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Voice Changes After Thyroid Surgery; A Prospective Cohort Study

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Abstract

Background and objectives: Voice changes (dysphonia) after thyroid surgery is an important complication that may have significant occupational, aesthetic, psychosocial and economic consequences on the patient. Two pairs of nerves supply the larynx, the recurrent laryngeal nerves and superior laryngeal nerves, which are susceptible to damage during thyroid surgery. The objectives of this study were to document the incidence, type, nature, severity, cause, and duration of voice complications after thyroid surgery.

Methods: The prospective cohort study included 100 patients who had thyroidectomy at the Sulaimani Teaching Hospital in Sulaimani City. The study carried out from January 2010 to December 2010. A special questionnaire Designed, which, included the following items: preoperative history (including age, sex, occupation, and professional voice user status), preoperative examination (encompassing local and general assessments), preoperative investigations check-up of vocal cords, intraoperative assessment by the anesthetist during extubation, and postoperative evaluations conducted by the researcher in the immediate, early, and late stages.

Results: The participant's age range was 20-75 years, mean age 38.0 ± 10.5 years, with 88 women and 12 men. Immediately after the first postoperative week, voice changes were observed in 15.0% of the patients. Subjective voice changes (non neurogenic) account for 10.0% and objective changes account for 5.0% At three months of follow-up, Subjective voice changes were observed in 1.0% of the patients, with objective voice changes accounting for 4.0%. Finally, after six to 12 months, objective voice changes were observed in 2.0% of the patients, the result was not signifint statistically.

Conclusion: Objective voice change complaints require precise laryngeal nerve identification and protection durig surgery. These findings show that rigorous surgical procedures and thorough pre- and postoperative vocal examinations are needed to reduce risks and control long-term effects. Subjective change lesions were more prevalent than objective lesions.

Keywords: Objective voice changes, Post-thyroidectomy voice change, Recurrent laryngeal nerve, Subjective voice change

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Introduction

Thyroid disorders were prevalent, and almost all disorders of the thyroid gland resulted in some degree of swelling, which is referred to as "goiter." Clinically, these disorders can present as euthyroid, hyperthyroid, or hypothyroid. These diseases mainly affect women, with a female-to-male ratio of approximately 5-10:1.[1]As a result, surgeons often encounter patients with thyroid cancer who require surgical intervention like other surgical procedures, thyroidectomies carry the risk of complications, including general and specific complications e.g. nerve injury, and recurrent laryngeal nerve (RLN) injury is the most common neurogenic cause, followed by the external branch of superior laryngeal nerve (EBSLN).[2] Moreover, failing to address these issues during patient consent or during the operative procedure can have serious medicolegal consequences for the surgeon however, voice alterations after thyroidectomy are not always associated with nerve injury.[3] Several studies have shown that voice changes can occur even when the recurrent and superior laryngeal nerves are preserved. Factors contributing to these changes include surgical trauma, laryngotracheal fixation, and endotracheal intubation trauma, which can lead to vocal fold alterations and arytenoid cartilage trauma.[4] Surgeries on the thyroid gland must be performed precisely and accurately to avoid complications because thyroid surgeries can affect the functions of other neck organs, either temporarily or permanently therefore voice changes are one of the surgeries' complications.[5] The laryngeal nerves, which supply the important laryngeal muscles and vocal cords, are concentrated in the thyroid gland. And when performing a goiter operation, the vocal cords will be seen very closely. Any technical errors and psychological pressures for surgeons during surgery can have an impact on these vocal cords.[5]The objectives of this study were to document the incidence, types of subjective (non-neurogenic) objective (neurogenic) changes, nature (RLNs or EBSLNs), severity (unilateral or bilateral palsy), duration (1, 3, 6, 12 months), and relationship of voice change to the type of operation and pathology.

Patients and methods

The design of the study was a prospective cohort study. One hundred patients, who had thyroidectomy enrolled in the study in General Surgery Department, Sulaimani Teaching Hospital in Sulaimani City. This study was conducted between January 2010 and December 2010. A special questionnaire has been designed for this study, which, comprised the following items: preoperative history (including name, age, sex, occupation, and professional voice user status), preoperative examination (local and general assessments), preoperative investigations (such as Thyroid Function Tests(TFT), Serum Calcium (S. Ca++), Ultrasound (U/S), Fine Needle Aspiration Cytology (FNAC), and Ear, Nose, and Throat (ENT) check-up of vocal cords, intraoperative assessment by the anesthetist during extubation, and postoperative evaluations conducted by the researcher in the immediate, early, and late stages. Communication with patients was facilitated by phone, and laryngoscopy was performed in the ENT department of the Sulaimani Teaching Hospital. Follow-up assessments were scheduled at intervals of one week, three months, six months, and 12 months. The study sample criteria included exclusion criteria, such as thyroid surgery reoperation, diagnosis of a progressive neurological disorder, diagnosis of existing RLN recurrent laryngeal nerve paralysis (RLNP. The inclusion criteria were first-time thyroid surgery, normal preoperative vocal cords, assessment by an ENT specialist, and euthyroid status at the operation which mean that the clinical and biochemical were normal

