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Original Research Article

Voice changes after thyroidectomy: an experience with 364 cases of thyroid surgery

Arvind K. Prabhat*, Niranjan Dash, J. M. Gadekar

Department of General Surgery, DVVPF'S Medical College and Hospital, Ahmednagar, Maharashtra, India

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***Correspondence:**
Dr. Arvind K. Prabhat,
E-mail: pmttarget@gmail.com

ABSTRACT

Background: An study the voice changes and to evaluate the impact of thyroidectomy and effects of factors such as patient age, sex, operation-type, surgeons-experience, laryngeal nerve injury and orotracheal intubation on voice of patients undergoing thyroidectomy.
Methods: Author prospectively analyzed 364 cases of multinodular goiter (MNG) and neoplastic thyroid disorders, undergoing sub-total/total-thyroidectomy and completion-thyroidectomy in the department of surgery, during the study period of June 2016 to December 2016.
Results: The study comprised of 364 patients, with 298 females and 66 males. Voice changes were seen in 216(59.34%) patients. Transient voice changes were seen in 212(98.15%) patients and permanent in 4(1.85%) patents. Out of 216 patents, age group ≥65 years were 128(59.25%) and age group <65 years were 88(40.75%) patients(p:0.012324). Out of 216 patients in which voice changes were seen,165(76.39%) patients were females and 51(23.61%) patients were males(p:0.001046). Voice changes were seen in 190(88%) patients in which sub-total/total-thyroidectomies were performed and in 26(12%) patients completion-thyroidectomies were performed. Voice changes were statistically significant in which completion-thyroidectomies were performed(p:0.002102). Voice changes were seen in 205(68.56%) cases and 11(16.92%) cases which were performed by post-graduate-trainee and experienced-surgeon respectively. Voice changes were seen in 122(67.77%) cases in which orotracheal intubation was performed and in 94(51.65%) cases cervical-epidural anaesthesia was given (p:0.00281). RLN palsy was seen in 2(0.60%) cases in which sub-total/total-thyroidectomy were performed and 2(6.25%) cases in which completion-thyroidectomy was performed (p:0.003426).
Conclusions: Voice changes is common after thyroid surgery but usually transient and sometimes, permanent. So, patients must be informed about the risk of voice-impairment after thyroid surgery. Present study is novel as it investigates not only laryngeal neve injury but also highlights patient age, sex, types of operation, surgeons experience and laryngeal complications during orotracheal intubation.

Keywords: Completion thyroidectomy, Recurrent laryngeal nerve (RLN) palsy, Sub-total thyroidectomy, Total thyroidectomy

INTRODUCTION

Voice changes due to laryngeal dysfunction after thyroid surgery is a very common complication. However, very few data in the literatures are available which highlights the impact of thyroidectomy and effects of factors, such as patient age, sex, operation type, surgeons experience, laryngeal nerve injury and orotracheal intubation on voice of patients undergoing thyroid surgery.

Total thyroidectomy has become a routine surgical procedure. Voice changes is a known complication after thyroid surgery. In majority of cases voice changes are transient. The voice recovery time ranges from less than one-month up to 6 months in majority of cases. At the 1-year post-operative examination, the permanent impaired voice rate is about 1%.[1] Spontaneous recovery of voice changes secondary to vocal cord paralysis has been reported in 79% to 87.5% cases.[2]

There are two sets of nerves near the thyroid gland that control the voice. These are the external branch of superior laryngeal nerve (EBSLN) and recurrent laryngeal nerve. In the second century, Galen first identified and named RLN.[3]

Transient voice changes, such as hoarseness, voice tiring, and voice weakness are more common and can happen in majority of cases. The transient voice changes usually occurs because one or more of the nerves are irritated either by moving them out of the way during the dissection of thyroid gland or because of the inflammation that happens after the thyroid surgery. Although the impaired voice usually improves in first few weeks after surgery, it can last up to 6 months.[4]

In the present era identification and preservation of laryngeal nerves are widely practiced during thyroid surgery. Intraoperative neuromonitoring (IONM) and RLN Visualization alone (VA) are the two methods usually used for identification of RLN nerves. RLN visualization alone (VA) is considered as gold standard for the prevention of nerve injury during thyroid surgery.[5] Despite meticulous identification of laryngeal nerves, RLN injury still persist. Incidence of transient RLN palsy reported as 0.4% to 12% and permanent RLN palsy as 5% to 6%.[6,7]

Endotracheal intubation causes voice change in 5% cases and causes permanent voice damage in 3% cases.[8]

METHODS

Author prospectively assessed voice changes in 364 patients after thyroidectomy at DVVPF'S Medical College and Hospital, Ahmednagar, Maharashtra during the study period of June 2016 to December 2016. Voice changes were seen in 216 (59.34%) patients. Out of 216 patients, temporary voice change was seen in 212 (98.15%) patients and permanent in 4 (1.85%) patients. Proper assessment of vocal cord function was done by indirect and direct laryngoscopy, pre- and post-operatively to rule out injury to the laryngeal nerves during surgery. The clinical diagnosis was supported by ultrasonography, FNAC and CECT neck.

