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# Patterns of Laryngeal Nerves Injuries Following Thyroid Surgery in Al-Imamein Al-Kadhmein Medical City

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## Abstract

**Background** Morbidity after thyroid surgery related to injuries to parathyroid, recurrent laryngeal nerve (RLN) and external branch of superior laryngeal nerve (EBSLN), mostly due to unawareness of the anatomical variations and lack of meticulous dissection added to that patient comorbidity and type of goiter.

**Objective** To assess the incidence of nerves injuries (RLN and EBSLN) and evaluation of the risk factors for nerves injuries.

**Methods** A prospective study included 250 patients admitted to the General Surgical Unit at Al-Imamein Al-kadhimein Medical City from the first of October 2014 to the end of October 2017. Evaluation of nerves injuries (RLN and EBSLN) with regard to thyroid pathology, types of resection, age and gender. Thyroidectomies were done by different surgical teams. Patients with recurrent goiter, prior cervical surgery and preexisting vocal cord paralysis were excluded. Vocal cords assessment was done preoperatively, intraoperatively at time of extubation and postoperatively. Patients with injury to the RLN were managed accordingly and followed up by serial examination for 6-12 month, while patients with symptoms of EBSLN injuries were followed depending just on clinical feature due to lack of diagnostic facilities.

**Results** There were 78 (31.2%), 172 (68.8%) male and females subsequently. The age range was (18-70) years and mean±SD was (44±11.9). Multinodular goiter was the main presentation in (168 patients), while thyroiditis was the least (6 patients). Injury to RLN was reported in 8 (3.2%) patients, 3 had unilateral and 5 had bilateral. Permanent damage documented in 2 patients. There was a significant RLN injury association with malignancy and total thyroidectomy. EBSLN injury have been reported in 55 patients (22%), it was transient in 43 patients and permanent in 12 patients.

**Conclusion** Nerve damage after thyroidectomy is not uncommon and affect significantly on quality of life. Careful dissection and awareness of anatomical variation is essential. Majority of injuries were transient and recovered spontaneously. Immediate intervention is not recommended unless airway compromisation ensure.

**Keywords** RLN, EBSLN, thyroidectomy

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**List of abbreviations:** EBSLN = External branch of superior laryngeal nerve, EMG = Electromyography, LEMG = Laryngeal electromyography, RLN = Recurrent laryngeal nerve, SLN = Superior laryngeal nerve, STA = Superior thyroid artery, V.C. = Vocal cord, ZT = Zuckerkandl's tubercle

## Introduction

In the early nineteenth century, thyroid surgery was associated with high (40%) morbidity and (20%) mortality rates, due to

the lack of meticulous dissection techniques and sepsis [1]. With the advent of antiseptic techniques, refinement in surgical procedure, recognition of the presence of parathyroid, recurrent laryngeal nerve (RLN), and protection of the external branch of superior laryngeal nerve (EBSLN) resulted in lower morbidity and less than 0.1% mortality [1].

The complication which is most feared is trauma to the RLN estimated to occur in between 1 to 10% of operations. The nerve may be out, stretched or burnt, usually as a result of failure to recognize or dissect it properly. Unilateral paralysis of the RLN results in immobile vocal cord in the paramedian position which causes weak, cracked and breathy voice. Bilateral paralysis leads to severe airway obstruction necessitating an urgent tracheostomy in the majority of patients [2].

The external laryngeal nerve is traumatized more often than one supposes. Its close relationship to the superior vascular pedicle and an occasionally aberrant course predisposes it to damage [3].

Complications associated with thyroidectomy are related to the type of disease, extent of disease, removal approaches, surgeon's training, and experience. Several studies have shown that increased surgeon experience is significantly associated with decreases in complications after thyroid surgery [4-7].

This study aimed to assess the incidence of nerves injuries (RLN, EBSLN) in our center and to evaluate the risk factors of nerves injuries.

## Methods

A prospective study included 250 patients admitted at the General Surgical Unit at Al-Imamein Al-kadhimein Medical City from the first of October 2014 to the end of October 2017; they have been assessed, investigated and prepared for surgery, all patients subjected to vocal cord examination pre, intra and post operatively.

### Inclusion and exclusion criteria

All cases have been discussed with endocrinologist, referred, consented and agreement documented for enrolment in the study, they include: symptomatic euothyroid goiter not respond to medical treatment or patient wish for cosmetic purposes, toxic goiter (diffuse or multinodular) relapsed after medical treatment, suspected or malignant or goiter. While those with recurrent goiter, prior cervical surgery, associated parathyroid pathology and patient with preoperative vocal cord paralysis have been excluded.

