Annals of Otology, Rhinology & Laryngology 120(4):239-242.

Vibratory Asymmetry in Mobile Vocal Folds: Is It Predictive of Vocal Fold Paresis?

C. Blake Simpson, MD; Linda Seitan May, MD; Jill K. Green, MS; Robert L. Eller, MD; Carlayne E. Jackson, MD

Objectives: The purpose of this study was to determine whether the videostroboscopic finding of vibratory asymmetry in mobile vocal folds is a reliable predictor of vocal fold paresis. In addition, the ability of experienced reviewers to predict the distribution (left/right/bilateral) of the paresis was investigated.

Methods: This is a retrospective chart review of all patients who presented to our clinic during a 3-year period with symptoms suggestive of glottal insufficiency (vocal fatigue or reduced vocal projection) accompanied by the videostroboscopic findings of bilateral normal vocal fold mobility and vibratory asymmetry. Twenty-three of these patients underwent diagnostic laryngeal electromyography of the thyroarytenoid and cricothyroid muscles to determine the presence of vocal fold paresis.

Results: Nineteen of the 23 patients (82.6%) were found to have electrophysiological evidence of vocal fold paresis, either unilaterally or bilaterally, when videostroboscopic asymmetry was present in mobile vocal folds. However, the three expert reviewers' ability to predict the distribution (left/right/bilateral) of the paresis was poor (26.3%, 36.8%, and 36.8%, respectively).

Conclusions: The videostroboscopic finding of vibratory asymmetry in mobile vocal folds is a reliable predictor of vocal fold paresis in most cases. However, the ability of expert reviewers to determine the distribution (left/right/bilateral) of the paresis using videostroboscopic findings is poor. This study highlights the value of laryngeal electromyography in arriving at a correct diagnosis in this clinical situation.

Key Words: electromyography, videostroboscopy, vocal fold paralysis, vocal fold paresis.

INTRODUCTION

Vocal fold paresis (VFP) is a well-established, albeit controversial, entity. Its incidence is not well established, but it is likely rare. The few reports that are available in the literature have shown a range of as many as 29 cases in a year to as few as 13 cases over 4 years in tertiary laryngology practices.[1-4] Although all of these studies used laryngeal electromyography (LEMG) to confirm the diagnosis, clinicians often use subtle asymmetries on videostroboscopy as indicators that paresis is likely present. During videostroboscopic examination, reduced vocal fold movement (adduction or abduction), vocal fold bowing, incomplete glottal closure, and vibratory asymmetry can all be associated with VFP.[4,5] Rubin et al[6] have also described the use of repetitive phonatory tasks to induce fatigue as a means of bringing out hypomobility in paretic vocal folds. As pointed out by Sulica and Blitzer, however, "Separating innocent asymmetries [on laryngoscopy] from significant findings may present the greatest challenge in defining vocal fold paresis."[7(p159)] The clinical setting of glottal insufficiency symptoms and grossly intact vocal fold mobility has previously been described. In these cases, vibratory asymmetry may be the only laryngoscopic clue to suggest VFP.[7] Identification of the asymmetry may help guide the clinician toward performing LEMG and eventually confirming a diagnosis of VFP.

The purpose of this study was to determine whether the videostroboscopic finding of vibratory asymmetry in mobile vocal folds was a reliable predictor of VFP. In addition, the ability of experienced reviewers to predict the distribution (left/right/bilateral) of the paresis was investigated.

METHODS

Institutional Review Board approval was obtained

From the Departments of Otolaryngology–Head and Neck Surgery (Simpson, May, Green) and Neurology (Jackson), University of Texas Health Science Center–San Antonio, and the Department of Otolaryngology–Head and Neck Surgery, Wilford Hall Medical Center, Lackland Air Force Base (Eller), San Antonio, Texas.

Presented at the meeting of the American Broncho-Esophagological Association, Las Vegas, Nevada, April 28-29, 2010.

Correspondence: C. Blake Simpson, MD, Dept of Otolaryngology–Head and Neck Surgery, University of Texas Health Science Center, Medical Arts and Research Center, 8300 Floyd Curl Dr, San Antonio, TX 78229.

from our institution before the study period. A retrospective chart review was carried out for all patients who presented to our clinic during a 3-year period and underwent LEMG for suspected vocal fold paresis.