Inclusion criteria

- Patients diagnosed as multinodular goiter (MNG) and neoplastic thyroid disorders
- Euthyroid patients
- Patients of age group 35-72 years
- Both sexes

Exclusion criteria

- Patients in which pre-operative voice disorder
- Non euthyroid patients
- Pre-operative laryngeal nerve palsy

The patient was positioned supine, with a sandbag between the scapulae. The head was placed on a head ring, and the neck was extended to provide maximal exposure. A Kocher transverse collar incision, typically 4 to 5cm in length, was placed in or parallel to a natural skin crease 2cm above the sternal notch. The subcutaneous tissues and platysma were incised sharply, and subplatysmal flaps were raised superiorly to the level of the thyroid cartilage and inferiorly to the suprasternal notch. The strap muscles were divided in the midline along the entire length of the mobilized flaps, and the thyroid gland was exposed. On the side to be approached first, the sternohyoid muscles were separated from the underlying sternothyroid muscle by blunt dissection. The middle thyroid veins were ligated and divided. The superior thyroid pole was identified by retracting the thyroid first inferiorly and medially, and then the upper pole of the thyroid was mobilized caudally and laterally. The dissection plane was kept as close to the thyroid as possible, and the superior pole vessels were individually identified, skeletonized, ligated, and divided low on the thyroid gland to avoid injury to the external branch of the superior laryngeal nerve. The lower pole of the thyroid gland was mobilized. The inferior thyroid vessels were dissected, skeletonized, ligated, and divided as close to the surface of the thyroid gland as possible to minimize devascularization of the parathyroid. This procedure was repeated on the opposite side for a total thyroidectomy.

In subtotal thyroidectomy there was removal of majority of both lobes leaving behind 4-5gm of thyroid tissue on one or both sides. Completion thyroidectomy was done after a patient had a previous partial thyroid resection (lobectomy) and resected segment revealed carcinoma.

Statistical analysis

Data was analyzed using the Chi-Square test where appropriate $P < 0.05$ was considered significant. Confidence level of 95% was specified. Margin of error was 5%. Therefore: $N=Z2(\alpha/2)[p(1-p)/d2]$

Where N = sample size; p = Proportion of patients with voice changes; d = marginal error between sample and population (0.05).

RESULTS

There were 364 patients in the study. Out of 364 patients, 298 (81.87%) patients were female and 66 (18.13%)

patients were males. Mean age was 67 years. Out of 364 patients, 302 (82.97%) patients were MNG, 30 (8.24%) patients were PTC and 32 (8.79%) patients were follicular thyroid carcinoma.

Table 1: Characteristics of patients.

Total number of patients	364
Female	298 (81.87%)
Male	66 (18.13%)
Mean age (Range) in years	67 (35-72)
Mean hospital stay in days	10 (7-28)
Number of patients with multinodular goiter (MNG)	302 (82.97%)
Number of patients with papillary thyroid carcinoma (PTC)	30 (8.24%)
Number of patients with follicular thyroid carcinoma (FTC)	32 (8.79%)

Table 2: Characteristics of patients in which voice changes were seen.

Total number of patients	364
Number of patients in which voice changes	216 (59.34%)
Number of female patients in which voice changes	165 (76.39%)
Number of male patients in which voice changes	51 (23.61%)
Number of patients in which temporary voice change	212 (98.15%)
Number of patients in which permanent voice change	4 (1.85%)

Out of 364 patients, Voice changes were seen in 216 (59.34%) patients. Temporary voice changes were seen in 212 (98.15%) patients and permanent in 4 (1.85%) patients.

Table 3: Characteristics of age.

		Age group	No. of patients	Chi-square	p-value
Total no. of patients	**364**	≥65 years	196 (53.85%)		
		<65 years	168 (46.15%)		
Total number of patients in which voice changes were seen	216	≥65 years	128 (59.25%)	6.2636	0.012324
		<65 years	88 (40.75%)		

Out of 216 patients in which voice changes were seen, 165 (76.39%) patients were females and 51 (23.61%) patients were males.

