

Original Research Article

A prospective study to evaluate the etiologies and parameters of voice assessment in patients of vocal cord paralysis

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ABSTRACT

Background: Evaluation of voice disorders are performed using multiple approaches but there is no single standard method. Our study compared the various voice assessment measures and their clinical relevance for unilateral vocal cord palsy (uVCP).

Methods: 30 patients of uVCP were assessed and followed up on day 15, 30 and 90 of diagnosis. At each visit, perceptual analysis of voice, grade (G), rigid 70⁰ Hopkins laryngoscopy to measure the phonatory gap (PG), maximum phonation time (MPT), and voice handicap index (VHI) were noted.

Results: The results were analysed in two ways, one on the basis of improvement in VHI and the other on the basis of PG. When two groups ('improved group 1' and 'unimproved group 1') were formed and compared on the basis of VHI; MPT, Grade and 'change in PG' of the improved group showed a significant difference as compared to the unimproved group. Whereas when two groups ('improved group 2' and 'unimproved group 2') were formed and compared on the basis of improvement in PG, none of the parameters of the improved group showed a significant difference as compared to the unimproved group.

Conclusions: All parameters correlate well with VHI than with PG, hence VHI alone can be sufficient to assess the improvement in voice. Although rigid laryngoscopy is essential initially for diagnosis, it need not be necessary to for further evaluation for improvement in voice.

Keywords: Unilateral vocal cord paralysis, Voice disorders, Voice handicap index

INTRODUCTION

Unilateral vocal cord paralysis (uVCP) is defined as unilateral immobility of the vocal cord due to a neurological cause. It can be caused due to injury to the recurrent laryngeal nerve or vagus nerve innervating the larynx. Aetiology can be varied ranging from metastatic infiltration to idiopathic.

Patients with unilateral vocal cord paralysis usually present with symptoms of hoarseness of voice, aspiration and aphonia.^{1,2}

Evaluation of voice disorders can be performed using multiple approaches which include laryngoscopy, electromyography, imaging techniques, aerodynamic measurements, acoustic analysis, perceptual evaluation, and measures of functional disability that are self-evaluated by the speaker.³

Each of these methods of assessment is unique in its own way. While perceptual evaluation can be performed only by experts, acoustic analysis is computerized and reduces differences in personal opinion of experts. Voice Handicap Index (VHI) is a standardized self-assessment questionnaire to assess voice under three different

domains- Physical, Functional and Emotional. It is the only one to include the emotional aspect associated with the disease pathology.⁴

Murrey and Rosen compared VHI of various groups of voice disordered patients and found the highest score in patients of vocal cord paralysis.⁵ Rigid laryngoscopy gives a two-dimensional view of impaired vocal fold mobility; position of vocal fold, presence of sulcus, or bowing of vocal fold.

The abundance of voice assessment measures stems from the inherently numerous aspects of voice that can be studied. This brings us to the obvious question of which is the most clinically relevant and effective method to assess a patient of voice disorder. There is no single standard method for evaluation. Usually the ease of availability of equipments decides their clinical use. A lack of Indian studies and limited resources in our scenario made it important to conduct such a study. Our study aimed at comparing these parameters and assessing their clinical relevance.

The aim of the present study was to ascertain the aetiology of uVCP and to correlate various parameters of voice evaluation with VHI and PG.

METHODS

This was a longitudinal descriptive study initiated after approval by the institutional ethics committee.

Study site: Department of Ear, Nose and Throat of a tertiary care teaching hospital.

Study population: The subjects in this study included patients visiting the voice clinic in this department.

Sample size: 30

Study duration: January 2016 to October 2016

Inclusion criteria:

- Patients diagnosed of unilateral vocal cord paralysis (uVCP) on rigid laryngoscopy.
- Patients willing to participate in the study.
- Patients following up for a period of three months.

Exclusion criteria

- Patients with direct malignant infiltration of the vocal cord.
- Patients with cricoarytenoid joint dislocation or fixation.

Prior to the assessment protocol, each patient was explained the procedure and purpose of the study. Patients willing to participate in the study signed an informed consent form.

Patients diagnosed of uVCP underwent routine otorhinolaryngologic examination to evaluate the cause of uVCP. CTscan (from skull base to mediastinum) was done for patients with an unidentifiable cause.

Patients were followed up on day 15, 30 and 90 of diagnosis. At every visit patients were evaluated on the basis of perceptual analysis, rigid laryngoscopy, maximum phonation time (MPT), and voice handicap index (VHI). Quality of voice was perceptually analyzed by a single otorhinolaryngologist by using the GRBAS scale which was proposed by the Japanese Society for Logopedics and Phoniatrics.⁶ Five parameters of voice were scored for grade, roughness, breathiness, asthenia and strain according to a 4-point rating system ranging from 0 (normal) to 3 (severe impairment). Rigid laryngoscopy was performed using a 70° Hopkins laryngoscope and videos were recorded. During the assessment, the individual was instructed to sustain the vowel/e/in modal vocal, after a deep inspiration, all the way to the end of expiration. All video records were reviewed by the same otorhinolaryngologist and the phonatory gap was assessed in each case as done in other studies.⁷ MPT was assessed during sustained vowel 'a' after deep inspiration at a conversational pitch and loudness level by using a stop watch. A Hindi validated version of the VHI was used.⁸ The VHI consists of 30 statements on voice related aspects of daily life a 5-point rating system ranging from 0 (never) to 4 (always). It is subdivided into 3 domains– Physical, Functional and emotional. The total score ranges from 0 to 120.

