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Video stroboscopic evaluation of benign vocal pathologies

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Abstract

Aim: Benign vocal cord lesions affect vibratory vocal fold function resulting in significant dysphonia. The goal of this study was to determine the significant relationship between stroboscopic parameters and benign vocal fold lesions.

Materials and Methods: Present study was done in Department of ENT, Raipur Institute of Medical Sciences, Raipur, Chhattisgarh, India, analyzing 34 patients with benign vocal fold lesions. Stroboscopic parameters were systematically rated for each patient and results of the ratings were analyzed. Stroboscopic evaluation was done for symmetry, vocal edge, mucosal wave, amplitude, regularity, and glottic closure.

Results: vocal fold lesions revealed a characteristic pattern of stroboscopic parameters findings and exhibited differences of most predominant signs.

Conclusion: The results suggest that subjective evaluation of stroboscopic examinations can be valuable in making correct diagnosis. Its routine use in a voice clinic is recommended.

Keywords: Benign vocal lesions, stroboscopy, vocal nodule, vocal polyp, vocal cyst.

Introduction

Basic science and clinical studies over past decades has led to advances in understanding of benign vocal lesions. Otolaryngologists and speech language pathologists have continued to push this frontier over the past several years. The etiology of benign vocal lesions like nodules, cysts and polyps is becoming clearer, and advances in diagnostic techniques and therapeutic interventions are leading to improved outcomes for patient with dysphonia from this lesion.

The first description of vocal fold visualization was made in 1855 by Manuel Garcia. The larynx was seen through sun light beam reflected on the mirror. In his studies, the-re are details on vocal fold action during inspiration and

vocalization, as well as important observations on how the larynx produced sound.[1]

In 1895, Oertel published a paper on the use of the mechanical stroboscope, used to study vocal fold vibration. He applied a stroboscopic light source to a laryngeal mirror in order to examine the slow-motion appearance of the vocal folds throughout the pitch range.[2] In 1960 the electronic stroboscopy was described. However, only after the creation of more powerful light sources and with the development of the rigid scopes and micro-cameras, the laryngeal tele-stroboscopy became a truly important tool for the diagnosis of vocal fold lesions.

Complex motion of the vibratory margin of the vocal folds is essential for normal voice. Dysphonia may be the result of small abnormalities in the mucosal wave vibration of the vocal folds, or secondary to an incomplete glottal closure, or an association of these factors.[3] Because the vocal folds open and close between about 60 and 1500 times per second depending upon pitch of phonation, valid, reliable physical examination of the vibratory margin cannot be accomplished by using continuous light and a laryngeal mirror. Videostroboscopy is currently the most convenient technique permitting the otolaryngologist to perform a detailed assessment of the vibratory margin of the vocal cord.

The present study was undertaken to determine the clinical usefulness of the procedure and to determine the significant relationship between stroboscopic parameters and benign vocal fold lesions.

Materials and Methods

The present study was carried out in the Department of ENT, Raipur Institute of Medical Sciences, Raipur, Chhattisgarh, India. Total 34 patients with chief complaint of change in voice were evaluated.

Video stroboscopic examination

Video stroboscopic examination was carried out after history, routine ENT examination and indirect laryngoscopic examination. Videostroboscopic examinations were conducted using a 70-degree Karl Storz rigid endoscope connected to Karl Storz Pulsar stroboscope unit. During the videostroboscopic examinations, the subjects were seated in an upright position facing the clinician and instructed to approximate the vowel /i/, while the rigid endoscope was inserted into the oral cavity. The vocal images seen onto the screen and is recorded. Further evaluations were done on the basis of the recordings.

Evaluation of recordings

Three otolaryngologists served as judges. Each judge independently evaluated recordings with no audio playback using standard rating forms to record his or her responses. The rating form used by the judges was adapted from videostroboscopic rating forms described by DM Bless, M Hirano and RJ Feder in 1987 with few modifications.[4]

All cases were rated by three judges and subjective analysis of stroboscopic parameters like glottic closure, vocal fold edge, mucosal wave pattern, symmetry, amplitude and periodicity were done. The judges were instructed to rate separately each parameter by different rating score as given in rating form. The judges were allowed to slow down and replay each video sample as many times as they wanted to before finalizing their ratings. They made the provisional diagnosis of each recording.

