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Original Research Article

Acoustic analysis and video-stroboscopic evaluation of voice disorders

Arunabha Chakravarti*, Moazzam Mojahid

Department of Otorhinolaryngology, Lady Hardinge Medical College, Connaught place, New Delhi, India

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***Correspondence:**
Dr. Arunabha Chakravarti,
E-mail: drachakravarti@yahoo.co.in

ABSTRACT

Background: The presence of pathologies of vocal folds cause significant changes in their normal vibratory patterns, which impact the resulting voice. Accurate and early diagnosis is needed for proper and timely management of the underlying vocal cord pathology. Diagnostic assessment in dysphonic patients should comprise both clinical aspects and voice-related problems experienced by the patients in their daily life. A combination of video-stroboscopy, acoustic analysis and Voice handicap index (VHI) helps in detailed evaluation of vocal cord abnormalities.
Methods: This was a prospective, observational study. A total of 134 patients with voice disorders were included in the study. The VHI-10 questionnaire was filled by the patients. Acoustic analysis of their voice samples and Video-stroboscopic evaluation of their larynx was done.
Results: A VHI-10 score of >11 was noted in 102 patients. Fundamental frequency, jitter and shimmer were significantly related to the type of lesion. All the video-stroboscopic parameters were significantly related with the vocal cord lesions.
Conclusions: Acoustic analysis along with video-stroboscopy serve as a better diagnostic tool for quantification and categorisation of vocal cord pathologies. VHI-10 helps in assessing the limitations/the impact on quality of life (QOL) (caused by the various vocal cord pathology).

Keywords: Videostrobodcopy, Acoustic analysis, Voice, Dysphonia

INTRODUCTION

Of all the creatures, the use of voice in humans is unique. The human voice is a final product of a smooth, balanced, interrelated system involving respiration, phonation, and resonance. The vocal folds are basically a protective sphincter, which in combination with the articulators, are capable of producing highly intricate arrays of sound.[1,2] It is well known that the presence of pathologies of vocal folds cause significant changes in their normal vibratory patterns, which impact the resulting voice production. The different pathologies include congenital malformations, inflammatory conditions, benign and malignant tumours, neurogenic functional problems and psychogenic problems.[3] The introduction of videostroboscope into ENT practice has revolutionized the assessment of vocal fold pathology.[4] With technological advances and video recording equipment, videostroboscopes are now being used more often to visualize the vocal folds and its vibratory function. In vocal fold lesions, there also occurs distortion of voice signal which can be demonstrated by Acoustic Analysis.[5] It is an alternative method of assessment which is non-invasive in nature and can provide quantitative data about the clinical state of the functions of the larynx and the vocal tract. Voice disorder or dysphonia affects communication and social integration as well. A combination of videostroboscopy and acoustic analysis helps to evaluate vocal fold abnormalities in detail but do not specifically evaluate the resulting handicap as the patient perceives it. Dysphonic patients have reported psychological and emotional problems as a direct consequence of their voice disorder.[6,7] Therefore, a structured questionnaire to evaluate the quality of life in these patients is required.[8,9] One of the most widely used dysphonia-specific quality of life questionnaire is the Voice handicap index (VHI).[10] The aim of the study was to highlight the understanding of the videostrobocopic findings of various voice disorders and their corresponding acoustic findings in a comprehensive way. Moreover, VHI helped in the assessment of the impact of voice change on the quality of life.

METHODS

Place of study

The study was carried out at Department of Otorhinolaryngology and Head-Neck Surgery, Lady Hardinge Medical College and Associated Hospitals.

Study design

This was a prospective, observational study. All participants signed an informed consent form.

Study period

The study was carried out from November 2017 to March 2019.

Sample

All the patients above the age of 12 years who presented with dysphonia were included in the study.

Patients with any of the following criteria were excluded: (a) who had undergone previous micro-laryngeal surgery; (b) with advanced (i. e. stage T3 and T4) glottic or supraglottic malignancy; and (c) with diagnosed pulmonary dysfunction.

Thus, a total of 134 patients underwent thorough clinical evaluation, and structural and functional assessment of their larynx which included criteria as follows.

