequency and percentage was calculated for categorical variables. Pearson correlation was applied to see relationship among variables. The *p* value of ≤0.05 was considered as significant.

RESULTS

Sixty patients planned for total thyroidectomy or lobectomy were enrolled in our study. The male and female ratio was 1:3, the mean age was 45.00+12.22 years, the mean height was 164.55 ± 5.02, average BMI was 26.59±2.16 kg/m2. Mean diameter of right and left recurrent laryngeal nerve was 1.46±0.20 mm and 1.71±0.20 mm respectively (Table-I).

Table-I: Demographic Characteristics of the Patients (n=60)

Study Parameters	Mean±SD
Age in years	43.70±12.22
Weight in kg	72.10±8.24
Recurrent laryngeal Nerve Diameter (mm)	
Right	1.46±0.20
Left	1.71±0.20
Height in cm	164.55±5.02
BMI in kg/m2	26.59±2.16
Gender	**n(%)**
Male	13(21.70)
Female	47(78.3)

The correlation between BMI and RLN diameter was positive for Right RLN (r=0.748) and Left RLN (r=0.812) with significant p value 0.001, which shows that recurrent laryngeal nerve size was directly associated with an increased BMI shown in Table-II.

Table-II: Relationship between Recurrent Laryngeal Nerve Diameter and Body Mass Index of the Patients (n=60)

BMI & Right Recurrent laryngeal nerve diameter	**r-value***	**0.748**
	***p*-value**	**0.001**
BMI & Left Recurrent laryngeal nerve diameter	r-value*	0.812
	p value	0.001

**An r value of more than 0.7 indicates a strong positive correlation. An r value of more than 0.8 indicates a very strong positive correlation.*

Correlation of RLN diameter with BMI in males and females revealed that the statistical significant varied, as shown in Table-III.

Table-III. Relationship between Recurrent Laryngeal Nerve Diameter and Body Mass Index across Genders (n=60)

BMI Male & Right Recurrent laryngeal nerve diameter	**r-value**	**0.293**
	***p*-value**	**0.331**
BMI Male & Left Recurrent laryngeal nerve diameter	r-value	0.645
	p value	0.017
BMI Female & Right Recurrent laryngeal nerve diameter	r-value*	0.779
	p value	0.001
BMI Female & Left Recurrent laryngeal nerve diameter	r-value*	0.820
	p value	0.001

**An r value of more than 0.7 indicates a strong positive correlation. An r value of more than 0.8 indicates a very strong positive correlation.*

DISCUSSION

This was among the first studies in Pakistan to specify the association between weight and height of the patient and intraoperative measurement of recurrent laryngeal nerve diameter. We found that the RLN width was directly related with the patients BMI, which was characterized by their weight and height. Literature evaluation found a correlation between postoperative risks of RLN injury and a smaller RLN diameter[8].

Numerous studies showed that precise identification of the nerve reduces the risk of developing permanent recurrent laryngeal nerve palsy.[9-11]. This may also help in spinal, cardiac and esophageal surgeries[12], as these surgical techniques are also known to expose RLN trajectory. Prior to surgery, patients should be fully informed of postoperative risk of RLN injuries. This can assist to reduce serious surgical and medico legal complications.[13,14]

China's Affiliated Cancer Hospital of Zhengzhou University has analyzed 386 papillary thyroid carcinoma patients who had thyroid surgeries and lateral neck dissection between January 2013 and December 2016[15]. They evaluated complications in non-obese (BMI <28.0 kg/m2) and obese (BMI 28.0 kg/m2) patients. Patients with increased body weight showed a higher risk of postoperative bleeding, length of surgery, and infection. Wu *et al*. enrolled 848 patients with 1357 RLNs at risk in the study1. Patients with body heights under 160 cm and BMIs under 25 had thinner RLN diameters. Height, bodyweight and BMI all correlated positively with RLN diameter. This was in accordance with our findings. In our study the key finding was strong association between nerve size and BMI. This is in line with other international studies [16,17].

Previously it was considered that increase in BMI leads to increased postoperative complications18,19 High BMI was not, however, a documented contraindication for outpatient thyroidectomy. Our data suggests that high BMI leads to increase in size of recurrent laryngeal nerve and easy identification of nerve.

The prior knowledge of the exact thickness of the nerve diameter using body height, weight and size measuring data improves clinical decision-making in both thyroid and parathyroid procedures. However further studies and a larger of series of patients may be more beneficial regarding the prediction of RLN injury during thyroid surgery.

CONCLUSION

In our data we observed that BMI is strongly correlated with size of recurrent laryngeal nerve.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MS, AAG: Conception, study design, drafting the manuscript, approval of the final version to be published.

UA, SF: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

NR, IY: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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