A criterion level of at least two judge agreements was set for accepting the videostroboscopic rating for each parameter. The parameter that failed to reach this level of agreement were not used for final evaluation and mentioned as “cancelled”. The rating forms from each

stroboscopic evaluation were than analyzed to evaluate various factors.

Data Analysis

All statistical analysis was conducted using the SPSS v. 10.0 statistical software package (SPSS Corporation, Chicago, IL). The findings of each parameter in all 4 entities of benign vocal fold lesions were analysed by Chi-Square test for equal occurrence hypothesis to know the significance value. Level of significance in each calculation was .05.

Results

In our study 4 different entities were observed in total 34 cases of benign vocal cord lesions (Table 1). It includes 21 cases (61.76%) of nodule, 7 cases (20.59%) of cyst, 5 cases (14.71%) of polyp and 1 case (2.94%) of Reinke's oedema. 18 (52.94%) cases were male and 16 (47.06%) cases were female with male: female ratio 1.12:1. A slight male predominance was observed. All patients were presented with change in voice, hoarseness or vocal fatigue.

(1) Glottic closure: Complete closure was found in 7 cases of nodule and 1 case of cyst and polyp. Posterior gap was found in 2 cases of cyst, 2 cases of nodule and 1 case of Reinke's edema. Hourglass shape glottic closure found in 9 cases of vocal nodule and 2 cases of cyst. Irregular closure was seen in 2 cases of nodule.

Table 1: Age group and sex distribution in benign vocal pathologies

Sn.	Diagnosis	Age (year)												Total
		11-20		21-30		31-40		41-50		51-60		>60		
		M	F	M	F	M	F	M	F	M	F	M	F	
1.	Cyst	0	0	0	0	2	2	3	0	0	0	0	0	7(20.59%)
2.	Nodule	4	0	0	5	2	4	3	1	1	1	0	0	21(61.76%)
3.	Polyp	0	0	0	1	1	1	0	1	1	0	0	0	5(14.71%)
4.	Reinke's edema	0	0	0	0	1	0	0	1	1	1	0	0	1(2.94%)

Incomplete closure found in 1 case of polyp. Anterior and spindle shaped closure not seen. 1 case of vocal cord polyp was cancelled for this parameter due to disagreement between ratters and not included for analysis. Statistical analysis: Hourglass glottic closure was significantly related to vocal nodule ($\chi 2$ =31.95).

(2) Symmetry: 17 cases (80.95%) of vocal nodule are symmetrical. All cases of cyst, polyp and Reinke's oedema were asymmetrical.

Statistical analysis: In vocal nodule ($\chi 2$=22.57) the corresponding $\chi 2$ value suggest that there is statistically significant relationship with symmetry of vocal cord. In polyp ($\chi 2$=10) and cyst ($\chi 2$=14) corresponding $\chi 2$ values suggest statistically significant relationship with asymmetry of vocal cord.

(3) Vocal fold edge: Bilateral rough vocal edges seen in 20 cases of bilateral vocal nodule. One case showed unilateral roughness on right side (unilateral vocal nodule). Only case of reinke's edema showed bilateral rough vocal edge. Significant number of cases of unilateral cyst and polyp showed bilateral rough vocal edges due to contact lesions on opposite vocal cord. 1 case of vocal cord polyp was cancelled for this parameter due to disagreement between raters and not included for analysis.

Statistical analysis: Chi square value showed significant relationship between cyst and rough vocal edge on right

side (($\chi 2$ =8.85). Chi square value showed significant relationship between nodule and rough vocal edge on both right ($\chi 2$ =42) and left side ($\chi 2$ =36.28).

(4) Mucosal wave: Bilateral Reduced mucosal wave was found in 2 case of cyst, 5 case of nodule, 2 case of polyp and 1 case of Reinke's edema. Parameter of 1 case of vocal cyst was cancelled due to disagreement between raters and not included in the study.