Voice handicap index (VHI-10)[11]

The VHI-10 was administered to the patients before their clinical evaluation. This included a set of 10 statements, describing the patients voice and its effects on their lives. The patients were asked to grade (0-4) how frequently they had the same experience. Either English or Hindi version of VHI-10 was provided to the patients, as per their preference.

A detailed history and clinical examination

A proforma was used to record the patient's demographic profile, their presenting complaints and relevant associated history. This also included the patient's use of voice and voice demands in daily routine. Complete clinical examination of the patient's head and neck was carried out with special attention to the oral cavity, oropharynx, nose, neck including indirect laryngoscopy and fibre-optic laryngoscopy.

Acoustic analysis

Patient's voice sample was recorded and analysed using the Laryngograph software and the Multi-Dimensional Voice Program (MDVP) within a sound-treated room. The electrodes were strapped on the neck of the patients and the patients were asked to produce a sustained vowel 'a'.

Videostroboscopy

The procedure was explained and topical anaesthesia of the oropharynx and larynx was done using 10% lignocaine spray. Then 90^{o} rigid telescopic examination of the larynx was done along with stroboscopy. A video recording of the patient's vocal cords during phonation was done. This video was later used to evaluate the stroboscopic parameters by two raters using the modified stroboscopy evaluation rating form (SERF).[12] After completing the clinical examination, a diagnosis was reached and the patients were given proper treatment as per standard guidelines.

Ethical clearance

Ethical guidelines for biomedical research on human subjects (as per the ICMR guidelines) was followed while conducting the study and it was approved by the institutional ethical committee.

Statistical analysis

Data was recorded on a pre-designed proforma. After verification and cleansing, data analysis was done by using SPSS (Statistical Package for the Social Sciences) software. The observations were described in terms of mean, median, percentage, standard deviation. A p value of <0.05 was considered as level of significance. The data was summarized in the form of tables and represented through suitable graphs.

RESULTS

The following results were obtained from the data collected:

Age and sex distribution

The age of the patients ranged from 12 years to 75 years, with mean age of 35.8 years. Out of the 134 patients, 59 (44%) were males and 75 (56%) were females. A female preponderance was seen in this study with a male to female ratio of 1: 1.3. The 21-30 years age group made up 38.5% of the total patients, followed by 31-40 years who were 23.1% of the total.

Vocal cord pathology

In the present study, we found 13 distinct vocal cord pathologies.

Of these, vocal nodule was the most common which was found in 38 (28.3%) patients, followed by vocal fold polyp seen in 17 (12.7%) patients (Figure 1).

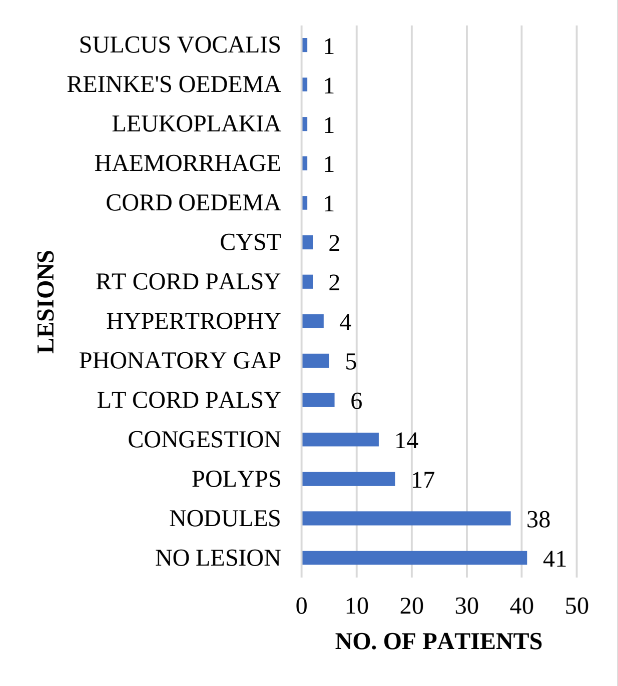

Figure 1: List of pathologies and their frequencies.

Sex distribution of lesions

Out of the 38 cases of vocal cord nodule, 30 were females while only 8 were males. The most common lesion in males was vocal cord polyp. It was found in 12 males out of a total of 17 cases. Out of the 41 patients without any lesions, 23 were females and 18 were males.