The type of operations includes hemi-thyroidectomy, subtotal thyroidectomy, near total thyroidectomy and total thyroidectomy.

Patients with postoperative signs and symptoms of RLN injury were managed accordingly and had been followed by serial examination for 6-12 month. Patients with symptoms of EBSLN injuries were followed clinically due to lack of diagnostic facilities.

Nerve injuries (RLN, EBSLN) that resolved within 6 months considered as transient. While in cases that persist more than 6 months regard as permanent.

Results were analyzed statistically in relation to the risk factors using statistical package for social sciences (SSPS) version 26. A P-values of less than 0.05 accepted as significant.

## Results

The study included 250 patients, 78 (31.2%) males and 172 (68.8%) females. The age range was between 18 to 70 years and the mean±SD was (44±11.9), as shown in figure 1.

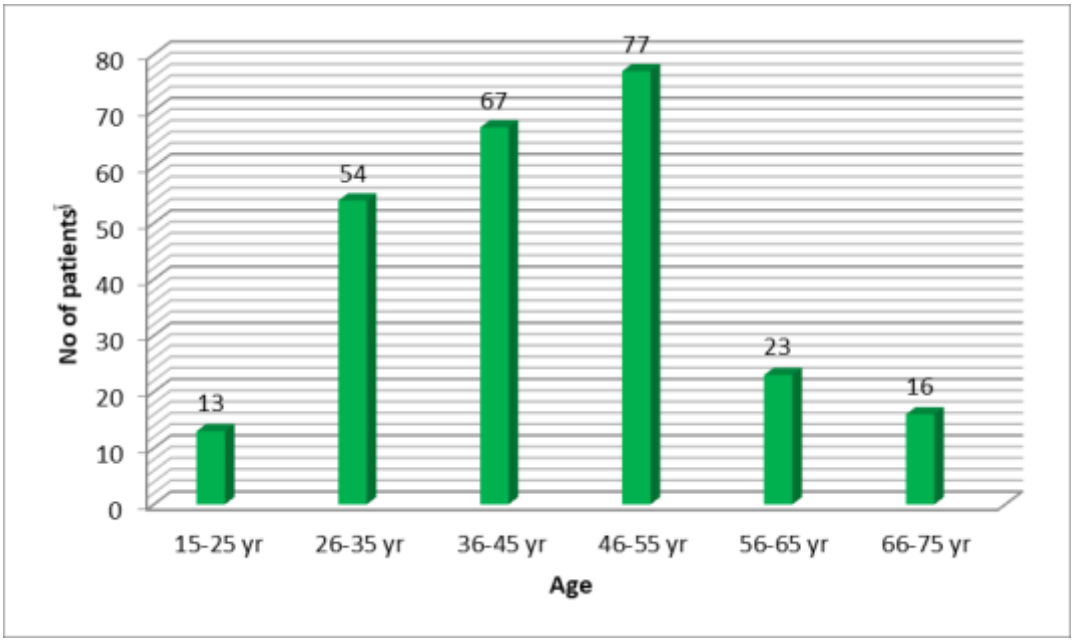


**Figure 1. Age distribution**

The majority of our patients were presented with symptomatic euothyroid multinodular goiter (MNG) goiter (168 [67.2%] patients), while the least were presented with thyroiditis (6 [2.4%] patients). Other pathologic distributions shown in figure 2.

