



Pre-operative subjective and objective voice assessment in patients with benign thyroid disorders

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Abstract:

Background: Changes in voice quality are common in patients with different thyroid disorders.

Objectives: This work aims to identify subjective and objective voice changes in candidates for surgery for nonmalignant thyroid diseases to highlight its role in preoperative voice assessment and early detection of laryngeal disorder in those patients for further management.

Patients and Methods: The patients' group included 60 consecutive patients with benign thyroid disease; their ages ranged between 19 and 65 years. Age and gender-matched control group included 30 healthy normal subjects. Both groups were subjected to clinical examination, modified GRBAS scale, Voice handicapped index, acoustic analysis, and flexible nasolaryngoscopy.

Results: Patients with thyroid disorders have significant dysphonia of mild to a moderate degree, as detected by APA in 38 % of patients. Acoustic analysis revealed altered jitter in 41% of patients and altered shimmer in 33%. Patients with abnormal thyroid hormone have more significant voice changes than patients with the euthyroid state.

Conclusion: The Auditory perceptual voice analysis and VHI revealed significant changes in overall voice quality and grade of dysphonia in patients with thyroid disease in a way that can be judged as a sensitive and reliable assessment tool being as acoustic analysis. Patients with abnormal thyroid hormone have a more chance to have voice disorders than patients with the euthyroid state. APA of voice must be a routine assessment for patients with benign thyroid disease, and patients with dysphonia have to be referred for voice specialists for further assessment.

Keywords: Voice parameters; VHI; thyroid diseases; acoustic analysis; thyroidectomy

Introduction

Thyroidectomy is one of the commonest surgical procedures. Since postoperative voice change and vocal cord palsy is a vital and serious complication, some authors have advocated routine voice and laryngeal examination before thyroidectomy.^{1,2}

Voice problems in thyroid disease are frequent, involving a wide range of dysphonia severity and voice quality changes.³ Voice alteration in thyroid disease is possibly due to structural or functional changes in the larynx. The thyroid gland and the larynx are closely related via both blood supply and

innervation; thus, damage to one structure could easily affect the other structure.⁴ Voice changes are a common problem in hypothyroidism, including lower pitch, roughness, decreased range, and vocal fatigue. Whereas, hyperthyroidism can cause a reduction of subglottic pressure and respiratory muscle weakness resulting in hoarseness, breathy voice quality, reduced loudness, and vocal fatigue.⁵ Preoperative voice abnormalities may recover or deteriorate by surgery, regardless of the preoperative voice condition.⁵

While preoperative voice and laryngeal assessment has been recommended as the guideline of practice in patients planned for thyroid surgery, its routine use is doubtful, and the data appear inconsistent.^{6,7} One recent large study of 5987 patients, who had preoperative laryngoscopy, vocal cord paralysis was found in only 0.68% of patients. Therefore, they support a selective approach to preoperative laryngoscopy only if the patient has a huge goiter, hoarseness, or previous neck surgery.⁶ Auditory perceptual analysis (APA) of voice using the modified GRBAS scale is a reliable, cost-effective measure for identifying perceived vocal changes. The ease of use and high predictive value of this measure makes it ideal for measuring voice parameters as experienced by the listener.^{8,9} The Voice Handicap Index (VHI) used as a reliable method in detecting patient subjective feelings of his voice from physical, functional, and emotional aspects. VHI has good reliability and validity as proved by previous studies and can be effective as a stand-alone voice screening tool.^{10,11}

Thyroid surgeon needs practical, easy, effective, and efficient mean to identify thyroid patients with voice problems in their routine clinic visit. If patients with thyroid disease display

vocal dysfunction by APA and VHI, the detection of these symptoms could aid in early detection of the laryngeal disorder and referral to voice specialists. Further, getting a baseline for preoperative voice dysfunction could enable documentation of the recovery process and help surgeons ascertain the success of their surgery.⁶

Patients and Methods:

The study involved 90 adults. The patient group includes 60 consecutive candidates for thyroidectomy for patients diagnosed clinically, radiological, and by FNAC as having benign thyroid disease as preoperative work-up at the Voice Clinic. The control group included 30 healthy normal adults; age and gender matched.

Exclusion criteria applied to control confounding factors that may affect voice other than thyroid disease. It includes smoking; any respiratory tract infection on the assessment's day; severe bronchial asthma, neuromotor impairment, hearing or psychiatric problems; previous neck surgery, and gross laryngeal lesions or vocal fold paralysis by laryngoscopy.

