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Original Article

Effect of thyroidectomy with totally preserved recurrent laryngeal nerve on the objective vocal functions

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ABSTRACT

Objective: To study the effect of thyroidectomy with totally preserved recurrent laryngeal nerve (RLN) on the objective vocal functions.

Methodology: It is a prospective pilot study of 10 patients undergoing thyroid surgery on whom to study the effect of thyroidectomy with totally preserved RLN on the objective vocal functions. Patient history and demographic data were collected at the time of admission and in each period of assessment average fundamental frequency; absolute jitter, shimmer, and others were measured. Furthermore, one-way analysis of variance (ANOVA) repeated measurements statistical technique was used to test the difference among the 3 time period of measurements and $P < 0.05$ was considered significant ($\alpha = 0.05$).

Results: The mean age was 39.5 ± 3.31 years. There were two males and eight females. Total thyroidectomy was performed on eight patients while one had left hemithyroidectomy and one completion thyroidectomy. Histopathology revealed papillary thyroid carcinoma in 50%. 34 acoustic voice analysis parameters were measured using the multidimensional voice program, which showed no significant differences at the end of 1st and 3rd month post-operative as compared to the pre-operative measurements. There was no significant difference in measurement for each factor over the time ($P > 0.05$).

Conclusions: All the acoustic analysis parameters for 10 patients showed no significant differences in 1st and 3rd month postoperatively as compared to the pre-operative values. However, due to small sample size, our study may have failed to detect any significant difference.

Keywords: Recurrent laryngeal nerve, thyroidectomy, vocal functions

Introduction

The thyroid surgical anatomy and the high prevalence of thyroid disorders requiring surgical interventions make thyroid one of the most challenging organs to be operated on.[1,2] Thyroid surgery has a number of complications, majority of which originate from iatrogenic injury to its surrounding anatomical structures.[3-6] Iatrogenic injury to recurrent laryngeal nerve (RLN) is of profound significance due to a multitude of factors such as the crucial major supply to the vocal cords, anatomical variations in the route of RLN, and nature of thyroid disease.[7-9]

RLN injury results in acute paralysis of the vocal cord, which may cause dysphagia, dysphonia, and aspiration problems. The signs and symptoms depend on the position of the affected vocal cord, midline, or paramedian. Considerable number of patients may be asymptomatic; thus, mobility of the vocal cords should be examined before and after surgery to detect any RLN injury.[10-12] The reported risk of RLN injury following thyroid surgery varies from center-to-center and it has been reported as high as 38%.[13-15] Thyroid disorders are quite frequent in the Kingdom of Saudi Arabia (KSA). According to Saudi cancer registry (June 2016), thyroid cancer was reported to be 7.6% of all newly diagnosis cancers in the year 2013. It was reported to be the second most common cancer in females while in males it came at number 12.[16] Current study was performed to evaluate the effect of thyroidectomy with totally preserved RLN on the objective vocal functions.

Methods

Study design

It was a prospective study performed in Otolaryngology-Head and Neck Surgery Department, King Abdul-Aziz University Hospital, Riyadh, Saudi Arabia. The study was approved by

King Saud University, KSA with Institutional Review Board approval number 12/3619/IRB. Informed consent was taken from every patient included in the study. The study period was from March 2014 to April 2015.

Methodology

It is a prospective pilot study of 10 patients undergoing thyroid surgery on whom voice assessment tests were performed, which included 34 acoustic voice analysis parameters [Table 1]: Preoperatively, at the time of admission; reassessment was done at the end of 1st and 3rd month postoperatively. Complete medical history and patient's demographic data were collected at the time of admission.

Table 1: Acoustic parameters

Acoustic parameters
Average fundamental frequency (Fo)
Mean fundamental frequency
Average pitch period
Highest fundamental frequency
Lowest fundamental frequency
Standard deviation of fundamental frequency
Phonatory Fo-Range in semi-tones
Fo-tremor frequency
Amplitude tremor frequency
Length of analyzed sample
Absolute jitter
Jitter percent
Relative perturbation
Pitch quotient perturbation
Smoothed pitch perturbation quotient
Fundamental variation frequency
Shimmer Db
Shimmer %
Perturbation quotient amplitude
Smoothed perturbation quotient amplitude
Peak-to-peak amplitude
Noise harmonic ratio
Voice index turbulence
Phonation index
Tremor intensity index Fo
Tremor intensity index amplitude
Voice breaks degree
Subharmonics degree
Voiceless degree
Number voice breaks
Number of sub-harmonic segments
Number of unvoiced segments
Number of segments computed
Total number detected pitch periods

One-way analysis of variance (ANOVA) repeated measurements statistical technique was used to test the difference between the three measurements. Greenhouse test was done in place of severity test if severity does not satisfy. $P < 0.05$ was considered significant ($\alpha = 0.05$).

