MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.7.610.613

Risk Assessment of Recurrent Laryngeal Nerve Injury in Thyroid Surgery: A Retrospective Analysis

[1]Rajesh Roat, [2]Namrata Khandelwal, [3]Vidushee Upadhyay and [4]Pradeep Balmiki

[1]Department of General Surgery, Government Medical College, Dungarpur, Rajasthan, India
[2]Department of Neurology, Superspeciality Hospital, NSCB Medical College, Jabalpur, Madhya Pradesh, India
[3]Sardar Vallabh Bhai Patel District Hospital, Satna, Madhya Pradesh, India
[4]Department of Surgery, ABVGMC, Vidisha, Madhya Pradesh, India

OPEN ACCESS

Key Words
Recurrent laryngeal nerve, thyroidectomy, thyroid carcinoma

Corresponding Author
Pradeep Balmiki,
Department of Surgery, ABVGMC, Vidisha, Madhya Pradesh, India
pradeepkumar2011@gmail.com

Author Designation
[1,2,4]Associate Professor
[3]Medical Officer

Received: 20 June 2024
Accepted: 30 July 2024
Published: 10 August 2024

Citation: Rajesh Roat, Namrata Khandelwal, Vidushee Upadhyay and Pradeep Balmiki, 2024. Risk Assessment of Recurrent Laryngeal Nerve Injury in Thyroid Surgery: A Retrospective Analysis. Res. J. Med. Sci., 18: 610-613, doi: 10.36478/makrjms.2024.7.610.613

ABSTRACT

A significant concern in thyroid surgery is the risk of iatrogenic injury to the Recurrent Laryngeal Nerve (RLN). One primary outcome of vocal cord paralysis is associated with thyroidectomy. This study aims to evaluate the incidence of RLN injury in patients undergoing thyroid surgery using data from a single institution and to investigate the factors contributing to RLN injury during these procedures. A retrospective review was conducted on 78 patients who had thyroid surgery at the ENT and Surgery departments. Patient records were assessed for history, physical examination, thyroid function tests and surgical reports to determine the type of surgery (total, near-total, or subtotal thyroidectomy) and RLN identification. Cases were classified as primary (no prior thyroid surgery) or secondary (one or more prior surgeries). RLN injury was evaluated in relation to gender, surgical type, category and histological diagnosis. Vocal cord paralysis or dysphonia was deemed permanent if lasting over six months and temporary if resolved sooner. In this cohort, the recurrent laryngeal nerve was successfully identified in 8 patients (33.33%), whereas it was not identified in the remaining 16 patients. Transient RLN injury was observed in 14 patients and 10 patients experienced chronic RLN damage. Temporary vocal cord paresis occurred in 9 patients (11.53%), with 3 cases being bilateral. The incidence of RLN injury was significantly higher in postoperative cases involving malignancy (23.08% in malignant conditions versus 7.69% in benign conditions) and in cases where the RLN was not identified during surgery (10.26% when identified versus 20.51% when not identified). The meticulous dissection and identification of the RLN during thyroid surgery may help mitigate the risk of iatrogenic nerve injury. The study highlights a significantly increased risk of operative RLN damage associated with thyroid cancer, repeat surgeries for recurrent goiter, and the failure to identify the RLN intraoperatively.

INTRODUCTION

Thyroid surgery is routinely performed for managing thyroid tumors. With a thorough understanding of thyroid anatomy and prevention strategies for complications, surgeons can minimize risks for each patient. Potential severe side effects of thyroid surgery include bleeding, recurrent laryngeal nerve (RLN) injury, hypoparathyroidism, hypothyroidism, thyrotoxic storm, superior laryngeal nerve damage and infection. Indications for thyroid surgery include the detection of thyroid cancer through fine needle aspiration biopsy, which remains the definitive diagnostic tool for thyroid nodules. Advances in hemostatic techniques, anesthetics, infection prevention and surgical approaches have accelerated the pace of thyroid surgery. Complications can be categorized into minor and major types, with seroma formation and significant wound scarring classified as moderate consequences[1,2].