Complete clinical examination: All patients subjected to full history taking, clinical examination, thyroid function test, and thyroid imaging workup. Fine needle aspiration cytology (FNAC) was done for pathological diagnosis of thyroid disease and to exclude malignancy.

Auditory perceptual analysis (APA): applying a modified GRBAS scale where the followings parameters were evaluated: The overall grade of dysphonia (G), Rough (R), Breathy (B), Strained (S), Leaky (L), or Irregular (I). Each parameter scored on a scale of 0 to 3 (0, normal; 1, slight; 2, moderate; and 3, severe disturbance).^{8,9} Evaluation of Pitch level, register, Loudness, glottal

attack, and associated laryngeal functions as cough and laugh sounds were done.

Voice recording: carried out in a sound-treated room with the patient sit 10 cm away from the microphone. Different voice and speech materials used as counting, vowel prolongation, and short sentences. Vowels prolongation with comfortable pitch and loudness, and louder to detect stability of voice quality.

Voice handicapper index (VHI) applied to both groups: The VHI is a self-assessment questionnaire including 30-items that evaluates patient-perceived handicap levels related to voice impairment. Every Single item is rated from 0 to 4, with three subscales: Physical, Functional, and Emotional. The total VHI score ranges from 0 to 120.¹¹

Acoustic analysis: The acoustic voice analysis was done using the Multidimensional Voice Profile (MDVP) in Kay CSL 450. Participants were asked to phonate a soft vowel with a comfortable pitch at a distance 30 cm from the microphone, and the room ambient noise level was 30 decibels. Data collected from MDVP includes the fundamental frequency (F0) in Hz), jitter percent, shimmer percent, and Harmonic to noise (H/N) ratio. Altered acoustic parameters estimated as jitter percent above 1.1%, shimmer percent above 3.8% and N/H ratio above 0.2.¹²

Flexible naso-laryngoscopy: To assess the mobility of the vocal folds and allows visualization of the larynx and supra glottal structures.

Ethics: The study protocol was approved by the Dubai health authority research and ethics Committee. The study was conducted in accordance with the ethical standards of Helsinki declaration. Patients were given a clear explanation of the study objectives and the plan of the study. They were free to

terminate participation in this study without affection of clinical service or clinical management. A written informed consent including the explanation was obtained from all subjects involved in the study prior to participation.

Statistical analysis :

Statistical analysis was done using SPSS 21 program. Qualitative variables measured by frequency and percentage, while the quantitative variables measured by the mean and standard deviation (mean \pm SD). Cross tabulation and Chi-square (χ^2) test were used for comparison of qualitative variables between the two groups and between different categories of the patient group. Comparison between numerical variables done by using independent sample t-test or Mann-Whitney U test. Correlation between different voice evaluation methods estimated by the Spearman test and Pearson correlation. Significance level at P-value $<$ 0.05.

Results:

The study's sample included 90 subjects in two groups. The patient group included 60 patients diagnosed with thyroid disease (goiter) preoperatively consisted of 8 males and 52 females; their ages ranged between (19 and 65 years) with a mean \pm SD (39.4 \pm 9.5). The Control group involved 30 healthy normal subjects consisted of 5 males and 25 females; their ages ranged between (20 and 63 years) with a mean \pm SD (37.2 \pm 11.7). The types of thyroid disease were Multinodular goiter in 36.6%, diffuse goiter in 13.3%, single simple nodule in 18.3%, Grave's disease in 20%, and Hashimoto thyroiditis in 11.6% of patients.

Figure 1. shows the results of the APA of both the patient and control

group. A statistically significant difference found between the two groups regarding dysphonia; 38.3% of patients with thyroid disease were dysphonic with P-value (0.05). The degree of dysphonia was slight to moderate in 33.3 % of patients and severe in 5% of patients. The voice quality was strained-asthenic in 31.6% and breathy in 8.3% of patients. It revealed a significantly higher percentage of patients with reduced loudness, reduced pitch, soft glottal attack, and altered cough and laughter sounds with P-value 0.015. Voice handicapper index (VHI) of 11 or more (were considered to have subjective dysphonia) were found in 38.3 % of thyroid disease patients and 10 % of the control group. VHI ranged from 0 to 38 with a mean (\pm SD) 21.5 (\pm 9) in the patient group and ranged from 0 to 12 with a mean of 5.5(\pm 3.6) in the control group with a statistical significant difference between the two groups with p-value 0.005.

According to the results of the acoustic analysis, the percentage of patients with altered jitter and shimmer percent was significantly higher in the patients' group, as shown in table 1.

The laryngoscopic finding was bilateral normal vocal folds mobility and no pathological laryngeal lesion. Patients with abnormal laryngeal findings were excluded from the study.