Exclusion criteria

Any patient having one or more of the following features was excluded from the study, as these would have modified the acoustic measurements.

1. Age below 16 years.
2. History of any neurological disorder.
3. History of voice problem.
4. Abnormal auditory perceptual voice assessment.
5. Abnormal laryngostroboscopic findings.
6. History of endotracheal intubation in the past 3 months.

Data analysis

Data were entered in Excel spreadsheet according to columns of data collection tool. The file was analyzed with Statistical Package for the Social Sciences software version 20. Qualitative variables, for example, gender, occupation, smoking status, etc., were given as frequency/percentages. Quantitative variables, for example, age, body mass index (BMI), etc., were given as mean ± standard error of mean. One-way ANOVA repeated measurement was used to test if there is significant difference among the measurements over time using Greenhouse-Geisser test in place of severity test if severity does not satisfy.

Results

In this case series, 10 patients undergoing thyroidectomy procedure were included. The characteristics of the patients are presented in [Table 2]. The age of patients ranged between 22 and 59 years and mean age was 39.50 ± 3.31 years (95% confidence interval for mean = 32.02–46.98). Males were 2 (20%) and females were 8 (80%). None of the cases was a smoker.

Mean BMI of patients was 28.51 ± 2.00 (23.98–33.05) kg/m^2 and it ranged between 20.11 and 38.34 kg/m^2. BMI was ≤25 kg/m^2 in 3 (30%) cases, it was between 25 and 30 kg/m^2 in 2 (20%), it was between 30 and 35 kg/m^2 in 3 (30%), and more than 35 kg/m^2 in 2 (20%) cases.

Regarding past medical history, two patients had a history of bronchial asthma, one of them had gastroesophageal reflux disease, and another had hypothyroidism. One patient had diabetes mellitus and hypertension. Remaining 7 (70%) patients did not have any significant medical history or past hospital admissions.

Regarding the occupation, five of the eight females were housewives, one was a teacher, one was a nurse, and one was

Table 2: Patient characteristics, smoking history, and past medical history

Characteristic	Number of patients (%)
Sex (*n*=10)	
Male	2 (20)
Female	8 (80)
Age (*n*=10) range (22–59) (year)	
20–29	1 (10)
30–39	4 (40)
40–49	4 (40)
50–59	1 (10)
Mean (SD) age, years	39.50 (3.31)
Occupation (*n*=10)	
Housewives	5 (50)
Teacher	2 (20)
Businessman	1 (10)
Nurse	1 (10)
Student	1 (10)
BMI (*n*=10) Range (23.98–33.05)	
≤25	3 (30)
25.1–30	2 (20)
30.1–35	3 (30)
>35	2 (20)
Mean (SD) BMI, kg/m^2	28.51 (2.00)
Smoking history (*n*=10)	
Yes	0 (0)
No	10 (100)
Past medical history (*n*=10)	
Yes	3 (30)
No	7 (70)

BMI: Body mass index, SD: Standard deviation

a student. Out of two men, one was a teacher and second was a businessman. All patients were operated between March 18, 2014 and December 23, 2014. In 8 (80%) cases, total thyroidectomy was performed out of which three patients underwent neck dissection as well, i.e., one underwent central neck dissection, one underwent right selective posterolateral neck dissection, and one underwent bilateral neck dissection. Out of remaining two cases, one had completion thyroidectomy and the second had only left hemithyroidectomy. The type of surgery was related to the pathological diagnosis. The most common histological entity was papillary thyroid carcinoma (50%), followed by follicular neoplasm (20%). In one case, the benign follicular nodule was diagnosed and the patient had undergone total thyroidectomy. One patient was diagnosed to have Hurthle cell lesion and focal atypia. Nodular goiter was found in one case, i.e., the patient who underwent left hemithyroidectomy.