Statistic data analysis was performed with Wilcoxon signed rank test for checking significant difference in VHI in final visit (fVHI) compared to initial visit (iVHI). Independent t-test was used to compare MPT and phonatory gap (PG) between the two groups. Mann Whitney U test was used to compare the grade (G) part of the GRABS score in the two groups. The correlation between VHI at final visit (fVHI) and MPT (fMPT), phonatory gap (fPG), and grade (fG) was measured using Spearman's coefficient. A significance level of 0.05 for all tests was used. The ranges of correlation were as follows <0.3, poor; 0.3-0.5, fair; 0.5-0.7, good; and 0.7-0.9, very good. Statistical analyses were performed using SPSS 21 package.

RESULTS

The study was carried out among 30 patients visiting the voice clinic of a tertiary care teaching hospital. The mean age was 44.53 years (16-80). There were 21 males (70%) and 9 females (30%). Left vocal cord was involved in 80% of the patients. (Table 1a) and majority of the cases (46.6%) were idiopathic in aetiology (Table 1b).

Voice handicap index (VHI) score obtained at final follow up on day 90 (fVHI) was compared to the VHI score at diagnosis (iVHI). There was a significant decrease ($p=0.022$) in VHI as calculated by Wilcoxon

Signed Rank test. Sixteen patients showing decrease in VHI was grouped as 'Improved group 1' and the fourteen others as 'Unimproved group 1' (Table 2). The final MPT (fMPT) and the final grade (fG) of the 'Improved group 1' showed a significant difference as compared to the 'Unimproved group 1' (Table 2). The final phonatory gap (fPG) did not show a significant difference ($p = 0.14$) in the two groups. However, there was a significant difference in the change in PG (dPG) in the two groups over the period of follow up.

When the fPG of all patients was compared with their iPG, a significant improvement in PG ($p=0.006$) was found by Wilcoxon signed rank test. The patients were then regrouped on the basis of phonatory gap. Fourteen patients that showed reduction in PG were named as 'Improved group 2' and sixteen others as the 'Unimproved group 2'. The VHI, MPT and G in the 'Improved Group 2', however did not show any

significant change as compared to the 'Unimproved group 2' ($p_{mpt} = 0.08$), ($p_g = 0.31$, $p_{vhi} = 0.31$) (Table 3).

Table 1a: Patient demographics and side of vocal cord.

Characteristics	Total number
Gender	
Male	21 (70%)
Female	9 (30%)
Total	30
Age (in years)	
Range	16-80
Mean	44.53
Side of vocal cord involved	
Left	24 (80%)
Right	6 (20%)

Table 1b: Aetiology of uVCP.

Aetiology	Number of patients	Percentage (%)
Idiopathic	14	46.66
Neoplasm	6	20
a. Bronchogenic carcinoma	2	
b. Metastatic bronchogenic carcinoma	1	
c. Oesophageal carcinoma	1	
d. Thyroid carcinoma	1	
e. Vagal Schwannoma		
Iatrogenic	5	16.66
a. Cardiac surgery	2	
b. Thyroidectomy	2	
c. Excision of midline neck swelling	2	
d. Intubation	2	
Trauma	3	10
Pulmonary tuberculosis	2	6.66

Table 2: Mean of various parameters between groups categorized on basis of VHI at final visit.

Parameters	Improved group 1	Unimproved group 1	P value
	Average	Average	
MPT	9.25*	5.57*	0.001 [#]
PG	0.62*	1.28*	0.14 [#]
dPG	1.12*	0.21*	0.042 [#]
Grade	1**	2**	0.031 ^{##}

*Mean, **Median, [#] Calculated by independent sample T test, ^{##} Calculated by Man Whitney U test

Table 3: Mean of various parameters between groups categorized on basis of PG at final visit.

Parameters	Improved group 2	Unimproved group 2	P value
	Average	Average	
VHI	15**	86.5**	0.31 ^{##}
MPT	8.64*	6.56*	0.08 [#]
Grade	1**	2**	0.31 ^{##}

*Mean, **Median, [#] Calculated by independent sample T test, ^{##} Calculated by Man Whitney U test

Table 4: Correlation between various parameters at final visit.

Parameters	PG	MPT	Grade
VHI			
Correlation co-efficient	0.7	0.8	0.8
P value	0.00	0.00	0.00
MPT			
Correlation co-efficient	0.5		
P value	0.002		
Grade			
Correlation co-efficient	0.5		
P value	0.003		

Table 5: Comparison of parameters between the two groups at first visit.