Out of 364 patients, age group ≥65 years were 196 (53.85%) patients and age group <65 years were 168 (46.15%). Voice changes were seen in 216 patients. Out of 216 patents age group ≥65 years were 128 (59.25%) and age group <65 years were 88 (40.75%). The rate of laryngeal complications was statistically significant in patients older than 65 years. (59.25% Vs 40.75%, X^2-6.2636, p- 0.012324).

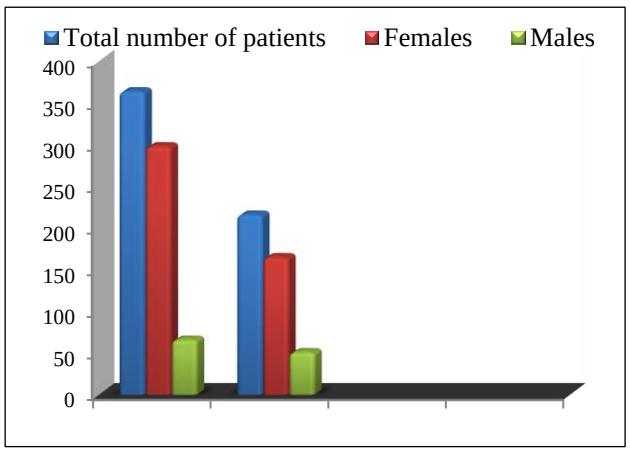

Figure 1: Sex distribution.

Out of 364 patients, 298 (81.87%) patients were females and 66 (18.13%) patients were males. Voice changes were seen in 216 (59.34%) cases. Out of 216 patients, 165 (76.39%) patients were females and 51 (23.61%) were males (Females Vs Males-76.39% Vs 23.61%, X^2 - 10.7443, p -0.001046). Voice changes were statistically significant in females.

Types of surgery performed

Out of 364 patients, sub-total thyroidectomies were performed in 152 (41.75%) cases, total thyroidectomies in 180 (49.45%) cases and completion thyroidectomies in 32 (8.80%) cases. Voice changes were seen in 80 (52.63%) cases in which sub-total thyroidectomies were performed, 110 (61.11%) cases in which total thyroidectomies were performed and 26 (81.25%) cases in which completion thyroidectomies were performed.

Out of 216 patients in which voice changes were seen, temporary and permanent voice changes were seen in 79(51.97%) and 1(0.06%) patients respectively in which sub-total thyroidectomies were performed. The cases in which total thyroidectomies were performed, temporary and permanent voice changes were seen in 109 (60.55%) and 1 (0.56%) patients respectively. The cases in which completion thyroidectomies were performed, temporary and permanent voice changes were seen in 24 (75%) and 2 (6.25%) patients respectively. Voice changes were statistically significant in completion thyroidectomy

surgery (X^2-16.8124, p -0.002102). Voice changes were seen in 216 patients. Temporary voice changes were seen in 212 (98.15%) patients and permanent voice changes in 4 (1.85%) patients (Figure 2).

Table 4: Summarizes types of surgery performed.

Types of surgery performed	Temporary voice change	Permanent voice change	No voice change	Chi-square	p-value
Sub-total thyroidectomy	79(51.97%)	1(0.67%)	72(47.36%)	16.8124	0.002102
Total thyroidectomy	109 (60.55%)	1 (0.56%)	70 (38.89%)		
Completion thyroidectomy	24 (75%)	2 (6.25%)	6 (18.75%)		

Table 5: Summarizes voice changes after sub-total/total thyroidectomy and completion thyroidectomy.

Types of surgery performed	No. of patients in which voice changes were seen	No. of patients in which no voice changes	Chi-square	p-value
Sub-total/ Total thyroidectomy	190 (57.22%)	142(42.78%)	6.9801	0.008242
Completion thyroidectomy	26 (81.25%)	6(18.75%)		

Table 6: Surgeons experience.

Surgeons	No. of operatio performed	No. of cases in which voice changes were seen	No. of cases in which no voice changes	Chi-square	p-value
Post-graduate trainee	299 (82.14%)	205 (68.56%)	94 (31.44%)	59.0096	Significant
Experienced surgeon	65 (17.86%)	11 (16.92%)	54 (83.08%)		

Table 7: Types of anaesthesia given orotracheal intubation Vs cervical epidural anaesthesia.

Types of anaesthesia given	No. of cases	No. of cases in which voice changes were seen	No. of cases in which no voice changes were seen	Chi-square	p-value
Orotracheal intubation	182(50%)	122(67.77%)	60(33.33%)	8.9269	0.00281
Cervical epidural anaesthesia	182(50%)	94(51.65%)	88(48.35%)		

Table 8: Summarizes laryngeal nerve palsy during thyroid surgery.