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but radiologically by ultrasound either diffuse, multinodular goiter and single nodule.Ethical considerations were addressed by obtaining formal consent from the Sulaimani Health Directorate, Sulaimani Teaching Hospital, Department of Higher Education, and the patients themselves. After obtaining the results of the tests, the data were entered into the SPSS software version 22, and then descriptive statistical tests, t-student and chi-square were used for analysis considering the significance level less than 0.05. Statistical analysis was performed with SPSS version 22 for Windows (Chicago, IL).

Results

The average age of the 20-75-year-old group was (38.0 ± 10.5) years. Most patients were women (88.0%). Before the operation, clinical and biochemically evaluations of the studied samples demonstrated that most patients had euthyroidism (80.0%). To exclude parathyroid gland diseases, all patients had their serum calcium levels tested, with 97.0% being normal and 3.0% falling within the lower limit. Neck ultrasound was performed, which revealed mainly multinodular goiter (87.0%). Most operations performed in the studied sample were subtotal bilateral thyroidectomy (48.0%), near-total bilateral thyroidectomy (15.0%), and subtotal unilateral lobectomy (14.0%). After the operation, a closed suction tube was used in 93.0% of patients Table (1).

Table (1): Operation type and drain in situ of the study sample

Type of operation and drain	No (%)
Total bilateral thyroidectomy	1(1%)
Near total bilateral thyroidectomy (Dunhill operation)	15(15%)
Subtotal bilateral thyroidectomy	48(48%)
Total unilateral lobectomy	13(13%)
Near total unilateral lobectomy	9(9%)
Subtotal unilateral lobectomy	14(14%)
Drain tube:	
Yes	93(93%)
No	7(7%)

The histopathological results of the study sample showed mostly a simple multinodular goiter (76.0%), toxic multinodular goiter (5.0%), Hashimoto's thyroiditis (5.0%), simple solitary nodule (3.0%), and papillary carcinoma (3.0%) Table (2).

Table (2): Histopathological results of the study sample

Histopathology results	N (%)
Simple multinodular goiter	76(76)
Simple solitary nodule	3(3)
Simple diffuse goiter	1(1)
Toxic multinodular goiter (Plummer's disease)	5(5)
Toxic diffuse goiter (Grave's disease)	2(2)
Toxic solitary nodule (Toxic adenoma)	3(3)
Lymphadenoid thyroiditis (Hashimoto's thyroiditis)	5(5)
Follicular adenoma	1(1)
Papillary carcinoma	3(3)
Follicular carcinoma	1(1)

Immediately after the first postoperative week, voice changes were observed in 15.0% of patients, with non-neurogenic changes accounting for 10.0% and neurogenic changes comprising 5.0% that are right recurrent laryngeal nerve or right vocal cord (Rt. RLN or Rt.VC) was affected in 2.0% of patients, while the Left recurrent laryngeal nerve paralysis or left vocal cord (Lt. RLN or Lt.VC) was affected in 3.0%. At three months of follow-up, non-neurogenic voice changes were observed in 1.0% of patients, with neurogenic changes accounting for 4.0%, including 2.0% Lt.VC and 2.0% Rt.VC. Finally, neurogenic voice changes were observed in 2.0% of patients, including Lt.VC and Rt.VC (1.0%), Table (3).

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Table (3): Incidence stage and types of postoperative voice changes

Postoperative vocal cord checkup	1st week (immediately)	3 months(early)	6-12 months(late)
	No. (%)		
Subjective (non neurogenic) voice change	10(10.0)	1(1.0)	0(0.0)
Objective(neurogenic) voice change:	5(5.0)	4(4.0)	2(0.0)
Lt. RLN or Lt. VC	3(3.0)	2(2.0)	1(1.0)
Rt. RLN or Lt. VC	2(2.0)	2(2.0)	1(1.0)
EBSLN palsies	0(0.0)	0(0.0)	0(0.0)

After six to 12 months, in this research, two participants suffered permanent paralysis (RLN), and one (6.7%) of them experienced Rt. RLN paralysis, and 1(6.7%) patient experienced Lt. RLN paralysis. These cases were directly correlated with near-total thyroidectomy surgery (Dunhill operation), but the result was not statistically significant P = 0.223, Table (4).