Intubation was easy and performed in single attempt in all 10 cases and tube size was 7 (40%) and 8 (60%). RLN was identified and responding to stimulation in 9 (90%) cases on the right as well as on the left side. However, in one patient, the right RLN and in another the left RLN was not identified. Superior laryngeal nerve (SLN) was identified in 4 cases, two each on the right and left side. In one patient, both the right and left SLNs were identified. Cricothyroid muscle was injured in one patient.

34 acoustic voice analysis parameters were measured using the multidimensional voice program for all the patients and showed no significant difference at the end of 1st and 3rd month postoperatively as compared to the pre-operative recordings. The one-way ANOVA repeated measurement presented the severity was not satisfied ($P < 0.5$) within factors while the Greenhouse-Geisser test showed there was no significant difference among the means of the measurement for each factor over the time ($P > 0.05$).

Discussion

The objective of our research was to study the effect of thyroidectomy with totally preserved RLN on the objective vocal functions. As this was a pilot study, there was no control group. However, we took the pre-operative voice parameters as control and compared them with the post-operative measurements. The voice of the patient was assessed with 34 acoustic voice analysis parameters using the multidimensional voice program: There was no significant difference at the end of 1st and 3rd month postoperatively as compared to the pre-operative recordings. This contrasts with other studies which reported voice changes after thyroid surgery.[17,18]

Objective voice parameters have been used before and after thyroid surgery by many reporters but majority of them[19-21] used univariate statistical analysis examining separately the pre-operative and post-operative acoustic changes.

Stojadinovic and colleagues reported post-thyroid surgery dysphonia through voice case history, voice handicap index (VHI), clinician-perceived-voice deficits Consensus Auditory Perceptual Evaluation–Voice (CAPE-V), and videolaryngoscopy in 50 subjects. Patients were assessed presurgery and 3 times postsurgery (1–2 weeks, 3 and 6 months). The study found that the CAPE-V and VHI were respectable measures for detecting dysphonia after thyroidectomy. Eight patients had temporary dysphonia and one had permanent voice abnormalities after thyroid surgery.[18] Our study might have missed temporary dysphonia as the voice parameters were recorded 1 month postoperatively. A few articles have reported some reversible voice changes in the initial post-operative phase in those patients in which there was no injury to the RLN.[19,21,22]

Stojadinovic *et al*. could not find significant voice changes in post-thyroidectomy patient using ANOVA at repeated post-operative measurement.[18] They also noticed that the

type of thyroid surgery performed had no relation to any voice changes. This is agreement with our study as we also did not find any post-operative voice changes.

DePedro and coworkers studied the quality of voice and voice self-assessment after thyroid surgery in 100 patients undergoing thyroid surgery and a group control of 30 patients undergoing breast surgery. Both groups were assessed through three subjective measures and one objective measures. Both groups were assessed preoperatively and 2 weeks postsurgery. The results showed that 28% of the thyroid surgery group had larynx changes (through videolaryngoscope evaluation) postsurgery, whereas the control group exhibited no significant changes. Moreover, the GRBAS scale, 29.7% of the thyroid surgery group had subjective voice changes (not including those with vocal cord immobility) postsurgery, with no statistically important subjective changes detected for the control group. Acoustic measurement analysis in both groups showed increased values of the voice turbulence index parameter; however, the VHI indicated higher voice complaints in the thyroid group. This study showed that voice differences after thyroid surgery are common even that not including those with vocal cord immobility.[21] In our study, we did not found any vocal cord abnormalities.

Limitations of study

The small sample size is the main limitation of the study. A larger series may allow us to apply the statistical tests of significance to make the results more relevant. Due to the small sample size, the patients were not subcategorized into groups depending on their diagnosis. The lack of subgroup discriminate may have limited the study finding as one or more diagnoses may lead to different voice symptoms and different voice analysis measurement.

Conclusions

All the acoustic analysis parameters for 10 patients showed no significant differences in 1st and 3rd month postoperatively as compared to the pre-operative values. However, due to small sample size our study may have failed to detect any significant difference.

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