Statistical analysis: Nodule ($\chi 2$=21.85) shows statistically significant relationship with normal mucosal wave pattern on both sides at .05 levels.

(5) Regularity: Regularity was constant finding in nodule (18 cases), cyst (5 cases) and polyp (3 cases). 2 cases were cancelled due to disagreement between three raters, one of cyst and another of polyp. Irregularity was found in 1 case of polyp, 1 case of cyst and 1 case of reinke's edema.

Statistical analysis: In cyst ($\chi 2$=11.33) and nodule ($\chi 2$=41.66) the corresponding $\chi 2$ values shows statistically significant relationship with periodicity of vocal cord.

(6) Amplitude: In our study amplitude was found normal in all the cases of benign vocal cord lesions.

Statistical analysis: Cyst ($\chi 2$=21), nodule ($\chi 2$ =63) and polyp ($\chi 2$=15) showed statistically significant relationship with normal amplitude of vocal cord.

Discussion

Perceptual judgements of the vibratory patterns of the vocal folds via videostroboscopy are based on knowledge of the layered structure, the normal gross anatomic appearance of the folds, and knowledge of how the mechanical properties of the fold vary as a function of frequency and intensity.[5] The relevant observable characteristics of the vibratory pattern typically include symmetry, periodicity, glottic closure, amplitude of vibration, mucosal wave pattern.[4]

The vocal folds are subject to several forms of mechanical stress during phonation. Vocal fold vibration during phonation leads to impact stress during collision between the left and right vocal fold surfaces. Titze (1994) has analysed these stress factors and has determined that maximal impact stress occurs in the midmembranous vocal fold.[6]

Vocal overuse (excessive quantity of voice use), abuse (yelling) and misuse (vocal hyperfunction with excessive muscle tension) leads to excessive mechanical stress and trauma in the mid- membranous vocal fold resulting in wound formation. Wound healing leads to remodelling of the superficial layer of the lamina propria, and to a lesser extent, the epithelium. This tissue remodelling results in the formation of vocal nodule, polyp and cyst. Several studies have demonstrated that the pathologic changes in vocal folds occur within the superficial layer of the lamina propria.[7,8]

Benign vocal lesions are non-cancerous growths of abnormal tissue on the vocal folds. They include "singer's" nodules, isolated polyps, polypoid degeneration (Reinke's edema), and cysts. Since these lesions are not cancerous, they are usually not life threatening. However, lesions may affect voice quality and excessive growth may affect breathing patterns. A clinical diagnosis of nodules, polyps or cysts does not rule out a malignancy (cancer) unless the lesion resolves with treatment or it is biopsied and is pathologically benign. The lesion may also be a benign neoplasm such as papilloma or leukoplakia that would not resolve with traditional treatment for nodules, polyps or cysts. The age and sex distribution of benign vocal pathologies are shown in Table 1 and the common stroboscopic findings are summarized in Table 2.

Table.2: Common stroboscopic signs related to benign vocal lesion as found in our study

Stroboscopic parameter	Nodules	Polyps	Cysts	Reinkes edema
Appearance	Bilateral, symmetrical, white to opaque	Unilateral, pedunculated, Translucent to red,	Translucent to pale	Bilateral, pale, Extensive swelling
Site of lesion	Anterior – middle third junction	Free edge , anterior-middle third junction	Free edge of superior surface , middle third	Superior surface and margins of vocal fold
Glottic Closure	Hourglass	Variable	Variable	Complete
Symmetry	Symmetrical	Asymmetrical	Asymmetrical	Asymmetrical
Edge	Rough	Rough	Rough	Rough
Mucosal wave	Present	Reduced	Diminished or absent	Decreased
Regularity	Regular	-	Regular	Aperiodic
Amplitude	Normal	Normal	Normal	Decreased

Vocal nodules

We have seen total 21 cases of vocal nodule out of 34 benign vocal pathologies. Age distribution ranges 11 to 52 years (Mean 32.5 years).11 females and 10 are male patients almost showing equal distribution. Most of the females were in age group 20-40 years. 5 cases in female age group are in third decade followed by 4 cases in fourth decade. In male 4 cases are in second decade followed by 3 cases in fifth decade. 4 cases in age group 11-20 years were male. This supports the finding of literature that in young age, boys are affected more than girls. All patients have history of vocal abuse.

