

ORIGINAL RESEARCH**Assessment of Intra-operative Risk of Recurrent Laryngeal Nerve Injury during Thyroidectomy**

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ABSTRACT**BACKGROUND**

In this study, we wanted to evaluate the risk of damage to the recurrent laryngeal nerve (RLN) during thyroidectomy, determine as to whether or not impairment of nerve function follows adequate dissection of the nerve during operation, and assess the risk of damage to the RLN in association with different techniques of thyroidectomy.

MATERIALS AND METHODS

This was a hospital based prospective study conducted among 100 patients who presented with thyroid swelling to the Department of General Surgery, M.K.C.G. Medical College Hospital, Berhampur from July 2019 to June 2021 (including six months of follow-up) after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

RESULTS

Out of the 100 nerves, 8 were found to be primarily injured in the immediate post-operative period. Among the 8 nerves injured, 4 cases recovered in the 1 year follow up; first 2 within 21 days after surgery and the remaining 2 cases recovered before the end of 1 year. In the remaining 4 cases, damage (all unilateral) was permanent, putting the overall incidence of permanent recurrent laryngeal nerve injury to around 4 %. The age incidence of the patients in the study group ranged from 15 - 70 years. Most of the patients in the study were in the age group of 35 - 50 years. In the study, 13 (18.5 %) were males and 57 (81.4 %) were females. Male : Female ratio is 22.8. In 53 dissected nerves, a total initial injury was observed in 4 cases (7.54 %), 3 (5.66 %) being temporary and 1 (1.88 %) being permanent. Majority of the paralysis in the dissected group was temporary. In the non-dissected 47 nerves, the incidence was higher. 4 nerves (8.52 %) showed an initial injury. Majority of the injuries were permanent; that is 3 nerves (6.39 %) showing no signs of recovery. A difference in the rate of injury could be noticed between right side and left side.

CONCLUSION

Routine systematic exposure of recurrent laryngeal nerves reduces the incidence of complications in thyroid surgery to a minimum. After the superior pedicle is ligated, the recurrent laryngeal nerve should be identified and its course traced to the entry at larynx. If we do a dissection of recurrent laryngeal nerve over its entire course, we will be able to avoid any inadvertent damage to any pre laryngeal branches, if present. Before operating on a thyroid, we should have a thorough knowledge of anatomy and variations of the thyroid and recurrent laryngeal nerve. Dissection should be meticulous with thorough haemostasis. RLN identification is protective more than non-identification & consequently pre-operative nerve identification is strongly recommended.

KEYWORDS

Assessment of Intra-operative Risk, Recurrent Laryngeal Nerve Injury, Thyroidectomy.