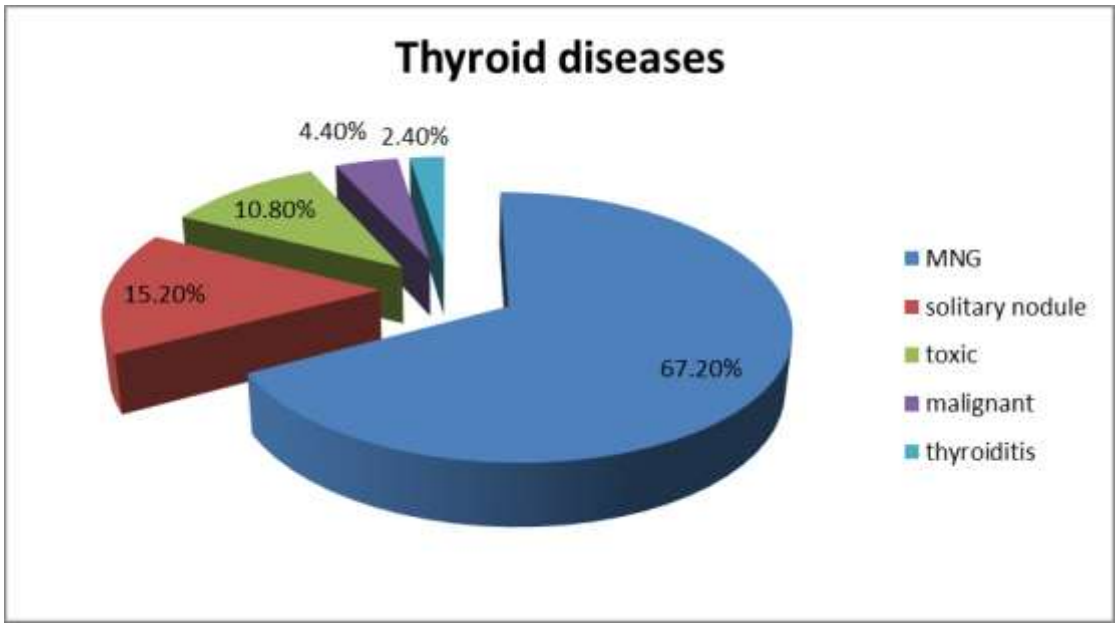


**Figure 2. Types of thyroid diseases**

Majority of patients underwent subtotal and near total thyroidectomies (36.8%), (34%) subsequently as in figure 3.

Injury to RLN was reported in 8 (3.2%) patients, 3 were unilateral, 5 bilateral, 6 transient and 2 permanents as shown in table 1.

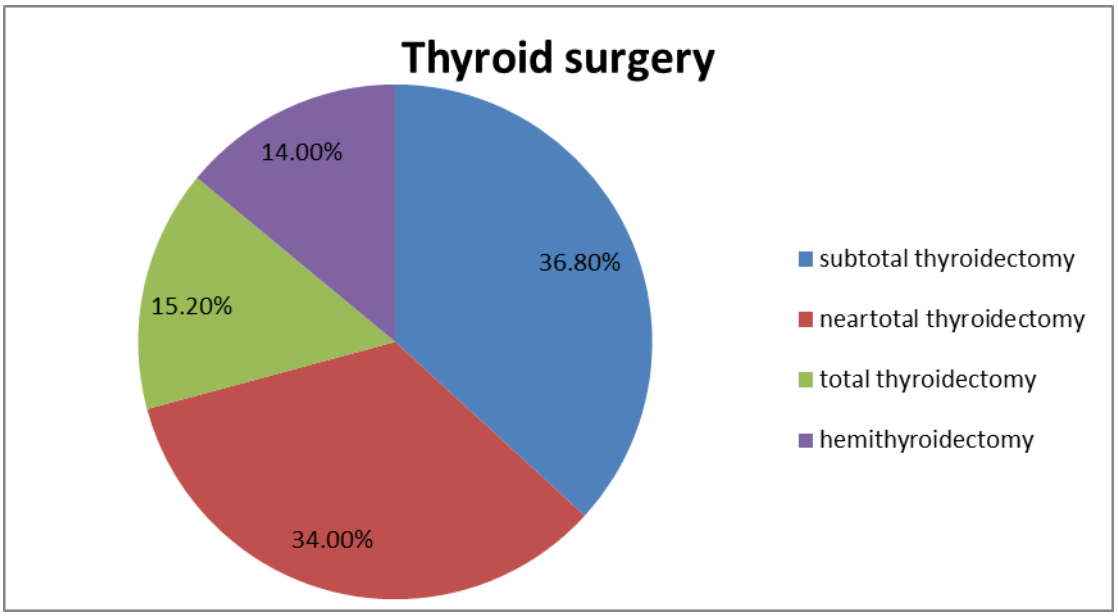


**Figure 3. Types of thyroid surgery**

**Table 1. Types of recurrent laryngeal nerve injury**

| Type of injury | Unilateral | Bilateral | Transient | Permanent |
|---|---|---|---|---|
| No. of patients | 3 | 5 | 6 | 2 |
| Total No. | 8 | | 8 | |

The relation of RLN injury to the age and gender was insignificant, on the other hand there was a significant relation to malignant thyroid enlargement and to total thyroidectomy as table 2.

On the other side, EBSLN injury was reported in 55 patients (22%), transient injury occurred in 43 patients and permanent injury occurred in 12 patients (Table 3).

There was no significant association between EBSLN injury and malignancy (Table 4).