VHI-10

The VHI-10 score ranged from 2 to 36, from a maximum possible score of 40, with a mean score of 17.47. Out of the total 134 patients, 102 had VHI-10 score >11. Of these 102 patients, 29 cases were of vocal cord nodule, 15 cases of polyp, 10 cases with cord congestion and all 8 cases of vocal cord palsy.

History

Vocal abuse and voice mis-use

There were 54 (40.3%) patients with history of vocal abuse and 11 (8.2%) patients with history of voice mis-use.28 of the 38 patients with nodules had history of voice abuse and only 4 had history of voice mis-use. In patients with polyp, 7 had voice abuse and 3 had voice mis-use (Table 1).

Voice fatigue

Voice fatigue was a complaint in 67 (50%) patients. Of these 27 had nodules, 7 had polyps, 5 had congestion, 3 had phonatory gap. 17 patients with fatigue were without any lesion (Table 2).

Acid reflux

History of acid reflux was present in 40 (29.9%) patients. 15 had vocal nodules, 4 had polyps and 4 had congested cords.

Smoking

26 (19.4%) patients out of the 134 were smokers. Of these, 6 had nodules, 6 had polyp, 4 had congestion.

Alcohol

Only 4 patients had history of alcohol consumption regularly. Of them, 2 had nodule, 1 had Reinke's oedema and 1 had no lesion.

Acoustic analysis

Fundamental frequency

The mean fundamental frequency in patients with vocal cord nodules was 238.02 Hz, vocal cord polyp was 197.19 Hz, vocal cord palsy was 204.81 Hz, congestion was 214.17 Hz (Table 3).

Jitter

The mean jitter in patients with vocal nodule was 10.53%, in polyp it was 8.09%, in congestion of vocal cord was 9.55% and in vocal cord palsy was 18.84% (Table 4).

Shimmer

The mean shimmer in patients with vocal nodule was 11.55 dB, in polyp was 14.39 dB, in congestion of vocal cords was 11.34 dB and in vocal cord palsy was 17.83 dB.

Harmonic to noise ratio

The mean harmonic to noise ratio in patients with nodules was 3.77, for patients with polyp it was 29.11, for congestion was 7.18 and for palsy was 14.38.

S/Z ratio

The mean S/Z ratio in patients with vocal nodule was 1.04, in patients with polyp was 1.04, in vocal cord congestion was 1.05 and in patients with cord palsy was 1.09.

Maximum phonatory capacity

The MPC was found to be reduced in most of the patients. However, it was not statistically significant with the type of lesion.

Videostroboscopic parameters

Symmetry

Symmetrical movements was seen in 31 of the 38 patients with vocal cord nodule, while it was asymmetrical in the remaining 7 patients.

In the 17 patients with polyp, it was asymmetrical in 14. Asymmetrical movement was seen in all 14 patients with vocal cord palsy (Table 5).

Regularity

Regularity of vocal cord movements was maintained in 36 of the 38 patients with vocal nodule, 12 of 14 patients with congestion, 7 of 8 patients with cord palsy. Out of the 17 patients with polyp, irregular movement was seen in 9 patients (Table 6).

Glottic closure

In the 38 patients with nodule, 28 had hour-glass gap and 1 patient had incomplete closure. The remaining 9 had complete closure. 12 of the 17 patients with polyp had incomplete closure, 1 had anterior gap, 1 had hour-glass gap while 3 had complete closure. 11 of the 14 patients with congestion had complete glottal closure, 2 had spindle gap and 1 had anterior gap. Of the 8 patients with cord palsy, 6 had incomplete closure, 1 had spindle gap and 1 had complete closure (Table 7).

Amplitude

Out of the 134 patients, there were 62 patients who did not have any lesion on their right cord and 58 patient who did not have any lesion on the left cord. The mean right cord amplitude was 6.03 (SD=1.64) and left cord amplitude was 5.52 (SD=1.96). However, 13 of the 62 right cords and 19 of 58 left cords had mucosal waves≤4.

Supraglottic activity

The supra-glottic activity during phonation was not found to have a significant relationship with the type of lesion.

Table 1: History of vocal abuse.