INTRODUCTION

Thyroid disorders are the most common among all the endocrine diseases in India. The burden of thyroid diseases in the community is formed by both, benign and malignant diseases. Thyroid nodules may be benign (simple non-toxic or multi-nodular goitre, follicular adenomas and cysts) or malignant (papillary carcinoma, follicular carcinomas and medullary carcinoma). They are more common in females and prevalence mainly depends on age, sex, iodine intake, diet (goitrogens), therapeutic and environmental radiation exposure. Although the vast majority are benign lesions, about 5 % may actually represent thyroid cancer.^[1] Surgery of thyroid is one of the most common surgical procedures. A post-operative recurrent laryngeal nerve palsy is a surgical tragedy. It is an iatrogenic horror comparable to a surgically induced facial nerve paralysis and more incapacitating than the loss of a lower limb.^[2,3] Unfortunately thyroidectomy continues to produce high rate of complications and damage to the recurrent laryngeal nerve is occasionally an inevitable complication of thyroid surgery. It may be temporary or permanent and/or unilateral or bilateral. The incidence of permanent palsies ranges from 0.3 to 3 % of cases^[4] and transient palsies occurs in 3 – 8 % of cases.^[4,5] Furthermore, such a disaster is one of the reasons for medico-legal litigation.^[6] These injuries induce a significant post-operative morbidity.^[7] In addition to the hoarseness that occurs with unilateral recurrent laryngeal nerve injury, bilateral recurrent laryngeal nerve injury leads to dyspnoea to life threatening acute airway obstruction.^[8,9] Identifying the recurrent laryngeal nerve during thyroid dissection is the gold standard to avoid neural injury.^[10] The difficulty of dissecting and finding the recurrent laryngeal nerve lies in the great anatomic variability of its position and sometimes due to an early division in branches.^[11] The RLN is very sensitive and can easily be harmed by different intra-operative actions i.e. stretching, compressing, cutting and heating.^[12] Post-operative RLN injuries can be transient or permanent. Transient injuries usually recover from 4 weeks to 12 months. Dysfunctions lasting more than 6 months are considered permanent. Opinion as to the advisability of deliberately exposing the nerve during thyroidectomy was sharply divided. In 1918 Judd, New and Mann showed that the RLN of dogs could be handled without fear of damage.^[13] Yet the routine exposure and visualization of the recurrent nerves at thyroidectomy was not undertaken on a large scale until 1935, when surgeons at Lahey clinic began the practice of demonstrating the nerves practically in thyroid operations and showed there by a marked reduction in their figures for nerve injury following thyroidectomy. A critical chapter of the recurrent laryngeal nerve was played out in the United States. Dr. George Crile, in his textbook, *Diagnosis and Treatment of Diseases of the Thyroid Gland*, from 1932 wrote, every student of surgery knows the general position of the recurrent nerves, and yet the greatest tragedies which follow thyroidectomies pertain to these structures. Even the surgeon who has had much experience in operations on the thyroid gland reviews the position of the recurrent nerves as an evil memory. The hazard is not due, however, to the anatomical location of these nerves, but rather to the vulnerability of their structures, to the neighbourhood of fixation, to adhesions, and to certain characteristics of the nerve conduction.^[14] Crile recommended leaving the posterior capsule of the thyroid in each thyroid resection. The area near the nerve is “no man’s land.” “It is not to be palpated; it is subjected to the least possible traction and no division of tissue is made. By these precautions, temporary and permanent injury of the recurrent laryngeal nerve may be completely eliminated.^[14] This philosophy, which influenced an entire generation of surgeons which still exists today in the minds of some inexperienced surgeons, is the cause of many permanent nerve injuries.

Electrical identification and monitoring of the recurrent laryngeal nerve has been proposed as an adjunct to standard visual identification of the nerve during thyroid.^[15]

Aims and Objectives

- To assess the risk of damage to the RLN during thyroidectomy.
- To assess whether or not impairment of nerve function follows adequate dissection of the nerve during operation.
- To assess the risk of damage to the RLN in association with different techniques of thyroidectomy

MATERIALS AND METHODS

This was a hospital based prospective study conducted among 100 patients who presented with thyroid swelling to the Department of General Surgery, M.K.C.G. Medical College Hospital, Berhampur from July 2019 to June 2021 (including six months of follow-up) after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

Inclusion Criteria

- Patients of all age groups and both sexes with bilaterally normal vocal cords were included.

Exclusion Criteria

- Patients with evidence of existing nerve lesions for e.g. abnormal vocal cord movements and hoarseness of voice were excluded.
- Patients in whom both vocal cords are not visualized on indirect laryngoscopy were excluded.
- Patients with prior history of thyroid surgery were excluded.

Study Procedure

A prospective study involving 100 RLNs in 70 surgical patients at MKCG Hospital was performed over a period of two and a half years. Patients were selected pre-operatively from different surgical units on a random basis. The patients ranged in age from 15 to 70 years and majority were in the 30 - 45 years group. Of these patients, 13 were males and 57 were females. All were scheduled for thyroidectomy - total / near total, subtotal or lobectomy. Disease entities were both benign and malignant including thyroid cancer, thyroid adenomas, multi-nodular goitre and Grave's disease.

Patients were selected pre-operatively on a random basis, from different surgical units. For all the patients, thorough history was taken including the history of any recent change in voice & also physical examination was done. Ultrasound sonography (USG) & fine needle aspiration cytology (FNAC) of the swelling was done. All the patients selected for the study were subjected to pre-operative indirect laryngoscopic examination to assess the status of the vocal cords. Only patients with bilaterally normal vocal cords were included. Operations on patients with evidence of existing nerve lesions and operations patients, in whom, for any reason both vocal cords were not visualized on indirect laryngoscopy were rejected. All patients were subjected to thyroidectomy under general anaesthesia with endotracheal intubation. There were two groups, one group of patients undergoing thyroidectomy without identifying the RLN and the other group only after identification of the course of the RLN. All the operations were carried out by qualified surgeons in accordance with the standard surgical techniques for thyroid operations.