Table 2 and figure 2 shows the comparison of APA, VHI, and acoustic measures according to different thyroid function states. There was a significant difference between the euthyroid group and both hypothyroid and hyperthyroid groups in the overall degree of dysphonia, strained leaky voice quality, and low-pitched voice. Figure 3 shows that the highest prevalence of overall dysphonia, altered jitter, and altered shimmer was observed in patients with hypothyroidism, while the highest VHI

was observed in hyperthyroidism. The lowest mean Fo, and the highest mean jitter and shimmer percent found in hypothyroidism. 85% of patients with altered APA and VHI have abnormal acoustic measures in at least one parameter. There is a strong positive correlation between the overall grade of dysphonia and VHI with p 0.001. The same correlation was found between dysphonia severity and altered acoustic measures.

Table 1: prevalence of altered acoustic parameters in thyroid patients and control group

| | Thyroid patients (60) | | The control group (30) | | P-value |
|-------------------|-----------------------|-------|------------------------|-------|---------|
| | No. | % | No. | % | |
| Altered jitter | 25 | 41.6% | 7 | 22.6% | 0.049 |
| Altered shimmer | 20 | 33.3% | 4 | 13.3 | 0.036 |
| Altered H/N ratio | 18 | 30% | 5 | 16% | 0.161 |
| Altered VHI | 23 | 38.3% | 3 | 10% | 0.005 |

Discussion :

There is a plethora of studies on voice changes in thyroid patient's post-thyroidectomy, but there is a shortage of studies that defined changes of voice before thyroidectomy. Therefore, the purpose of our study was to identify subjective and objective changes in voice for patients with thyroid disease pre-operatively as compared to the control group. The female predominance in thyroid disease in the present study was in agreement with previous studies as thyroid diseases are hormonal dependent and common in females with a 4:1 female to male ratio.^{13,14}

Table 2: Outcomes according to thyroid function:

| | Euthyroid | Hyperthyroid | Hypothyroid | p-value |
|------------------------------|--------------|--------------|---------------|---------|
| Total number | 37 (61.6%) | 12 (20.0%) | 11 (18.3%) | |
| Overall dysphonia no (%) | 9 (24.3%) | 5 (41.6%) | 8 (72.7) | 0.013 |
| Strained, leaky voice no (%) | 6 (16.2%) | 7 (58.3) | 3 (27.3) | 0.016 |
| Reduced loudness no (%) | 9 (24.3) | 6 (50%) | 5 (45.4%) | 0.167 |
| Low pitch no (%) | 2 (5.4%) | 0 | 3 (27.2%) | 0.147 |
| Altered VHI no (%) | 8 (21.6%) | 9 (75 %) | 6 (54.5%) | 0.001 |
| Altered Jitter no (%) | 11 (29.7%) | 6 (50%) | 8 (72.7%) | 0.050 |
| Altered shimmer no (%) | 6 (16.2%) | 7 (58.3%) | 7 (63.6%) | 0.004 |
| Altered N/H ratio no (%) | 9 (24.3%) | 4 (33.3%) | 5 (45.4%) | 0.459 |
| F0 mean (SD) | 186 (39) | 193 (42) | 176 (37) | 0.062 |
| Jitter % mean (SD) | 1.21 (0.92) | 1.53 (1.34) | 2.41 (.79) | 0.021 |
| Shimmer % mean (SD) | 3.78 (1.43) | 3.91 (1.27) | 4.25 (1.65) | 0.046 |
| N/H ratio mean (SD) | 0.152 (.328) | .147 (.187) | 0.156 (.0514) | 0.759 |