There was no significant association between EBSLN injury and the gender of the patients (Table 5).

There was no significant association between EBSLN injury and the age of the patients (Table 6).

**Table 2. Relation of RLN injury to age, gender, pathology and type of thyroidectomy**

| Parameter | | Total No. | No. RLN injury | P value |
|---|---|---|---|---|
| Gender | Male | 78 | 2 | 0.7 |
| | Female | 172 | 6 | |
| Age | ≥ 44 yr | 123 | 5 | 0.4 |
| | < 44 yr | 127 | 3 | |
| Pathology | Benign | 239 | 6 | 0.1 |
| | Malignant | 11 | 2 | 0.003 |
| Type of operation | Total thyroidectomy | 38 | 5 | 0.01 |
| | Subtotal thyroidectomy | 92 | 2 | 0.2 |
| | Near total thyroidectomy | 85 | 1 | 0.3 |

**Table 3. Relation of external branch of superior laryngeal nerve injury with thyroid disease**

| Thyroid disease | No. of patients | No. of EBSLN injury | Transient | Permanent |
|---|---|---|---|---|
| Multinodular Goitre | 168 (67.2%) | 33 (19.6%) | 27 (82%) | 6 (18.0%) |
| Solitary nodule | 38 (15.2%) | 9 (23.6%) | 7 (77.7%) | 2 (22.3%) |
| Toxic Goitre | 27 (10.8%) | 7 (25.9%) | 5 (71.4%) | 2 (28.6%) |
| Malignant | 11 (4.4%) | 3 (27.1%) | 2 (66.6%) | 1 (33.3% |
| Thyroiditis | 6 (2.4%) | 3 (50.0%) | 2 (66.6%) | 1 (33.3%) |
| Total | 250 (100%) | 55 (22.0%) | 43 (78.2%) | 12 (21.8%) |

**Table 4. Relation of EBSLN injury with type of pathology**

| Pathology | No. of patients | No. of EBSLN injury | P value |
|---|---|---|---|
| Benign | 239 | 52 | 0.6 |
| Malignant | 11 | 3 | |
| Total No. | 250 | 8 | - |

**Table 5. Relation of EBSLN injury with gender**

| Gender | No. of patients | No. of EBSLN injury | P value |
|---|---|---|---|
| Male | 78 | 18 | 0.7 |
| Female | 172 | 37 | |
| Total No. | 250 | 55 | - |

**Table 6. Relation of EBSLN injury with age**

| Age | No. of patients | No. of EBSLN injury | P value |
|---|---|---|---|
| ≥ 44 yrs | 123 | 24 | 0.3 |
| < 44 yrs | 127 | 31 | |
| Total No. | 250 | 55 | - |

## Discussion

Total thyroidectomy has replaced bilateral subtotal thyroidectomy in the last 25 years, and became preferred management for most of the patients with bilateral benign disease as MNG, Graves' disease, malignancy, the principal change in operative procedure has been the change from lateral dissection to capsular dissection [8].

Capsular dissection, sometimes referred to as Delbridge technique, involves hugging the gland and dividing the tertiary branches of the vessels, while dissecting the parathyroid glands with their vascular pedicles free from the thyroid surface, with minimal exposure of the recurrent laryngeal nerve or disturbance of its blood supply. When this technique is employed, the nerve is most often encountered within its sheath amongst the tracheo-esophageal groove [8].

The RLN may consist of multiple branches, which is closely associated with the inferior thyroid artery as it ascends to the middle third of the gland, so the inferior thyroidal artery regard as the most common used structure to identify the RLN, but it is not always a reliable guide, because it has a variable course even in the right and left side of the same patient [9].

Mechanisms of nerves injuries include traction, handling of the nerve, complete or partial transaction, contusion, burn, clamping, crush, and compromised blood supply and misplaced ligature [10]. The level of upper two tracheal rings regard as the most common site of accidental transaction where the Berry's ligament regarded as the area by which the nerve closely approximates thyroid gland [11]. The variable anatomical course of the nerve is another important risk factor for RLN injury, in addition to the absence of fixed relation of the nerve to close anatomic structures.

The surgical importance of Zuckerkandl's tubercle is that it must be dissected and excised in case of total thyroidectomy and its close relationship to the RLN, it is the posterolateral extension of thyroid lobes adjacent to RLN [12].