One of the most common serious complications following thyroid surgery is RLN injury. Unilateral RLN damage is more frequent. Increased awareness and surgical advancements have reduced RLN injury rates to approximately 0.5%-5% in international reports. Bilateral RLN injuries can lead to aphonia, dyspnea and potentially life-threatening suffocation, while unilateral RLN injuries can cause varying degrees of hoarseness, microaspiration and coughing[3-5]. RLN damage is a primary source of medical disputes following thyroid surgery. Although rare, RLN complications after thyroidectomy can severely impact quality of life. Bilateral RLN injury causes hoarseness similar to unilateral injury, but also dyspnea and often fatal glottal obstruction. RLN injury is more prevalent in thyroid cancer, Graves' disease and re-exploration surgeries[6-8]. Preventing and managing RLN damage during thyroid surgery is essential.

In recent years, the use of nerve monitoring devices during surgery has been adopted by many surgeons to further reduce the already low incidence of RLN injury. Several short series have been published demonstrating the potential benefits of nerve monitoring in decreasing nerve damage rates. Deliberate identification of the RLN reduces the likelihood of injury. When the nerve is identified and dissected, the reported risk of RLN damage post-thyroidectomy is between 0% and 2.1%. Successful nerve identification and preservation rely on intraoperative hemostasis and a solid understanding of anatomy. RLN monitoring is increasingly used during thyroid cancer surgeries, as well as in hyperthyroid (toxic) goiter and recurrent goiter cases. Injuries in recurrent goiter are due to adhesions and anatomical displacement, while increased gland vascularization is the cause in hyperthyroid cases[9-12]. This study aims to evaluate the incidence of RLN injury in patients undergoing thyroid surgery using data from a single institution and to investigate the factors contributing to RLN injury during these procedures.

MATERIALS AND METHODS

A retrospective review was conducted on all patients who underwent thyroid surgery and were admitted to the ENT and Surgery departments. Patient records were evaluated for history, physical examination findings, thyroid function tests and surgical reports to determine the type of surgery (total, near-total, or subtotal thyroidectomy) and whether the RLN was identified. Pre-operative and three-day post-operative indirect laryngoscopy reports were also reviewed.

The study included cases categorized as primary surgery (no previous thyroid surgery) or secondary surgery (one or more prior thyroid surgeries). In all cases, efforts were made to identify the RLN. To prevent damage when the RLN could not be identified, careful dissection of the gland was performed and the associated vessels were ligated close to their distal branches. Patients were assessed for RLN injury concerning gender, type and category of surgical procedure, and histological diagnosis. Vocal cord paralysis or dysphonia observed during indirect laryngoscopy was classified as permanent if it persisted for more than six months and as temporary if it resolved sooners.

RESULTS AND DISCUSSIONS

The indications for thyroid surgery among the 78 study participants varied, with the most common reasons being thyroid carcinoma (19.23%) and thyroiditis (17.95%). Recurrent simple goiter (16.67%) and hyperthyroidism (14.10%) were also notable indications. Cystic thyroid lesions were present in 14.10% of cases, while solitary thyroid nodules and multinodular goiter were less frequent, affecting 10.26% and 7.69% of participants, respectively (Table 1).

Regarding the incidence and types of recurrent laryngeal nerve (RLN) paralysis associated with different thyroid surgical procedures, the highest rate of transient RLN paralysis was observed in reoperations for recurrent goiter (50.00%). Bilateral subtotal thyroidectomy and unilateral hemi thyroidectomy had lower rates of transient paralysis (26.32% and 17.65%, respectively). Permanent RLN paralysis was most common in unilateral subtotal thyroidectomy (31.25%), with bilateral subtotal thyroidectomy showing a rate of 10.53%. Other procedures, including total bilateral thyroidectomy, near total thyroidectomy and completion thyroidectomy, exhibited varying rates of RLN paralysis, with total rates of transient and permanent paralysis being 17.95% and 12.82%,

Table 1: Indications for Thyroid surgery among study participants

Indication	N	Percentage
Thyroid carcinoma	15	19.23
Thyroiditis	14	17.95
Recurrent simple goiter	13	16.67
Hyperthyroidism	11	14.10
Cystic thyroid lesions	11	14.10
Solitary thyroid nodule	8	10.26
Multinodular goiter	6	7.69
Total	78	100

Table 2: Incidence and type of RLN paralysis in various thyroid surgeries

			Transient RLN Paralysis		Permanent RLN Paralysis	
Surgical Procedure	n	Percentage	n	Percentage	n	Percentage
Bilateral Subtotal Thyroidectomy	19	24.36	5	26.32	2	10.53
Unilateral Hemi Thyroidectomy	17	21.79	3	17.65	3	17.65
Unilateral Subtotal Thyroidectomy	16	20.51			5	31.25
Total Bilateral Thyroidectomy	13	16.67	3	23.08		
Reoperation for Recurrent Goiter	6	7.69	3	50.00		
Near Total Thyroidectomy	5	6.41				
Completion Thyroidectomy	2	2.56				
Total	78	100	14	17.95	10	12.82

