

ORIGINAL RESEARCH ARTICLE

## IDENTIFICATION OF RECURRENT LARYNGEAL NERVE AT ITS ENTRY POINT USING CRICOTHYROID MUSCLE AS A LANDMARK DURING THYROIDECTOMY- OUR EXPERIENCE

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### ABSTRACT:

Thyroidectomy is a commonly performed surgery for various thyroid diseases. The common complications associated with a thyroid surgery are recurrent laryngeal nerve palsy (unilateral or bilateral), hypoparathyroidism due to injury to parathyroid glands during surgery. We employed the technique of identifying recurrent laryngeal nerve at its entry point using cricothyroid muscle as landmark and noted the frequency of recurrent laryngeal nerve palsy and hypoparathyroidism in this technique.

**Objective:** To predict the frequency of occurrence of recurrent laryngeal nerve palsy and permanent hypo-parathyroidism during thyroidectomy by identifying the recurrent laryngeal nerve at its entry point using cricothyroid muscle as landmark and retrograde tracking of it.

**Material and methods:** We conducted a retrospective study at two tertiary care centres in India. In this study, we took all the patients of thyroidectomy where recurrent laryngeal nerve was identified at its entry point using cricothyroid muscle as landmark and traced in a retrograde manner. A total of 36 patients were included in the study. We predicted the frequency of recurrent laryngeal nerve palsy and hypoparathyroidism by using our method to identify recurrent laryngeal nerve.

**Results and discussion:** In present study there was no permanent laryngeal nerve palsy but the frequency of permanent hypoparathyroidism was 11.6 %.

**Key words:** recurrent laryngeal nerve, hypoparathyroidism, cricothyroid muscle.

### INTRODUCTION:

Thyroidectomy is a commonly performed surgery for various thyroid diseases like multinodular goiter, Grave's disease and thyroid carcinomas<sup>1</sup>. Various types of thyroid surgeries were performed in the past for thyroid diseases like lobectomy, isthumectomy, subtotal thyroidectomy, near total thyroidectomy and total thyroidectomy. But the current surgical trend favours operative procedures limited to lobectomy, isthumectomy and total thyroidectomies even for benign diseases like multinodular goiter and Graves' disease<sup>1-5</sup>. The common complications associated with a thyroid surgery are recurrent laryngeal nerve palsy (unilateral or bilateral), hypoparathyroidism due to injury to parathyroid glands during surgery, haematoma etc. But the most common complication is recurrent laryngeal nerve palsy. Various

surgical techniques have been used to recognize and trace the recurrent laryngeal nerve during thyroid surgery to avoid injury to it. Many landmarks are utilized to identify recurrent laryngeal nerve like berry's ligament, inferior thyroid artery

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and the tubercle of Zuckerkandle<sup>6</sup>. Frequency of recurrent laryngeal nerve palsy ranges from 0.3 to 9% in literature<sup>6,7</sup>. Another most common complication of total thyroidectomy is hypoparathyroidism. Preservation of parathyroid gland with its blood supply is mandatory to prevent hypoparathyroidism post-surgery. Several studies in the literature report the frequency of permanent hypoparathyroidism following total thyroidectomy to be ranging from 1.6% - 50%<sup>1,2,8,9</sup>. We are here in describing our experience of thyroid surgery cases, where we meticulously identified the recurrent laryngeal nerve at its entry point and traced it in a retrograde manner to prevent post-operative complications.

#### OBJECTIVES:

1. To predict the frequency of occurrence of recurrent laryngeal nerve palsy during thyroidectomy by identifying the recurrent laryngeal nerve at its entry point using cricothyroid muscle as landmark and retrograde tracing of it.
2. To furnish the chances of occurrence of permanent hypoparathyroidism by employing the same method in thyroidectomy

#### MATERIALS AND METHOD:

A multi-institutional retrospective cohort study was carried out at Kasturba Hospital, Manipal and Andaman and Nicobar Islands Institute of Medical Sciences, Port Blair on patients who underwent hemi-thyroidectomy, total thyroidectomy or completion thyroidectomy for various thyroid diseases from June 2012 to August 2017. The patient selection included solely those thyroidectomy cases, in which the recurrent laryngeal nerve was preoperatively identified and traced.