Over the study period, 48 patients with suspected VFP underwent diagnostic LEMG. Of those, 23 patients met the study criteria with symptoms of VFP (vocal fatigue or reduced vocal projection) accompanied by the videostroboscopic findings of bilateral normal vocal fold mobility and vibratory asymmetry. The diagnostic LEMG examinations included an evaluation of the motor unit morphology and recruitment of motor unit potentials (MUPs) for the thyroarytenoid and cricothyroid muscles. Interpretation of the LEMG findings was done by a neurologist (C.E.J.) who was blinded to the findings of the laryngoscopic examination. In all cases, abnormal LEMG findings were considered to be present when there were large-amplitude polyphasic MUPs and incomplete recruitment of MUPs. All abnormal LEMG findings were then classified as left, right, or bilateral, depending on the side of involvement. We did not distinguish between recurrent laryngeal nerve (RLN) and superior laryngeal nerve (SLN) neuropathy for the purposes of this portion of the study. In other words, if the RLN, SLN, or both showed electrophysiological evidence of denervation, the findings were considered "abnormal" for that side.

Our endoscopic clinical examination protocol was as follows. All of the patients underwent videostroboscopy by means of a flexible laryngoscope with a distal chip (Olympus ENF-VQ, Olympus Surgical, Orangeburg, New York) rhinolaryngoscope, and most also had rigid laryngoscopy with a 70° rigid endoscope (KayPENTAX, Lincoln Park, New Jersey). The patients were instructed to phonate /i/ at low, modal, and high frequencies. When indicated, the technique of "unloading" as described by Koufman[8] was also used to help reveal more subtle vibratory asymmetry that may have been hidden under compensatory muscle tension patterns.

When retrospective evaluation of the endoscopic segments was carried out, the following protocol was used. The best-quality videostroboscopic examination (either flexible or rigid) was used for each case. Of the 48 cases in which LEMG was performed for suspected paresis, 23 examinations that were considered to show isolated vibratory asymmetry were selected for the study. The other 25 cases, which showed vocal fold immobility, partial immobility, videostroboscopic evidence of incomplete closure, or vocal fold lesions, were excluded.

TABLE 1. VOCAL FOLD PARESIS DEMOGRAPHICS AND LEMG FINDINGS

Age (y)	*Gender*	*Duration*	*LEMG Findings*	*Cause of Paresis*
62	F	1 y	B RLN + SLN	Idiopathic
67	F	1 y	B RLN	Idiopathic
30	M	9 y	L RLN + SLN	Idiopathic
36	M	36 y	B RLN	Congenital
28	M	4 mo	B RLN	Idiopathic
65	M	6 y	B RLN + SLN	Idiopathic
36	F	10 y	B RLN	Idiopathic
69	F	2 mo	B RLN	Idiopathic
35	F	1 y	B RLN	Idiopathic
36	M	7 y	B RLN	Idiopathic
44	F	9 y	R RLN	Idiopathic
29	F	1.5 y	L RLN	Idiopathic
58	F	9 mo	L RLN	Idiopathic
37	F	1 y	B RLN	Idiopathic
51	F	5 y	L RLN	Idiopathic
43	F	16 mo	R RLN	Idiopathic
76	M	6 mo	B RLN	Idiopathic
58	M	14 mo	B RLN	Idiopathic
54	F	4 mo	L SLN	Traumatic

LEMG — laryngeal electromyography; B — bilateral; RLN — recurrent laryngeal nerve paresis; SLN — superior laryngeal nerve paresis; L — left; R — right.

The videos were edited to include only segments in which the vocal folds were in a fully adducted position and were engaged in vibratory activity. We decided not to show footage of vocal fold mobility, in order to help exclude any possible bias that could occur from interpreting vocal fold movement. The video segments were then randomized and were interpreted by three reviewers with extensive experience in videostroboscopic interpretation. Each video segment was reviewed, and the following questions were addressed: 1) Is asymmetry of vibration (amplitude or mucosal wave) present? 2) If vibration is asymmetric, which side has the increased amplitude and/or mucosal wave? and 3) On which side would you predict the paresis to be present?

The LEMG results were used as the gold standard for the diagnosis of VFP. Interpretation of the videostroboscopic findings by our reviewers was then compared to this gold standard to determine the predictive value of subjective vibratory asymmetry on videostroboscopic examination.