At the time of extubation, a note of the vocal cord position was made by the anaesthetist by a laryngoscopy. On the first post-operative day, any change in voice or hoarseness is elicited from the patient. Subsequently, these patients were subjected to indirect laryngoscopic examination at following intervals – 5 days, 3 weeks and 6 months after surgery. Patient was advised to follow up for change in voice and any deviation of vocal cords by laryngoscopy at third and sixth month. Thus, every patient was followed up for a period of 6 months after surgery. In case of vocal cord paralysis, if the vocal cord movement improved to normal status in this 6 month follow up, these were considered as temporary paralysis, and if the paralysis persisted after 6 months, they were declared as cases of permanent paralysis. We conducted a study to determine whether identification of the RLN reduces the number of permanent recurrent laryngeal nerve palsies by comparing it with non-identification of RLN.

Statistical Methods

Data was entered in MS Excel and analysed using Statistical Package for Social Sciences (SPSS) software. Results were presented as tables.

RESULTS

The results of the study were analyzed with references to the number of RLNs encountered during operations, and not in relation to the number of operations performed. A total of 100 nerves were observed. Of these, 53 nerves were exposed and 47 nerves were not identified. Right recurrent laryngeal nerves numbered 57 and left 43. No single case of bilateral paralysis was encountered in this study. Out of the 100 nerves, 8 were found to be primarily injured in the immediate post-operative period. Among the 8 nerves injured, 4 cases recovered in the 1 year follow up; first 2 within 21 days after surgery and the remaining 2 cases recovered before the end of 1 year. In the remaining 4 cases, damage (all unilateral) was permanent, putting the overall incidence of permanent recurrent laryngeal nerve injury to around 4 %.

Age (in Years)	Male	Female	Total	Percentage
1 to 10	0	0	0	0
11 to 20	0	0	0	0
21 to 30	1	2	3	4.28
31 to 40	1	11	12	17.14
41 to 50	4	26	30	42.85
51 to 60	5	10	15	21.42
More than 60	2	8	10	14.28
Age and Sex Incidence:				
Table 1. Demographic Distribution				

The age incidence of the patients in the study group ranged from 15 - 70 years. Most of the patients in the study were in the age group of 35 - 50 years. In the study, 13 (18.5 %) were males and 57 (81.4 %) were females. Male : Female ratio was 22.8.

Numbers	No of Nerves	Total Number of Palsy	Temporary Palsy	Permanent Palsy
Total	100	8 (8 %)	4 (4 %)	4 %
Dissected	53	4 (7.54 %)	3 (5.66 %)	1 (1.88 %)
Not dissected	47	4 (8.52 %)	1 (2.13 %)	3 (6.39 %)
Table 2. RLN Paralysis Based on the Number of Nerves				

There were two groups based on the exposure and non-exposure of the RLN during surgery. Of the 100 nerves, 53 were identified during surgery and the remaining 47 were not dissected out. In 53 dissected nerves, a total initial injury was observed in 4 cases (7.54 %), 3 (5.66 %) being temporary and 1 (1.88 %) being permanent. Majority of the paralysis in the dissected group was temporary. In the non-dissected 47 nerves, the incidence was higher. 4 nerves (8.52 %) showed an initial injury. Majority of the injuries were permanent; that is 3 nerves (6.39 %) showing no signs of recovery. In the remaining one (2.13 %), the paralysis was temporary making good recovery in the stipulated period of follow up. A difference in the rate of injury could be noticed between right side and left side.

	No of Nerves	Initial Total No of Palsy	Temporary Paresis	Permanent Paresis
Right	57	5 (8.75 %)	2 (3.50 %)	3 (5.25 %)
Left	43	3 (6.97 %)	2 (4.65 %)	1 (2.32 %)
Table 3: RLN Vulnerability Based on the Side				

This provides a summary of the nerves on each side and the incidence of injury on either side. In none of the cases, bilateral paralysis was observed. On the right side, permanent injury in 3 cases (5.25 %) against one case (2.32 %) on the left side was observed.