All 36 patients selected for the study underwent Ultrasonography of neck, thyroid function tests and fine needle aspiration preoperatively. Extent of surgery was pre-decided depending on fine needle aspiration cytology (FNAC) and Ultrasonography neck reports. Patients with benign unilateral nodule underwent hemi-thyroidectomy while patients with malignant diseases underwent total or completion thyroidectomy. Patients with multinodular goiter involving both thyroid lobes also underwent total thyroidectomy.

In the current study, we identified recurrent laryngeal nerve precisely at its entry point to larynx and traced its course in a retrograde manner. [Fig 1] The nerve was duly recognised at its entry point using lower border of cricothyroid muscle as a landmark, after ligating the superior pole of thyroid. It was then traced along its course in a retrograde method. Post operatively second day, we carried out video-laryngoscopy

examination on all the operated patients to assess the vocal cord mobility. Loss of vocal cord mobility is termed as recurrent laryngeal nerve palsy. The same video-laryngoscopic examination was performed at 6 months post-operative to determine permanent recurrent laryngeal nerve palsy.

On the second post op day, we measured the serum calcium levels in all the patients to assess the parathyroid function. The calcium levels < 8 mg/dl were labelled as hypoparathyroidism. The calcium levels were also assessed at 6 months post operatively. Serum calcium levels below 8 mg/dl, were termed as permanent hypoparathyroidism. Data was analysed using SPSS 16 software.

#### OBSERVATIONS AND RESULTS:

A total of 36 patients who had undergone thyroidectomy were included in our study. Out of 36 patients, 32(89%) were females (F) and only 4 (11%) patients were males (M). There was a clear female preponderance, with a high F:M ratio of 8:1. The age of patients in the study ranged from 26 years to 62 years with a mean age of 43 years.

Fine needle aspiration and cytology was performed for all the 36 subjects. On the basis of FNAC findings, the patients were categorized as follows: 22(61%) patients were diagnosed with colloid goiter, 9(25%) patients suffered from papillary carcinoma and the remaining 5(13%) were diagnosed with follicular neoplasm. The thyroid diseases demonstrated the following gender distribution; out of 4 male patients, 2 were diagnosed with papillary carcinoma, one patient with colloid goiter and the remaining one patient with follicular neoplasm on FNAC. Out of 32 female patients, a majority (21) suffered from colloid goiter. Seven female patients were diagnosed with papillary carcinoma while the remaining 4 had follicular neoplasm. In the individual gender groups, 50% of the male patients, in male group were diagnosed with malignancy of thyroid while in the female group; only 22% of female patients were detected with malignancy of thyroid on FNAC.

A total of 19 of 36 (53%) patients underwent hemi-thyroidectomy, 12(33%) patients underwent total thyroidectomy and a minority of 5(14%) patients underwent completion thyroidectomy. Post thyroidectomy specimens were sent for final histopathological examination. A thorough histopathological examination revealed colloid goiter or multinodular goiter in 14(39%) patients. Thirteen (36%) patients were diagnosed with papillary carcinoma, 4(11%) with follicular adenoma, 4(11%) with follicular carcinoma and the remaining one (3%) patient was diagnosed as a case of anaplastic carcinoma. In our study, 50% of the patients were suffering from benign thyroid diseases and the other 50% with

malignancies of thyroid. In males, the final histopathological examination revealed papillary carcinoma in 2 patients and follicular adenoma and colloid goiter in the other two respectively. The female distribution of thyroid diseases on histopathological examination is as follows: 13 females were diagnosed with colloid goiter, 3 with follicular adenoma, 11 female patients were detected with papillary carcinoma, 3 with follicular carcinoma and the remaining one with anaplastic carcinoma. We calculated sensitivity of FNAC to able to identify true number of papillary carcinoma cases from total number of papillary carcinoma cases. Sensitivity of simple FNAC is 64% for diagnosis of papillary carcinoma in the current study.