Lesion	Voice abuse				P value
	No		Yes		
	N	%	N	%	
No lesion	27	33.8	14	25.9	<0.001
Vocal cord nodule	10	12.5	28	51.9	
Vocal cord polyp	10	12.5	7	13.0	
Cord congestion	12	15.0	2	3.7	
Vocal cord palsy	8	10.0	0	0.0	
Phonatory gap	4	5.0	1	1.9	
Cord hypertrophy	4	5.0	0	0.0	
Vocal cord cyst	0	0.0	2	3.7	
Vocal cord edema	1	1.2	0	0.0	
Cord hemorrhage	1	1.2	0	0.0	
Leukoplakic patch	1	1.2	0	0.0	
Reinke's edema	1	1.2	0	0.0	
Sulcus vocalis	1	1.2	0	0.0	
Total	80	100.0	54	100.0	

Table 2: History of voice fatigue.

Lesion	Voice fatigue				P value
	No		Yes		
	N	%	N	%	
No lesion	24	35.8	17	25.4	<0.016
Vocal cord nodule	11	16.4	27	40.3	
Vocal cord polyp	10	14.9	7	10.4	
Cord congestion	9	13.4	5	7.5	
Vocal cord palsy	8	11.9	0	0.0	
Phonatory gap	2	3.0	3	4.5	
Cord hypertrophy	1	1.5	3	4.5	

Continued.

Lesion	Voice fatigue				P value
	No		Yes		
	N	%	N	%	
Vocal cord cyst	0	0.0	2	30.0	
Vocal cord edema	0	0.0	1	1.5	
Cord hemorrhage	0	0.0	1	1.5	
Leukoplakic patch	1	1.5	0	0.0	
Reinke's edema	1	1.5	0	0.0	
Sulcus vocalis	0	0.0	1	1.5	
Total	67	1000.0	67	100.0	

Table 3: Mean fundamental frequency.

Lesion	Fundamental frequency (Hz)		P value
	Mean	SD	
No lesion	219.99	74.11	<0.001
Cord congestion	214.17	73.39	
Vocal cord edema	296.67	-	
Cord hypertrophy	177.27	23.08	
Vocal cord nodule	238.02	70.31	
Leukoplackic patch	123.79	-	
Vocal cord palsy	204.81	78.32	
Vocal cord polyp	197.19	52.47	
Phonatory gap	269.50	97.90	
Vocal cord cyst	251.50	71.04	
Cord hemorrhage	665.23	-	
Sulcus vocalis	295.62	-	
Reinkie's edema	102.43	-	

Table 4: Mean Jitter.

Lesion	Jitter (%)		P value
	Mean	SD	
No lesion	7.16	10.67	0.010
Cord congestion	9.55	14.13	
Vocal cord edema	12.96	-	
Cord hypertrophy	14.32	14.93	
Vocal cord nodule	10.53	15.20	
Leukoplakic patch	2.13	-	
Vocal cord palsy	18.84	15.22	
Vocal cord polyp	8.09	5.45	
Phonatory gap	5.79	4.17	
Vocal cord cyst	11.27	12.35	
Cord hemorrhage	66.73	-	
Sulcus vocalis	4.87	-	
Reinke's edema	3.11	-	

Table 5: Vocal cord symmetry.

Lesion	Symmetry				P value
	No		Yes		
	N	%	N	%	
No lesion	0	0.0	41	43.2	<0.001
Cord congestion	3	7.7	11	11.6	
Vocal cord edema	0	0.0	1	1.1	
Cord hypertrophy	3	7.7	1	1.1	

Continued.

Lesion	Symmetry				P value
	No		Yes		
	N	%	N	%	
Vocal cord nodule	7	17.9	31	32.6	
Leukoplakic patch	0	0.0	1	1.1	
Vocal cord palsy	8	20.5	0	.0	
Vocal cord polyp	14	35.9	3	3.2	
Phonatory gap	1	2.6	4	4.2	
Vocal cord cyst	2	5.1	0	.0	
Cord hemorrhage	0	0.0	1	1.1	
Sulcus vocalis	0	0.0	1	1.1	
Reinke's edema	1	2.6	0	0.0	

Table 6: Regularity of vocal cords.