In this study, 172 (68.8%) were females, this is consistent with Zakaria et al. [13]. Thyroid diseases are more prevalent in women particularly between puberty and menopause, the epidemiological data suggest a role of estrogen in the pathogenesis of thyroid diseases and studies suggest that estrogen and progesterone may contribute to the pathogenesis of goiter [14,15].

In current study, the RLN injury reported in 8 patients (3.2%), transient in six 2.4% and permanent in two 0.8% patients. Aytac et al. reported an incidence of injury of 5.2% (1.4% permanent and 3.8 temporary) [16], while Zakaria et al. reported an injury of 4.1% (3.8 temporary and 0.29 permanent) [13]. The incidence of injury in this study is somewhat less than the others may be due to exclusion of recurrent goiter from the study.

Multinodular goiter was the most common indication for thyroidectomy in the current study; 67.2% (168 patient), only 4 patients had RLN injury (2.3%), all of them were bilateral and transient, two followed total thyroidectomy, one followed subtotal thyroidectomy and one followed near total thyroidectomy, which is comparable with injuries reported by Zakaria et al. [13] and Aytac et al. [16], 3.1% and 2.4% subsequently.

In toxic goiter, there were 27 (10.8%) patients and the injury was reported in one case (3.7%) following subtotal thyroidectomy, Aytac et al. study reported 8.7% injury [16].

RLN injury was higher in association with thyroid carcinoma (2 of 11 cases (18%), all

cases of thyroid malignancy managed by total thyroidectomy with central neck dissection, which explain the higher risk of nerve injuries. The incidence of RLN injuries in association with thyroid malignancy reported by Zakaria et al. [13] and Aytac et al. [16] were 12.8% and 20% respectively.

Total thyroidectomy was performed for symptomatic thyroiditis, none responding to medical treatment, RLN injury reported in (1 of 6 cases which means 16.6%) so this the second common pathology associated with nerve injury due to dense adhesion encountered [17].

Total thyroidectomy was more associated with RLN (15.2%), while subtotal and near total procedures associated with lower rate of injury (2.1% and 1.1%) subsequently. Zakaria et al. [13] report a 7.2%, 1.9% and Aytac et al. [16] 21%, 2.3% in cases of total and subtotal thyroidectomy subsequently. Near total thyroidectomy was performed in 85 patients, injury was reported in one patient (1.1%) while not in other studies [16,18].

Intraoperative nerve monitoring has been used by many surgeons to reduce incidence of RLN injury. The benefits of this method have been reported in the literature none of these shown any statistically significant decrease in the RLN injury [19,20].

Several minimal approaches thyroidectomy have been described, mini-incision procedure uses a 3-cm incision with no flap creation and video assistance can be used to improve the visualization via the small incision. Totally endoscopic approaches also have been described, via the supraclavicular, anterior chest, axillary, breast and transoral robotic-assisted approach to avoid neck skin incision. These methods are feasible, but clear benefits over the traditional approach have not been established [21].

On the other side, EBSLN injury was reported in 55 patients (22%), transient injury occurred in (78.2%). The prevalence of ESLN injury is unknown and often goes undiagnosed. This nerve has significant relevance surgically, as its rate of injury in thyroidectomy is reported to be as high as 58% [22].

There are several technical approaches to preserve the integrity of the EBSLN, of which isolating with individualize ligating the superior pole vessels closely adjacent to the thyroid capsule, identifying the EBSLN before securing the vasculature in the same manner and neuromonitoring of the EBSLN through thyroidectomy are the most popular methods, no one is superior [23].

The most effective method for preserving RLN is still controversial. Some surgeons claim that omitting nerve identification may cause little trauma. However, most literatures have proved no rule for identification and the knowledge of the anatomic course of the nerve during the operation and its variations is the secret to decrease the incidence of RLN injury [24].

Identification of RLN during operation make the surgeon more confident about the nerve integrity and eliminate tension while waiting for recovery of transient injury. Here the surgeon experience plays a major role in preventing iatrogenic injury, it was reported that a dissection started from avascular space of cricothyroid was the safest procedure for identification of RLN [25].

This study concluded that surgeon experiences and awareness of anatomical variation with careful dissection is the art of safe thyroidectomy. Most of the nerve injuries are transient and recover spontaneously, so immediate intervention is not recommended unless it interfere with breathing or swallowing. EBSLN injury is more common but functionally pass frequently unnoticed. Nerve injury is associated with thyroidectomies for malignancies or cases of thyroiditis.

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## Author contribution

All authors participated in study design, performing surgeries, follow up of patients, data interpretation and manuscript organization and editing.

## Conflict of interest

Authors declare no conflict of interest.

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