Parameters	Improved group 1	Unimproved group 1	P value
	Mean	Mean	
iMPT	5.03	5.35	0.71
iPG	1.75	1.50	0.57
iG	2	2.5	0.79
iVHI	87.5	80.5	0.40

At final visit, the correlation coefficient of VHI with both Grade and MPT was 0.8. Whereas correlation coefficient of PG with Grade and MPT was 0.5. This reinforces the better correlation between VHI with the other parameters as compared to PG with the same parameters (Table 4).

The groups formed on basis of VHI were retrospectively compared for the values of each parameter at initial visit and no significant difference was found between the two groups ($p_{\text{impt}}=0.7$, $p_{\text{ipg}}=0.5$, $p_{\text{ig}}=0.7$) (Table 5). This proves that these two groups were comparable to each other at initial visit.

DISCUSSION

In any case of vocal fold paresis or paralysis it is utmost importance to confirm the diagnosis and be certain about the aetiology. In our study, most cases were found to be idiopathic (Table 1b), which is consistent with the findings of other studies.^{9,10} However there are various other studies proving either malignancy or iatrogenic as the major cause of uVCP.^{1,11}

Left cord was involved in 80% of the patients in our study. Although it was quantitatively higher in our study, it was consistent with other studies with respect to the side of involvement.^{1,9,10,12}

The voice was analyzed by various parameters at every visit. There was a significant difference in the VHI score of the sample in the final visit as compared to the first (fVHI and iVHI). The improvement in VHI was seen in 16 patients, 11 worsened and 3 patients had the same fVHI as iVHI.

After grouping these 16 patients as the ‘Improved group 1’ and the rest as ‘Unimproved group 1’, the parameters of final visit between the groups were compared. These groups were indistinguishable at diagnosis because there was no significant difference in the values of any of the parameters between the two groups (Table 5). The ‘Improved group 1’ showed significant improvement in MPT (fMPT) and Grade (fG) as compared to the ‘Unimproved group 1’. In other words, fMPT and fG improved in patients who showed an improvement in VHI. A study conducted by Reiter et al also showed a similar improvement in perceptual voice analysis ($p=0.03$) in the group that had an improved VHI and MPT.¹³ However their study was different in terms of grouping individuals in comparison to a set value of VHI and MPT ($VHI<35$ and $MPT>10$). Although their study mentioned a difference in the Phonatory gap in the two groups, no test of significance had been applied for the same. Various parameters in that study mainly aimed at evaluating the efficacy of a particular treatment modality.

In our study, we found that there was no significant difference in the phonatory gap of the 2 groups (Improved group1 and Unimproved group 1) but the change in phonatory gap over the period of follow up was significantly different in them ($p=0.04$).

Although there was a significant improvement in the fPG as compared to the iPG of the entire sample ($N=30$, $p=0.006$), the patients who showed this improvement did not show a corresponding significant change in other parameters. This helps us to conclude that an improvement in PG does not necessarily cause an improvement in other parameters. Therefore, it should not be considered as the parameter of choice for voice

assessment. This is in accordance with the conclusion of a study conducted by Anya et al, which states that it is ultimately the voice improvement and not laryngoscopic findings that should guide a surgeon's decision making.¹⁴ A limitation common in the studies is that a two-dimensional image modality is used to evaluate a three-dimensional configuration of the larynx. However, this is the method used by laryngologists to evaluate patients in practice and reflects limitations with laryngeal evaluation in general. Another study conducted on thyroidectomy patients proved that an invasive visualization of the larynx is warranted only when acoustic analysis showed a worsening of at least 3 or more parameters or a post-operative worsening of perceptual analysis that did not improve within 1 month. This study aimed to limit laryngoscopy as an investigation due to high patient reluctance to undergo an uncomfortable invasive examination. It needs specific instruments and skills, adds extra cost and is time consuming. It can be normal even in presence of clinically evident voice disabilities.¹⁵

The fair but significant correlation between VHI and MPT, Grade and PG is consistent with that proved in other studies.^{16,17} A recent study proved that there was a strong correlation between the grade and VHI.¹⁶ Another study specifically proved a strong correlation between the functional score of VHI and MPT.¹⁷ Majority of the studies aimed at finding level of correlation between acoustic analysis and VHI score. While some studies proved that the two measures give independent information.^{18,19}

Although VHI provides significant benefits, it should be used in conjunction with direct visualization of the larynx to identify associated lesions in vocal folds and guide doctors to appropriate surgical or therapy treatments.

In conclusion, the findings of the study indicate that maximum phonation time and grade show significant change in the group that shows significant improvement in VHI. However, when the various parameters (VHI, MPT, and Grade) were compared between two groups made on the basis of Phonatory Gap (PG), there was no significant difference. Hence, although rigid laryngoscopy is required for visualisation of the larynx, it should be used in conjunction with VHI to evaluate the improvement in voice.

A fair correlation between change in VHI and change in other parameters suggests that patients' self assessment is, to a fair extent, correlated with a change in auditory perceptual analysis (Grade) and improvement in objective measures (MPT, PG).

Further work should have a sample which is larger in size and more homogenous in terms of duration of disease and treatment modality employed. A more comprehensive study which simultaneously compares other parameters would bring further clarity on the topic. Parameters other than phonatory gap should be assessed on laryngoscopy.

A gold standard assessment of voice is yet to be deciphered.

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