We divided the patients into three age groups of < 20 years, 20-40 years and > 40 years. We tried to find distribution of the benign and malignant thyroid diseases in different age groups There was no patient recorded in the age group of < 20 yrs. Sixteen patients were in the age group of 20-40 yrs. Out of the latter, 10 patients (62.5%) were detected with benign thyroid disease (7 colloid goiter, 3 follicular adenoma); 6 (37.5%) patients suffered from carcinoma of thyroid, 5 patients with papillary carcinoma and 1 suffered from follicular carcinoma. Twenty patients were in the age group of > 40 yrs. In this group, 12(60%) were diagnosed with carcinoma thyroid gland (8 papillary carcinoma, 3 follicular carcinoma and 1 anaplastic carcinoma); the remaining 8(40%) patients were detected with benign disease (7 colloid or multinodular goiter, 1 follicular adenoma).

Twelve patients underwent total thyroidectomy, 19 patients hemi thyroidectomy and the remaining 5 patients underwent completion thyroidectomy. During surgery, the recurrent laryngeal nerve was identified at its entry point in all cases and traced in a retrograde manner Total no of recurrent laryngeal nerves identified were 48. On the second post-operative day, vocal cords were visualised with Hopkins rod (video laryngoscopy) to check the vocal cord mobility. Out of 48 nerves identified, 1(2%) showed paralysis 2<sup>nd</sup> post op day. At 6months follow up, the paralysis of the nerve recovered fully. In our study, observed transient recurrent laryngeal palsy was 2%, but no permanent palsy was noted. It was statistically significant.

In all cases, parathyroid glands were identified and preserved. We measured the serum calcium levels in patients at post-operative day 1. Calcium level < 8 mg/dl were considered to indicate hypoparathyroidism. Out of 19 patients who underwent hemi thyroidectomy, none developed hypoparathyroidism. In our study, 12 patients underwent total thyroidectomy and 5 patients, completion thyroidectomy.

Thus, a total of 17 patients were at risk of developing hypoparathyroidism. Out of the latter, 8 (47%) patients developed low calcium levels at post op day 1.[Table 1] On a complete follow up over a period of 6 months, 6 of 8 patients, recovered completely while 2 patients still required calcium supplements at 6 month post op for recovery. In our study, 47% patients developed transient hypoparathyroidism and 11.6 % patients developed permanent hypoparathyroidism. [Table 2] It was statistically significant.

#### DISCUSSION:

Thyroid diseases are very common in the current Indian population.[10] These diseases have been found to have a greater incidence in females as compared to males. In our study also, F:M ratio was 8:1. Preoperative workup for thyroid diseases includes thyroid function tests, Ultrasonography of neck but the most imperative diagnosis is imparted by FNAC of thyroid lesions. Recent literature recommends lobectomy, isthumectomy and total thyroidectomy for thyroid diseases. The type of thyroidectomy depends upon the pathology of the thyroid lesion, which is predetermined by FNAC.

**Table 1.** Post operative hypoparathyroidism at day 2 in total and completion thyroidectomy

Surgery	Hypoparathyroidism post op day 2		Total patients	Patients who developed hypoparathyroidism %	P value <0.05 considered significant
	Present	Absent			
Total thyroidectomy	6	6	12	50%	
Completion thyroidectomy	2	3	5	40%	
<b>Total</b>	<b>8</b>	<b>9</b>	<b>17</b>	<b>47%</b>	<b>&lt;0.003</b>

**Table 2.** Hypoparathyroidism at 6 months post-operative after total and completion Thyroidectomy.

Surgery	Hypoparathyroidism post op at 6 months		Total patients	Patients who developed hypoparathyroidism %	P value <0.05 considered significant
	Present	Absent			
Total thyroidectomy	2	9	12	16.7%	
Completion thyroidectomy	0	5	5	0%	
<b>Total</b>	<b>2</b>	<b>15</b>	<b>17</b>	<b>11.7%</b>	<b>&lt;0.038</b>



**Figure 1.** Recurrent laryngeal nerve at its entry point (small arrow) during thyroidectomy and its relationship with cricothyroid muscle (big arrow).