Lesion	Regularity				P value
	No		Yes		
	N	%	N	%	
No lesion	0	0.0	41	35.0	<0.001
Cord congestion	2	11.8	12	10.3	
Vocal cord edema	0	0.0	1	0.9	
Cord hypertrophy	2	11.8	2	1.8	
Vocal cord nodule	2	11.8	36	30.8	
Leukoplakic patch	0	0.0	1	0.9	
Vocal cord palsy	1	5.9	7	6.0	
Vocal cord polyp	9	52.9	8	6.8	
Phonatory gap	0	00.0	5	4.3	
Vocal cord cyst	0	0.0	2	1.7	
Cord hemorrhage	0	0.0	1	0.9	
Sulcus vocalis	0	0.0	1	0.9	
Reinke's edema	1	5.9	0	0.0	

Table 7: Types of glottal closure.

Lesion	Glottal closure										P value
	Anterior gap		Complete		Hourglass		Incomplete		Spindle gap		
	N	%	N	%	N	%	N	%	N	%	
No lesion	2	400.0	36	54.5	0	0.0	2	7.7	1	14.3	<0.001
Cord congestion	1	200.0	11	16.7	0	0.0	0	0.0	2	28.6	
Vocal cord edema	0	0.0	0	0.0	0	0.0	1	3.8	0	0.0	
Cord hypertrophy	1	200.0	3	4.5	0	0.0	0	0.0	0	0.0	
Vocal cord nodule	0	0.0	9	13.6	28	93.3	1	3.8	0	0.0	
Leukoplakic patch	0	0.0	1	1.5	0	0.0	0	0.0	0	0.0	
Vocal cord palsy	0	0.0	1	1.5	0	0.0	6	23.1	1	14.3	
Vocal cord polyp	1	200.0	3	4.5	1	3.3	12	46.2	0	0.0	
Phonatory gap	0	0.0	0	0.0	0	0.0	2	7.7	3	42.9	
Vocal cord cyst	0	0.0	0	0.0	1	3.3	1	3.8	0	0.0	
Cord hemorrhage	0	0.0	0	0.0	0	0.0	1	3.8	0	0.0	
Sulcus vocalis	0	0.0	1	1.5	0	0.0	0	0.0	0	0.0	
Reinke's edema	0	0.0	1	1.5	0	0.0	0	0.0	0	0.0	

Table 8: Mucosal waves of right cord.

Lesion	Mucosal wave (right)				P value
	≤4		>4		
	N	%	N	%	
No lesion	7	16.3	55	60.4	<0.001
Cord congestion	9	20.9	5	5.5	
Vocal cord edema	1	2.3	0	0.0	
Cord hypertrophy	4	9.3	0	0.0	
Vocal cord nodule	9	20.9	26	28.6	
Leukoplakic patch	0	0.0	1	1.1	
Vocal cord palsy	2	4.7	0	0.0	
Vocal cord polyp	5	11.6	0	0.0	
Phonatory gap	1	2.3	4	4.4	
Vocal cord cyst	2	4.7	0	0.0	
Cord hemorrhage	1	2.3	0	0.0	
Sulcus vocalis	1	2.3	0	0.0	
Reinke's edema	1	2.3	0	0.0	

Table 9: Mucosal waves of left cord.

Lesion	Mucosal wave (left)				P value
	≤4		>4		
	N	%	N	%	
No lesion	12	23.5	46	55.4	<0.001
Cord congestion	7	13.7	4	4.8	
Vocal cord edema	1	20.0	0	0.0	
Cord hypertrophy	2	40.0	0	0.0	
Vocal cord nodule	11	21.6	25	30.1	
Leukoplakic patch	0	0.0	1	1.2	
Vocal cord palsy	6	11.8	0	0.0	
Vocal cord polyp	9	17.6	3	3.6	
Phonatory gap	1	20.0	4	4.8	
Vocal cord cyst	0	0.0	0	0.0	
Cord hemorrhage	0	0.0	0	0.0	
Sulcus vocalis	1	20.0	0	0.0	
Reinke's edema	1	20.0	0	0.0	

DISCUSSION

The human voice is the quintessential human tool for the most powerful system of communication, the human speech. The ability to phonate is often taken for granted, however it is totally dependent on the uniqueness of human anatomy. Voice disorders present in a wide spectrum of patients, across all ages, gender and social status. Therefore, it necessitates thorough and detailed evaluation.