Types of thyroid surgery performed	Permanent RLN palsy	No RLN palsy	Chi-square	p-value
Sub-total / total thyroidectomy	2(0.60%)	330(99.40%)	8.5655	0.003426
Completion thyroidectomy	2(6.25%)	30(93.75%)		

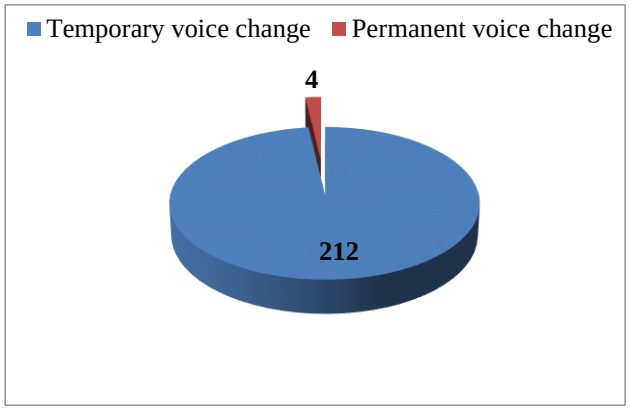

Figure 2: Distribution of patients in which voice changes were seen.

Voice changes were seen in 190 (88%) patients in which sub-total/total thyroidectomies were performed and in 26 (12%) patient's completion thyroidectomies were performed. Voice changes were statistically significant in completion thyroidectomy surgery (81.25% Vs 57.22%, X^2 - 6.9801, p - 0.008242) (Table 5).

Out of 364 cases, 299 (82.14%) cases were performed by post-graduate trainee and 65 (17.86%) cases by experienced surgeons. Voice changes were seen in 205 (68.56%) cases and 11 (16.92%) cases which were performed by post-graduate trainee and experienced surgeon respectively. Voice changes were statistically very significant in experienced surgeons. (68.56% Vs 16.2 %, X^2-59.0096, p-value is significant). Thus, the surgeons experience is the most important prognostic factor (Table 6).

Out of 364 cases, orotracheal intubation and cervical epidural anaesthesia were given in 182(50%) and 182(50%) cases respectively. Voice changes were seen in 122(67.77%) cases in which orotracheal intubation was performed and in 94(51.65%) cases cervical epidural anaesthesia was given. Voice changes were statistically significant in patients in which orotracheal intubation were performed. [67.77% Vs 51.65%, X^2 - 8.9269, p - 0.00281(Table 7).

Out of 364 cases, Permanent RLN palsy was seen in 4 (1.10%) patients. RLN palsy was seen in 2 (0.60%) cases in which sub-total/total thyroidectomy were performed and 2 (6.25%) cases in which completion thyroidectomy was performed. Voice changes due to RLN palsy were statistically significant in patients in which completion thyroidectomies were performed. (6.25% Vs 0.60%, X^2 - 8.5655, p - 0.003426) (Table 8).

Follow up

During the study period, voice changes of patients were followed up to a period of 1 year.

DISCUSSION

In this study, author highlighted the impact of thyroid surgery and effects of factors such as patient age, sex, operation type, surgeons experience, laryngeal nerve injury and orotracheal intubation on voice of patients undergoing thyroid surgery. Present study had no control group. The postoperative voice parameters of the patients were compared with their preoperative voice parameters, which acts as their own controls.

Age of patients

Voice changes after thyroid surgeries are more in older patients (age ≥65 years). Echternach M et al study showed voice changes due to alteration in the vocal folds more in older patients (age ≥65 years) than patients of age group <65 years (39.8% Vs 30.8%; p-0.03).[9] Present study, also showed the same finding. Out of 364 patients, voice changes were seen in 216 (59.25%) patients. Out of 216 patients, patients of age group ≥65 years were 128 (59.25%) and age group <65 years were 88 (40.75%) (59.25% Vs 40.75%; p-0.012324) (Table 3). Voice changes due to vocal fold injuries in older patients (≥65 years) are probably due to decrease in flexibility and atrophy of the vocal tissues. Very few literatures mentioned co-relation between age group and voice changes after thyroid surgery. So, it needs furthermore studies before assigning any conclusion.

Sex of patients

Voice changes in female patients were more common than male patients after thyroid surgery. In Akyildiz S et al study patients sex had no effect on the voice parameter after thyroid surgery (p-0.68).[10] In contrast to this study, present study showed there was voice changes were more in females after thyroid surgery (p-0.001046) (Figure 1).