Sensitivity of FNAC to diagnose thyroid diseases ranges from 63%-93 % in various studies<sup>11,12</sup>. In the present study, sensitivity of FNAC to diagnose papillary carcinoma was observed to be 64%. Extent of benign diseases like multinodular goiter is accessed with the help of Ultrasonography of neck and thyroid function tests which further assist in diagnosis of Grave's disease. Lobectomy is usually done in benign diseases like nodular goiter confining to only one lobe of thyroid. Total thyroidectomy is done for carcinoma of thyroid gland, multinodular goiter involving both thyroid lobes and for Graves' disease. In our study, 19 patients underwent lobectomy, 12 underwent total thyroidectomy and 5 underwent completion thyroidectomy.

In cases of thyroid swelling, chances of getting thyroid carcinoma are greater in male patients and in an age group greater than 40 years. In our study, in both male and female patient groups, 50 % of the patients were diagnosed with carcinoma of thyroid gland in the final histopathological report. Age group of >40 years was found to have higher incidence of carcinoma of thyroid gland as compared to the age group of 20-40 years.

The most common complication of thyroid surgery has been found to be recurrent laryngeal nerve palsy. Various landmarks are used to identify the recurrent laryngeal nerve accurately during thyroid surgeries like tracheoesophageal groove, relation to inferior thyroid artery, berry's ligament and tubercle of Zuckerkandle<sup>6</sup>. The observed frequency of recurrent laryngeal nerve paralysis in the current literature is between 0.3% and 9%. The common modes of injury to the nerve include partial or complete transection, traction or mishandling of the nerve, contusion, crush, burn, clamping,

misplaced ligature, and compromised blood supply<sup>13,14</sup>. Accidental transection of the nerve usually occurs at the level of the upper two tracheal rings, where the nerve closely approximates the thyroid lobe in the area of Berry's ligament. Intraoperative haemostasis along with comprehensive knowledge of anatomy are indispensable for an accurate nerve identification and preservation<sup>15,16</sup>. Proper identification of the recurrent laryngeal nerve and careful dissection during thyroid surgery minimizes the chances of recurrent laryngeal nerve palsy. The recurrent laryngeal nerve palsy can be transient which recovers over a period of time. It can be permanent due to more severe injury. In our study, frequency of transient recurrent laryngeal nerve palsy is 2% and no permanent palsy reported.

Postoperative clinically manifested hypoparathyroidism is another major and occasionally a serious complication of total thyroidectomy. Postoperative hypoparathyroidism after thyroidectomy has been variably defined, frequently based on the total serum calcium levels. Moreover, in the recent times, the intraoperative, perioperative, or immediate postoperative intact parathyroid Hormone (iPTH) levels are employed to categorize and foretell postoperative hypoparathyroidism more precisely. Literature suggests varying rates of developing hypoparathyroidism post thyroidectomy which ranges from 1.6%-50 %.<sup>17</sup> Most authors recommend serum calcium levels below 8 mg/dl to be called as hypocalcaemia and hypoparathyroidism. It is a relatively cheaper method to detect post-operative hypoparathyroidism. iPTH levels <10pg/ml is also considered as an indicator of hypoparathyroidism by a majority of authors. Transient hypoparathyroidism occurring post total thyroidectomy is common and the prevalence of hypoparathyroidism is quite high. Majority of patients of transient hypoparathyroidism recover over a period of time. Some authors suggest a waiting period of at least 6 months duration, for complete recovery of parathyroid functions and before labelling it as permanent hypoparathyroidism<sup>18-22</sup>. In our study, transient hypoparathyroidism was observed in 47% cases, but a majority of patients recovered completely after a 6 months period. Permanent hypoparathyroidism was noted in 11% of patients postoperatively after 6 months.

#### CONCLUSION:

Recognition of recurrent laryngeal nerve at its entry point to larynx and then tracing it in a retrograde manner during thyroid surgery is a novel method which immensely reduces the chances of permanent recurrent laryngeal nerve palsy. In spite of meticulous precise surgical techniques, the chances of getting hypoparathyroidism post thyroid surgeries are inevitable.

**DISCLOSURES:**

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- (c) Funding - None
- (d) Written consent of patient- taken
- (e) Animal rights - not applicable
- (f) Plagiarism - not crossed the limit

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