Stroboscopy involves the use of high-speed flashes of light at a frequency slightly lower or higher than the frequency of the patient's vocal fold vibrations. The image thus obtained is an optical illusion of slow motion, based on Talbot's law i.e the persistence of an image on the retina for 0.2 seconds after exposure. With technological advances and video recording equipments, videostroboscopes are now being used more often to visualize the vocal folds and its vibratory function.

Acoustic analysis demonstrates advantages on the methods of current examination due to its non-invasive nature and its potential to provide quantitative data about the clinical state of the functions of the larynx and the vocal tract.

Voice disorder may cause a deterioration in the quality of life of the affected person and may be as important for restrictions in the daily life of the patient as the disorder itself. Hence, diagnostic assessment in dysphonic persons should comprise both clinical aspects, i.e. organic and functional parameters, and voice-related problems experienced by individual patients in their daily life.[13]

Demography

The demographic profile in this study was comparable with the study done by Zhukhovitskaya et al (2014) which showed that most of the patients were in the age group of 18 to 39 years and there were more female patients compared to males.[14] Similarly, in a study conducted by Chan et al (2015), 53.16% patients were in the 21 to 40 years range and females were 74.21% of the total number of patients.[15] However, Banjara et al (2011) reported a male preponderance (male: female=1.5: 1).[16]

Vocal cord pathology

There were 13 different vocal cord lesions which were found in the patients in the present study. Vocal cord nodule was the most common lesion followed by vocal cord polyp. The p valuefor sex and type of lesion was statistically significant (p value=00.01). Similar findings have been observed by Milovanovic et al and Banjara et al in their studies.[16,17] Also, there were 44 cases whose vocal cord lesions were either missed (20 cases) or mis-diagnosed (24 cases) on routine clinical examination. Stroboscopic evaluation helped in the confirmatory diagnoses in these cases.

VHI-10 score

VHI-10 score of >11 was considered significant. However, in this study the VHI-10 score was not found to be statistically significant with the type of lesion (p value>0.194). Similarly, in a study by Lopes et al no correlation with the VHI-10 score and other acoustic measures was found.[18] Dehqan et al in his series of 82 patients found significant correlation between VHI-30 score and acoustic measurements.[19]

Videostroboscopy

The SERF developed by Poburka was used to record the findings of stroboscopy.[12]

Symmetry

As vocal nodules are bilateral in most cases, symmetry of vocal cord movement is maintained in most cases. Symmetry was also maintained in most cases of cord congestion and phonatory gap. Asymmetrical movements were seen in cases with polyps, palsy, and cysts as these pathologies usually affect unilateral cord, asymmetrical movement is seen in these cases. The symmetry of vocal cord movement was statistically significant with the type of lesion (p value<00.001). Similar results were found in a study conducted by Banjara Hansa et al in 2010.[16]

Regularity

The findings of regularity of vocal cord movement were statistically significant with the type of lesion (p value<00.001).

Glottal closure

Hourglass configuration is seen typically in vocal cord nodule. Complete glottal closure was seen in congestion, cord hypertrophy, leukoplakic patch, sulcus vocalis, and Reinke's oedema. The findings were statistically significant (p value<00.001).

Amplitude

Amplitude was found to be decreased in patients with polyps, palsy, cord hypertrophy, cyst, haemorrhage and sulcus vocalis. Normal amplitude was seen in cases with nodules, phonatory gap, cord edema, leukoplakic patch. These results were statistically significant with a p value of 00.001.

Mucosal waves

Mucosal waves on the vocal cord surface were decreased in polyp, palsy, congestion, cyst, haemorrhage, sulcus vocalis and Reinke's oedema. This finding can be explained by the mass effect of the lesion in cases of polyps and cyst. Due to tethering of mucosal cover in sulcus vocalis and alteration of mucosal cover in congested cords, haemorrhage and Reinke's oedema (Table 8 and 9)