The most important video stroboscopic parameters which affected the voice quality in this group of patients were the hourglass leak both anterior and posterior to the lesion. Very early vocal nodule shows almost complete closure while some cases also show posterior gap. The next parameter which seemed responsible for deranged voice quality was the affection of the mucosal wave especially anterior one third of vocal cords. Very early nodule can show normal mucosal wave. Vocal nodule almost shows symmetry, as in our study 17 out of 21 shows symmetry and only 4 asymmetric appearances. Vocal edge always shows roughness at the site of lesion. In our study about 71.43% cases showed nodule at junction of anterior one third and posterior two third regions. Rest of 28.57% were in middle one third of region. Periodicity was observed in 85.71% cases. Amplitude was normal in all cases.

Vocal cyst

7 out of 34 cases were diagnosed as cyst. All cases were in age group 31-50 years (mean 41 year). 5 cases were male and 2 cases were female. The most important video stroboscopic parameter affecting voice quality was the amount of incomplete glottic closure. It could be posterior or hourglass shape. The other parameter affecting the voice quality was reduced amplitude of mucosal wave. Vocal fold edge could be found rough at the site of lesion. Asymmetry could be found in all cases of vocal cyst as in our study (100% cases). Periodicity was observed in

83.33% cases. Amplitude could be also found normal in vocal cyst.

Vocal polyp

5 (14.71%) cases of Vocal polyp were in age group 27 to 60 years (Mean 40 year). 3 cases were female and 2 cases were male. Additional features like, surface ulceration and adjacent vocal contact ulcers were evident on detailed stroboscopic evaluation. Pedunculated polyps could be seen to move frequently in between the vocal cords during phonation, which explain the diplophonia in these patients. Videostroboscopy could document the incomplete glottic closure affecting the voice quality coupled with reduced amplitude and asymmetry of mucosal waves. Asymmetry could be observed in all cases, as in our study. Vocal fold edge could be observed rough at affected site of lesion. Regularity was found in 75% cases. Polyp showed normal amplitude in all cases.

Reinke's edema

Only one case was diagnosed as Reinke's edema. Posterior glottic closure, asymmetry, bilateral rough vocal edges, decreased mucosal wave pattern, aperiodicity with decreased amplitude of vocal cord were noted.

Treatment modality of benign lesion

Continued support for behaviour modification as a primary treatment modality for benign vocal fold has been published, and refinements in technical aspects of laryngeal microsurgery persist. Benign laryngeal lesions, irrespective of maturity, often will respond favorably to behavioral intervention, and that a trial of appropriate voice therapy is warranted in almost all cases of vocal lesions arising from vocal overuse, abuse, and misuse prior to consideration of surgery.[9]

Summary

1. Significant relationship is seen between Hourglass shaped closure and vocal nodule.
2. Vocal nodule showed significant relationship with symmetry of vocal cord.
3. Vocal cyst and polyp has significant relationship with asymmetry of vocal cord.
4. Vocal polyp, cyst and nodule have significant relationship with rough vocal edge.
5. Early vocal nodule has significant relationship with normal mucosal wave pattern.
6. Vocal cyst and nodule shows significant relationship with periodicity of vocal cord.
7. Cyst, nodule and polyp have significant relationship with normal amplitude of vocal cord.

Conclusion

The study design has very few numbers of cases in each pathology instead results suggest that the subjective evaluation of videostroboscopic parameters can be valuable in making correct diagnosis. It provides valuable information that alters the diagnosis and also the treatment strategies in voice complaints. The technique of stroboscopy and video documentation is practical and easy to use. Its routine use in a voice clinic is recommended.

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