Table (4): Relation between postoperative voice change and operation procedure

Histopathology results	Postoperative vocal cord checkup						p value
	No voice change	Subjective voice change	Objective temporary Lt. RLN voice change	Objective temporary Rt. RLN voice change	Objective permanent Lt. RLN voice change	Objective permanent Rt. RLN voice change	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Total bilateral thyroidectomy	0 (0.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0.001
Near total bilateral thyroidectomy (Dunhill operation)	11(73.3)	1(6.7)	1(6.7)	0(0.0)	1(6.7)	1(6.7)	
Subtotal bilateral thyroidectomy	42(87.5)	5(10.4)	0(0.0)	1(2.1)	0(0.0)	0(0.0)	
Total unilateral lobectomy	12(92.3)	1(7.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Near total unilateral lobectomy	8 (88.9)	0(0.0)	1(11.1)	0(0.0)	0(0.0)	0(0.0)	
Subtotal unilateral lobectomy	12(85.7)	2(14.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

From a histopathological perspective, only two patients exhibited permanent RLN paralysis, including one (33.3%) with Rt. RLN and one (33.3%) with Lt. RLN. Both of these patients had cancer, one with papillary carcinoma and another with follicular carcinoma, respectively, indicating an increased risk of change in voice. The P value was 0.001 (significant), as shown in Table (5).

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Table (5): Relation between Postoperative Voice Change and histopathological result

Histopathology results	Postoperative vocal cord checkup						p value
	No voice change	Subjective	Objective temporary		Objective permanent		
		voice change	Lt. RLN voice change	Rt. RLN voice change	Lt. RLN voice change	Rt. RLN voice change	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Simple multinodular goiter	66(86.8)	8(10.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0.001
Simple solitary nodule	3(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Simple diffuse goiter	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Toxic multinodular goiter (Plummer's disease)	5(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
Toxic diffuse goiter (Grave's disease)	2(100.0)	0(0.0)	1(50.0)	0(0.0)	0(0.0)	0(0.0)	
Toxic solitary nodule (Toxic adenoma)	3(100.0)	2(66.6)	1(33.3)	0(0.0)	0(0.0)	0(0.0)	
Lymphadenoid) (Hashimoto's thyroiditis)	3(60.0)	0(0.0)	1(20.0)	0(0.0)	0(0.0)	0(0.0)	
1-Follicular adenoma	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	
2-Papillary carcinoma	0 (0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(33.3)	
3-Follicular carcinoma	1(100.0)	0(0.0)	0(0.0)	0(0.0)	1(33.3)	0(0.0)	

Discussion

The prevalence of voice changes within the first week after surgery was 15.0%, which is comparable to other studies that reported rates ranging from 14% to 47%.[3]In terms of early voice changes (three months postoperatively), 10.0% of the symptomatic patients recovered, and 5.0% still complained (subjective voice change in one patient; objective voice change, in four patients). Minuto et al reported the recovery rate between 10% and 50%.[6] Six months after the operation, voice changes related to RLN injuries were recorded in 2.0% of the cases, including 1.0% on the Lt. RLN and 1.0% on the Rt. RLN. This is comparable to other studies reporting RLN injury rates of 1.0% - 2.0%.[2] The permanence of neurogenic voice changes was considered based on the duration of dysphonia, with permanent dysphonia lasting more than 6 months.[7]After 12 months, dysphonia was found to be permanent in some studies.[8] whereas in other studies, dysphonia was found to be permanent after 18 months.[8, 9] or more than two years.[10] The incidence of neurogenic voice change in our study was 5%, (2.0% injury to the Rt. RLN and 3.0% injury to the Lt. RLN).[11] It is important to note that the left has a longer course, curving around the ligamentum arteriosum at the aortic arch and traveling in the tracheoesophageal groove. The right nerve rears around the subclavian artery and is normally anterolateral to the