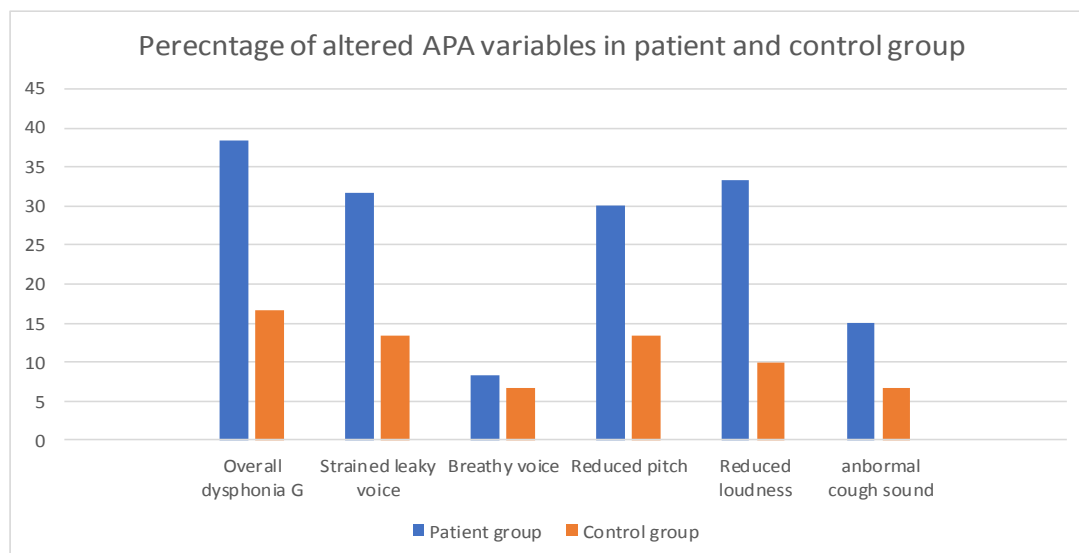


Figure 1: Histogram showing percentage of altered APA measures in patient and control group

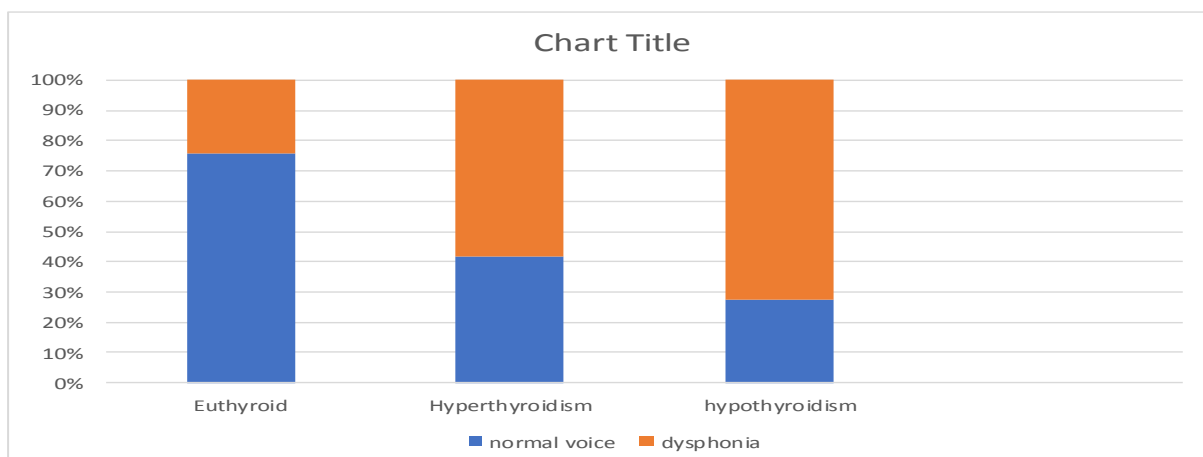


Figure 2: Grade of dysphonia according to thyroid hormone status

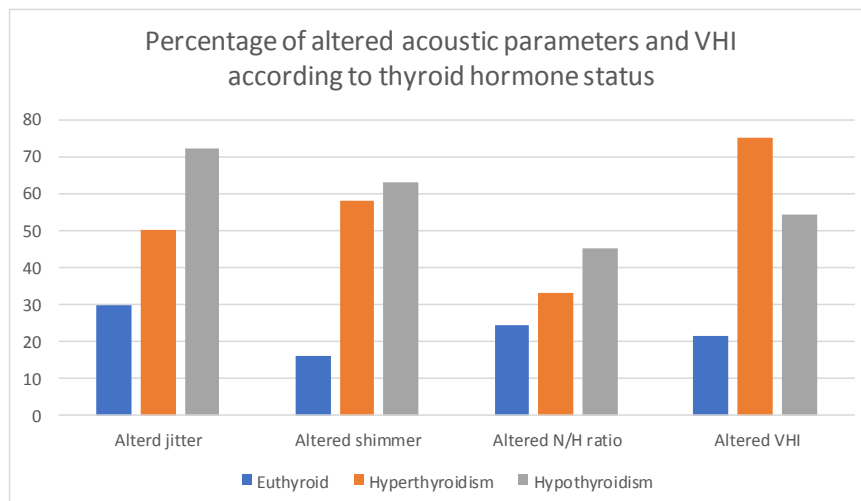


Figure 3: Histogram showing percentage of altered acoustic parameters and VHI according to thyroid hormone