DISCUSSION

This prospective study was undertaken to find out the magnitude of thyroidectomy related damage to the RLN and it proved significant. A total of 100 nerves were subjected to study with 53 nerves being exposed and the remaining 47 were not exposed during thyroidectomy. This study concentrates mainly on the permanent damage suffered because both the patients and the surgeons are scared of the permanent palsy of the vocal cord. The results can be analysed in two ways i.e. (1) number of paralysis may be expressed in relation to the number of patients operated (2) second method is correlating the number of paralysis to the total number of nerves at risk, which is opted by most of the authors. Hence, to avoid disparity, we preferred the latter method. All the results were analysed statistically to find out the significance (Z test). The extremely low result observed by Riddell may be due to the technical expertise.

Study	% RLN Paralysis (Permanent)	P Value
Sinclair IS ^[16]	5.20 %	P > 0.05
Balanzoni ^[17]	5 %	P > 0.05
Riddell ^[3]	1.20 %	P < 0.001
Svendsen ^[18]	2.60 %	P > 0.05
Elnor A et al ^[19]	13.20 %	P < 0.001
Thompson ^[20]	11.90 %	P < 0.001
Gisselson ^[21]	3.90 %	P > 0.05
Van Zuideevigan DB ^[22]	3.10 %	P > 0.05
Moerman ^[23]	3.20 %	P > 0.05
Martensson ^[24]	3.60 %	P > 0.05
Ladurner ^[25]	5.40 %	P > 0.05
Current study	4 %	

Table 4: Permanent RLN Injury during Thyroid Surgery Comparison of the Result of This Study with Various Authors

This gives a vivid picture of the facts. The overall incidence of permanent RLN damage of 4 % figured in this study is well comparable to those from various institutions, "It is felt that a figure of about 5 % for RLN injuries in general surgical practice is not excessive" (Wade 1955)

Another important aspect of the study was whether unidentified recurrent nerve is in danger during thyroidectomy. Currently most authors have proved an improvement in the injury rate with RLN identification and hence many prefer this technique to a blind thyroidectomy.

In this study, the rate of recurrent nerve injury fell from 6.39 % to 1.88 % making an obvious difference of 4.51 % when RLN was identified. From the surgeon's point, we consider this 4.51 % as significant, though statistically this difference failed to show any significance. Lahey & Hoover (1938) noticed a fall from 1.6 % to 0.3 % when RLN was identified. Similarly, Cattell (1948) gave a figure of 3 % falling to 0.7 % (2.3 % diff.). Also Riddell (1969) noted a fall from 2 % to 0.6 % (1.4 % diff.) when RLN was identified. All of them consider this as clinically significant. Hence, in spite of the statistically insignificance, we strongly support the view that the unidentified RLN is in danger, however careful the surgeon.

Author	% Perm	P Value
Hoie J ^[26]	4.70 %	> 0.05
Riddell ^[3]	0.60 %	< 0.001
Holt G R ^[27]	4.20 %	< 0.05
Remacle ^[28]	4.50 %	> 0.05
Current study	1.88 %	

Table 5: Showing Comparison of Results with RLN Identification

In this study, the rate of recurrent nerve injury fell from 6.39 % to 1.88 % making an obvious difference of 4.51 % when RLN was identified. It is comparable to other authors.

Author	% Permanent	P Value
Riddell ^[3]	2 %	< 0.05
Gisselson ^[21]	3.90 %	> 0.05
Wagner ^[29]	7 %	> 0.05
Current study	6.39 %	

Table 6: Result of This Study Unidentified (RLN) Thyroidectomy & its Comparison to Other Authors

The difference in vulnerability between left and right nerves. As previously mentioned, it has been an experience of most of the observers that the right recurrent nerve is more often damaged than the left nerve. From this study, we feel that right sided nerves are more prone to injury even though we could not find out a statistically significant difference. The reasons for the increased vulnerability are already mentioned.

CONCLUSION

Routine systematic exposure of recurrent laryngeal nerves reduces the incidence of complications in thyroid surgery to a minimum. After the superior pedicle is ligated, the recurrent laryngeal nerve should be identified and its course traced to the entry at larynx. If we do a dissection of recurrent laryngeal nerve over its entire course, we will be able to avoid any inadvertent damage to any pre-laryngeal branches, if present. Before operating on a thyroid, we should have thorough knowledge of anatomy and variations of the thyroid and recurrent laryngeal nerve. Dissection should be meticulous with thorough haemostasis. RLN identification is protective more than non-identification & consequently pre-operative nerve identification is strongly recommended.

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