Voice changes were statistically significant in females. One of the reason may be, there were more number of females in present study [Females-298 (81.87%), Males-66 (18.13%] (Table 1). One of the reason postulated by Mupparapu M et al that, mineralization of thyroid cartilage differs in males and females patients and a preponderance of ossification of laryngeal cartilage in male as compared to female.[11] Weymuller EA et al also found higher rates of voice changes (hoarseness) in female patients as compare to male patients after thyroid surgery.[12] The exact reason behind it is not clearly mentioned in the literature. So, further studies need to be conducted.

Types of surgery performed

Voice changes after thyroid surgery is a very common problem. Voice changes secondary to laryngeal nerve palsy ranging from 0% after primary surgery to 20% after completion thyroidectomy.[13] In Echternach M et al study, revision or completion thyroidectomy was associated with higher rate of voice changes secondary to impairment of RLN (11.6% Vs 6.2%; p-0.04).[9] In present study, voice changes were also more after completion thyroidectomy (81.25% Vs 57.22%; p-0.008242) (Table 5). Voice changes were statistically significant in completion thyroidectomy surgery.

Surgeons experience

The surgeons experience is the most important prognostic factor. The skills and experience of the surgeons are more important than the type of thyroid surgeries was performed. In literature, it is reported that individual experience of surgeon is significantly associated with length of hospital stay and complication rates after thyroid surgery.[14] Voice changes secondary to laryngeal nerve injury was more common in patients in which surgery were performed by post-graduate trainee. More experienced surgeon performs more delicate dissection technique, providing less injury to strap muscle and laryngeal nerves. Complication rates in form of voice changes after thyroid surgery appear to be affected by experience of surgeons. A study of Maryland comprising 5860 patients, reported the lowest complication rates in patients operated by surgeons who performed more than 100 neck exploration surgeries annually and other studies also confirmed these results.[15] In present study, also voice changes and other complications were more after thyroid surgery, which were performed by post-graduate trainee (68.56% Vs 16.92%, p-significant) (Table 6).

Orotracheal intubation vs cervical epidural anaesthesia, voice changes secondary to injury to vocal folds during orotracheal intubation is much more common. Vocal fold injuries are seen on the first day after thyroid surgery, but they are quickly heal.[16] Peppard and Dickens described

hematoma of glottis healing within 4 weeks in 21 out of 22 patients.[17] In literature, it should be mentioned that the nerve can be impaired/injured during orotracheal intubation as well.[18] Orotracheal intubation can cause hoarseness of voice as well.[19] The incidence of laryngeal complications caused by orotracheal intubation is about 6%-70% after thyroid surgery.(20-22) In present study, out of 364 patients cervical epidural anaesthesia and orotracheal intubation were done in 182(50%) and 182(50%) patients respectively. Voice changes secondary to laryngeal complications were more in patients in which orotracheal intubation were performed (67.77% Vs 51.65%; p-0.00281) (Table 7). Voice changes were statistically significant in patients in which orotracheal intubation were performed. However, in literature very few data are available to differentiate voice changes because of injury to the laryngeal nerve or to the vocal folds from orotracheal intubation. So, further studies need to be conducted.

RLN palsy

Voice changes after thyroid surgery are usually due to the injury of RLN. In the present era identification and preservation of laryngeal nerves are widely practiced. Intraoperative neuromonitoring (IONM) and RLN Visualization alone (VA) are the two methods usually used for identification of RLN nerves. RLN visualization alone (VA) is considered as gold standard for the prevention of nerve injury during thyroid surgery.[4] Despite meticulous identification of laryngeal nerves, RLN injury still persist. In one of the study, permanent RLN palsy was reported up to 5%-6%.[5,6] In present study, permanent RLN palsy was seen in 4 (1.10%) patients. In Echternach M et al study, revision or completion thyroidectomy was associated with higher rate of voice changes secondary to injury of RLN (11.6% Vs 6.2%; p-0.04).[9] In present study, voice changes due to RLN injury was statistically significant in patients in which completion thyroidectomies were performed (6.25% Vs 0.60%, X^2-8.5655, p-0.003426) (Table 8).

CONCLUSION

Voice changes is common after thyroid surgery but usually transient and sometimes, permanent. Recovery of transient voice change is quite good, but voice changes due to RLN palsy were statistically significant in patients in which completion thyroidectomies were performed. So, patients must be informed about the risk of voice impairment after thyroid surgery. Further-more studies are required to evaluate the impact of thyroidectomy and effects of factors such as patient age, sex, operation type, surgeons experience and orotracheal intubation on voice of patients undergoing thyroidectomy.

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