The results of the present study revealed a relatively high prevalence of abnormal perceptual voice characters of slight to moderate degree in patients with thyroid disease. The finding of previous studies, on perceptual voice changes in thyroid gland disorders, reported symptoms of voice change ranged from 10 % to 38%.¹⁵ The most common voice symptoms reported in the literature were hoarseness, roughness, breathiness, strain, vocal fatigue.¹⁶⁻¹⁹

Our results agree with a previous finding on patients before thyroidectomy using Visipitch and subjective questionnaire for voice. One-third of patients presented with dysphonia before surgery, and the reported dysphonia matched the dysphonia recorded with Visipitch with 64% accuracy.⁵ The findings of our study regarding the grade of dysphonia are similar to the results of a previous study that found that 33.3% of patients with thyroid disorders had mild to moderate degree of dysphonia. The majority of cases were multinodular goiter, hypothyroidism, and thyroid nodule, which had a mild to moderate effect on vocal performance.¹⁷

The altered voice quality in patients with thyroid disease can be attributed to many premorbid ailments that can affect the voice but are often unnoticed before a thyroidectomy procedure. Patients may have coexisting anxiety, maladaptive voice behaviors, or laryngeal muscle tension due to the presence of a mass in the neck.¹² Patients with thyroid disease had a significant low-pitched voice, which was more prominent in hypothyroidism. Hypothyroidism increases hyaluronic acid and fluids retention ((myxedema) in the deeper layers of lamina propria, which increases vocal folds mass.²⁰ Still, hyperthyroidism can cause low pitched voice due to laryngeal edema and muscle weakness.

The findings of this study can verify that patients with hyperthyroidism or hypothyroidism have a higher prevalence of dysphonia and voice disability than patients with thyroid disease with normal thyroid hormone (TH) state (euthyroid). Dysphonia and voice disability in hyperthyroidism could be attributed to respiratory muscle weakness with reduced subglottic pressure that causes greater effort for voice production, causing strained leaky voice. The voice alteration is more

evident in hyperthyroidism, with higher effect on quality of life, due to the rapid onset of the disease, in addition to tension and anxiety as symptoms of hyperthyroidism.²⁰ From these findings, we can advise proper voice assessment for all patients with goiter and abnormal thyroid hormones due to the high prevalence of voice disorders.

Voice alterations may appear even in mild thyroid failure as the receptors of thyroid hormone (TH) exist in the larynx, which confirms that the TH acts on the laryngeal tissue affects voice stability and loudness.²¹ Previous studies reported that 27% of hyperthyroidism patients and in 2% - 98% of hypothyroidism patients encounter voice change.¹⁴ The anatomical relation of the thyroid gland and its neurovascular linking with the larynx can explain the presence of voice alterations in thyroid disorders patients with euthyroid state.²²

Several studies found that voice quality can be affected in patients with thyroid disease.²²⁻²⁵ The VHI is a more objective evaluation in detecting vocal symptoms as 38% of the patients group reported voice alteration, and this finding agreed with APA and acoustic measures. A previous study of 395 patients using the patients' subjective feeling of voice, 30% of patients reported with voice abnormalities such as low-pitched voice.²⁵ The current results can confirm that patients with thyroid disease have changes in vocal quality before thyroidectomy. Subjective measures are a valuable method for screening of voice preoperatively due to the positive correlation between subjective and objective voice analysis. Previous studies found no difference between means of vocal self-assessment and APA. However, the patient's self-assessment is worse than APA due to proprioceptive concerns of the patient,

which the listener cannot measure. Therefore, it is advised to use APA with VHI for proper screening of voice disorders in thyroid patients.^{12,14}

There is a percentage of patients who develop post-thyroidectomy vocal disturbances without any apparent causes, one issue to explain these post-thyroidectomy cases of dysphonia is to verify pre-surgical dysphonia through voice screening. Thyroid Association Guidelines endorse selective preoperative laryngeal assessment only for patients with voice abnormalities, previous cervical surgery, or known cancer thyroid.²⁵ This study provides several points that highlight the role of preoperative subjective voice assessment and VHI as it is simple, sensitive, and cost savings; it does not need for endoscopy or ENT specialist.

Conclusion :

The Auditory perceptual voice analysis and VHI showed significant changes in overall voice quality and grade of dysphonia in patients with benign thyroid disease in a way that can be judged as sensitive and reliable assessment tools being as acoustic analysis. Patients with hyperthyroidism or hypothyroidism have more prevalence of voice disorders than patients with the euthyroid state. APA of voice must be a routine assessment for patients with benign thyroid disease, and patients with dysphonia have to be referred for voice specialists for further assessment.

Declaration of interest:

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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