Table 3: Risk Factors for RLN injury in Thyroid surgeries

Category	n	Percentage	p-value
Gender			
Male	8	10.26	<0.05
Female	16	20.51	
Category of Operation			
Primary	6	7.69	<0.05
Secondary	18	23.08	
Identification of the Nerve			
Yes	8	10.26	<0.05
No	16	20.51	
Type of Operation			
Subtotal	13	16.67	0.56
Total/Near Total	11	14.10	
Pathology			
Benign	6	7.69	<0.05
Malignant	18	23.08	

respectively (Table 2). Analysis of risk factors for RLN injury revealed significant associations with gender, type of operation, and pathology. Female patients experienced a higher rate of RLN injury (20.51%) compared to males (10.26%), with a $p<0.05$. Secondary operations were associated with a significantly higher risk of RLN injury (23.08%) compared to primary operations (7.69%). Identification of the nerve during surgery was also a crucial factor, surgeries where the nerve was not identified had a higher incidence of RLN injury (20.51%) compared to those where the nerve was identified (10.26%). The type of operation did not significantly affect RLN injury risk, with subtotal and total/near total operations showing similar rates (16.67% and 14.10%, respectively). Malignant pathology was associated with a higher risk of RLN injury (23.08%) compared to benign conditions (7.69%), with a p-value<0.05 (Table 3).

One of the most common complications after thyroid surgery is persistent phonation dysfunction resulting from RLN damage[14]. Preventing irreversible RLN injury necessitates precise identification and careful tracing of the nerve's path. Factors such as anatomical variations, surgical techniques, prior thyroid surgeries, surgeon experience and histopathological findings significantly influence this complication. Nerve damage can occur due to mechanisms such as transection, traction, manipulation, contusion, crush, burn, clamping, misplaced ligature, or impaired blood flow[13-15].

Despite several high-quality studies, the value of RLN dissection remains debated, as some studies found no benefit or even an increased risk of vocal cord paralysis. While some research indicates that RLN dissection may not be necessary for subtotal resections, it is still considered beneficial in complex cases like thyroid cancer and for practical reasons. Our study found a 20.51% RLN injury rate in cases where the nerve could not be located. Dissection from the avascular cricothyroid space has been recommended as a safe technique for preserving the RLN, allowing surgeons to verify the nerve's anatomical integrity and identify any extra-laryngeal branches. The poor outcomes reported by surgeons who only partially exposed the nerve further support the preference for complete nerve exposure over partial[16].

Recent efforts to minimize RLN injury have included the use of nerve monitoring devices during surgery. Although various devices have been utilized, they all effectively detect vocal cord movement in response to RLN stimulation[16]. Numerous short-term studies have explored the potential benefits of monitoring to

reduce nerve damage rates[17]. However, nerve stimulators have only been effective in identifying the superior laryngeal nerve and have not significantly aided in anatomical dissection of the RLN. For experienced surgeons, continuous nerve monitoring during total thyroidectomy does not offer substantial advantages in terms of nerve identification, functional testing, or injury prevention. Intentional identification of the RLN is crucial for minimizing harm. Successful nerve preservation relies on effective intraoperative hemostasis and a thorough understanding of anatomy. RLN injury is increasingly common in thyroid cancer surgeries, as well as in hyperthyroid (toxic) goiter and recurrent goiter cases. Injuries in recurrent goiter are often due to adhesions and anatomical displacement, while hyperthyroid cases tend to involve increased gland vascularization[18]. In our study, the RLN injury rate was 23.08% in thyroid cancer cases and 7.69% in benign goiter cases. The type of surgical procedure also impacts RLN injury rates, with partial thyroidectomy associated with a lower RLN injury rate compared to total thyroidectomy.

CONCLUSION

Iatrogenic injury to the recurrent laryngeal nerve and its branches may be avoided through meticulous tracing, identification and exposure of the nerve. We advocate for a comprehensive extracapsular thyroidectomy combined with a systematic approach to locating the nerve. Surgeons should possess a thorough knowledge of the surgical anatomy of the thyroid region and be aware of the highly variable pathways of the recurrent laryngeal nerve, the inferior thyroid artery and their interrelationships.

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