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tracheo-oesophageal groove.[12] Researchers suggest that the uneven distribution of this phenomenon may be due to the Lt. RLN being more susceptible to injury than the Rt. RLN; this susceptibility may be linked to the longer and more twisted route that the Lt. RLN takes around structures in the mediastinum. Furthermore, the somewhat smaller diameter and increased susceptibility to traction of the Lt. RLN make it more prone to injury, while the Rt. RLN is distinguished by a higher amount of protective epineurium and adipose tissues.[13]The incidence of RLN injuries has been reported between 1% and 2% at different centers of thyroid surgery when performed by experienced neck surgeons. This incidence is higher when thyroidectomy is performed by a less experienced surgeon.[14]In this study, the incidence of EBSLN was 0.0%, while in other studies, it was between (0.0% - 14.0%).[15-18] EBSLN injury is the second most common nerve injury that causes a change of voice.[19] The popular Cernea classification of EBSLN had limitations, including its decreased reliability with increasing thyroid size and its irrelevance in cases of 'buried' variants[20]. The causes of neurogenic voice changes (nerve injury) were pressure and compression.[21], traumatic dissection (Iatrogenic).[23,24] Thermal and conduction injury: (Cauterization especially unipolar cautery).[21] Retraction and stretching: (By a goiter or surgical retraction).[21, 22] And invasion by pathology: (Scarified nerve in case of carcinoma).[22] The present study shows that the incidence of non-neurogenic voice change is 10.0 % higher than that of neurogenic, while in other studies it is between 10.0 % - 30.0 %.[6, 23] Documented subjective voice change not related to RLN or EBSLN function.[24, 25] The causes of non-neurogenic voice disturbances were Intubation (Laryngeal bruising, edema, and trauma to the laryngeal muscles).[21], muscle cutting (Laryngotracheal fixation of the pre-laryngeal strap muscles). psychogenic dysphonia (as a consequence of diagnosis or surgery).[21], endocrine changes (At the time of surgery (e.g in hypothyroid).[26], hematoma formation.[26], And drain left after thyroidectomy.[27] In this present study, 2.0% of patients with permanent voice change were directly related to the type of operation, which was near-total bilateral thyroidectomy (p-value = 0.223, non-significant). In other studies, the rates of change in voice increased according to the extent of thyroidectomy.[27-29] Furthermore, 2.0% of patients with permanent voice change were directly related to the type of pathology including papillary carcinoma and follicular carcinoma (P value = 0.001, significant). Chiang et al.[30] Found that thyroid cancer is associated with high rates of RLN. Most injuries to the RLN occur at the level of the Berry ligament of the upper third of the thyroid gland, as the RLN may be hidden behind the Zuckerkandl tubercle (thickening). Meticulous dissection and identification of the recurrent nerve course were the best ways to avoid injury and ligation of the inferior pedicle near the capsule (tertiary branches) to preserve the RLN parathyroid gland.[31] External neuromonitoring of the RLN technique and electromyography (EMG) of arytenoid muscle function internally[32], were the gold standard for preoperative, intraoperative, and postoperative evaluation of RLN.Identification of the course of EBSLN is better to avoid as it may induce injury. Preservation, including isolation and individual ligation of the superior pole vessels near the thyroid capsule (distal ligation of the superior thyroid vessels), neuromonitoring,[33], and EMG are gold standard techniques for intraoperative and postoperative evaluation of EBSLN.[33]

Limitations of the study include the fact that it was not always possible to clarify the intraoperative and postoperative voice when the indirect laryngoscope (Macintosh)

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findings were normal. In such situations, new methods, such as video laryngeal endoscopy with a stroboscope, electromyography, and neuromonitoring, could be used to clarify the exact causes, but were not available in our centre.

Conclusions

The divergent impacts of non-neurogenic versus neurogenic voice changes underscore the multifactorial nature of this complication. Non-neurogenic changes, often resulting from factors such as intubation and psychogenic responses to surgery, tended to resolve more quickly than neurogenic changes, which are directly related to surgical technique and nerve damage. The persistence of neurogenic symptoms necessitates a highly skilled surgical approach, including precise identification and protection of the laryngeal nerves during surgery. This prospective study on post-thyroidectomy voice changes emphasizes that such complications, while often temporary, can persist and evolve. Initially, 15% of patients experienced voice changes, primarily non-neurogenic. Although most of these disturbances were resolved, 2% of patients experienced enduring neurogenic changes after one year. These findings suggest a need for meticulous surgical techniques and comprehensive pre- and postoperative vocal assessments to mitigate risks and effectively manage potential long-term impacts. Such strategies are essential not only for patient care but also for legal and ethical considerations surrounding thyroid surgeries.

Conflict of interest

None

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