Mucosal waves were good in most of the cases with vocal cord nodule, phonatory gap and leukoplakic patch. Since vocal nodules do not alter the vibratory function of the vocal cord, normal mucosal waves are seen. The results were statistically significant (p value<00.001) for the type of the lesion and mucosal waves. In a study by Sohet et al for differentiating true vocal fold cysts from polyps, found that mucosal waves were reduced in cases of vocal fold cysts but normal or increased in cases of polyps.[20] The normal finding in case of polyps can be explained on the basis of 'body-cover complex theory', in which vocal cord is regarded as a double-structured vibrator consisting of a body of vocalis muscle and elastic conus and a cover of mucous membrane.[21] An increase in elastic constant in the body or cover causes a decrease in the mucosal waves, as seen in forceful vocalis muscle contraction or fibrotic lesion. A decrease in the elastic constant, as found in submucosal edema, causes an increase in the mucosal waves. Polyps and nodules are likely to cause submucosal edema than cysts and hence, mucosal waves may be normal or increased in cases of polyps and nodules but cysts cause absent or decreased waves.

Acoustic analysis

Acoustic analysis of the voice aims to quantify and characterise a sound signal in a non-invasive manner. The various acoustic parameter measures like fundamental frequency, jitter, shimmer, harmonic to noise ratio help in characterisation of various voice related pathologies, both organic and functional.

Fundamental frequency

The mean fundamental frequency of 128 Hz in males and 225 Hz in females was considered normal. The mean Fundamental Frequency of the patients was statistically significant with the type of lesion. The p value for the type of lesion and fundamental frequency was <00.001.

Jitter

Jitter is the perturbation measure for variability in glottal cycle frequency. The normative value of Jitter was taken as ≤10.040%. In our patients, the lesion specific mean jitter was statistically significant (p value=00.01)

Shimmer

It is the perturbation measure for variability in glottal cycle amplitude. The normative value was taken as ≤3.810%. The mean lesion specific shimmer was significant with a p value of 00.022.

Harmonic to noise ratio

A value of less than 20 is considered to be hoarseness of significant measure. No statistical significance was found between the mean HNR and the lesions in our study (p value=0.993).

These parameters show variations from healthy voice and can help in discriminating different vocal cord pathologies. In the present study we found significant association between different lesions of vocal cords and mean fundamental frequency, mean jitter, mean shimmer values in decreasing order. However, HNR was found to be poorly associated with the lesions. Similarly, in a study by Lopes et al which investigated the accuracy of acoustic measures in discriminating between patients with different laryngeal diagnoses, they found that isolated.[22] Fundamental frequency, jitter and GNE showed acceptable performance. But when the findings were combined, then it improved the ability to classify the patients. Teixeira in his study analysed usefulness of acoustic measures to differentiate vocal dysphonia and concluded that jitter and shimmer were relevant parameters to differentiate dysphonia pathologies, while HNR did not show any strong discriminant capacity.[23]

Patients with no vocal cord lesions

In the present study, there were 41 patients who presented with voice related complaints but they did not have any organic vocal cord pathology. Of these, 26 had a significant VHI-10 score (>11). The findings in this group of patients can be explained by the presence of functional dysphonia. This functional dysphonia can be hyperfunctional dysphonia or psychogenic dysphonia. Hyperfunctional dysphonia is a consequence of improper phonation resulting in an excessive involuntary muscle contraction. Psychogenic dysphonia results from strong emotional influence that causes changes in voice. Strong emotions like anger, joy, anxiety or fear cause psychogenic dysphonia. For proper diagnosis of functional dysphonia further evaluation of the patients is needed.

Limitations

Dysphonia due to a non-organic or functional cause needs further evaluation which has not been done in this study.

CONCLUSION

Considering the magnitude and impact of voice disorders, all cases should be examined in a well-equipped voice laboratory, so that thorough evaluation can be done to reach a confirmatory diagnosis and help in proper management. Videostroboscopy helps in visualisation of lesions which may be missed on routine laryngeal examination. An important utility of this is to provide visual feed-back to the patients, which is a necessary requirement for treatment of hyper-functional dysphonia. Also, it is a semi-invasive procedure which requires adequate compliance from the patient for proper visualization of vocal cord function. So far, acoustic analysis has been used for quantification of clinical state of the larynx. From the present study we suggest that Acoustic analysis should also be included along with videstroboscopy as a good diagnostic tool for categorization of vocal cord pathologies. However, it needs further research with large study population.

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