RESULTS

Of the 19 patients with a diagnosis of LEMG-confirmed VFP (Table 1), the mean patient age was 48.5 years (range, 28 to 76 years). Twelve of the patients were female (63.2%) and had a mean age of 48.8 years, and 7 patients were male (36.8%) and had a mean age of 47 years. The mean time interval from

TABLE 2. LEMG RESULTS AND REVIEWERS' INTERPRETATION

Patient	*Reviewer 1*	*Reviewer 2*	*Reviewer 3*	*LEMG*
1	L	R	R	B
2	R	R	R	B
3	R	R	R	L
4	R	B	R	Normal
5	R	B	B	B
6	R	R	R	Normal
7	R	R	R	B
8	L	L	L	B
9	L	R	B	R
10	B	B	B	B
11	R	B	B	B
12	L	L	L	B
13	R	B	L	R
14	L	B	B	Normal
15	R	B	R	L
16	L	L	R	L
17	R	B	B	B
18	R	L	L	Normal
19	L	B	B	L
20	R	B	R	R
21	R	L	R	B
22	R	B	B	B
23	R	B	L	L

L — left-sided paresis; R — right-sided paresis; B — bilateral paresis.

the onset of symptoms to presentation to our clinic was 4.8 years (range, 2 months to 36 years). The cause of the paresis was idiopathic in the vast majority of cases (17 of 19 or 89.5%), and the remaining cases were congenital (1 of 19 or 5.2%) or traumatic (1 of 19 or 5.2%). In terms of neural involvement, the majority of cases involved the RLN only. Ten cases were bilateral RLN paresis, and 5 cases were unilateral RLN paresis. The remaining cases were 2 cases of bilateral combined RLN and SLN paresis, 1 case of unilateral combined RLN and SLN paresis, and 1 case of unilateral SLN paresis.

Of the 23 patients with symptoms of glottal insufficiency and isolated vibratory asymmetry on videostroboscopy, 19 (82.6%) were found to have electrophysiological evidence of denervation of one or both vocal folds (Table 2). However, the individual reviewers' ability to correctly predict the distribution of the paresis was quite poor. Given three options (bilateral, left, or right), each reviewer was unable to correctly predict the side in most cases (reviewer 1, 5 of 19 correct; reviewer 2, 7 of 19 correct; and reviewer 3, 7 of 19 correct). With all examination evaluations combined, the side of paresis was correctly predicted in only 33.3% of cases (19 of 57).

DISCUSSION

The idea behind this study was to answer a common question that is posed in our multidisciplinary clinics. As a general rule, the voice team (which includes the senior author, speech pathologist, and resident physician) reviews the videostroboscopic examination of the patient and discusses the subjective interpretation of the vibratory parameters. In most cases of suspected VFP, the clinicians can agree that vibratory asymmetry is present, and LEMG will later confirm the diagnosis. However, the reliability of using vibratory asymmetry to correctly predict the presence of VFP has not been examined. Although we can usually agree on the presence of vibratory asymmetry, there is often a debate about the sidedness of the suspected paresis. Conventional thinking suggests that the denervated side will have an increased amplitude and/or mucosal wave due to the laxity of the paretic vocal fold. Despite this consensus, we have noted that many times the clinicians do not agree as to which side(s) is involved.

Obviously, the clinical diagnosis of some cases of VFP is fairly straightforward when based on videostroboscopic findings and clinical history. In the setting of gross hypomobility and glottal insufficiency, the diagnosis is not often in question. However, when there are no readily apparent differences in vocal fold mobility, the diagnosis can be more difficult to make, or may not be suspected by the clinician at all. In these cases, vibratory asymmetry may be the only clue that VFP is present.[7] This finding may help guide the clinician toward performing LEMG and establishing a correct diagnosis.

Our clinical protocol for patients with symptoms suggestive of glottal insufficiency and an increased amplitude and/or mucosal wave or "chasing wave" (asymmetry of vibration) is to recommend LEMG. Obviously, not all patients with this combination of symptoms and findings agree to undergo or follow up for diagnostic LEMG, so we are not able to comment on the positive predictive value of vibratory asymmetry in these cases. Nonetheless, when vibratory asymmetry prompted LEMG testing in our series, the clinical "hunch" ended up being correct in 83% of cases. However, the ability of experienced clinicians to correctly predict which side was involved was quite poor (33.3%). This is exactly the percentage one would expect if the clinician's determination were randomly generated; ie, there is a 1-in-3 chance of predicting the outcome correctly. The difficulty partially arises from using the subjective observation that one side demonstrates increased vibratory amplitude (often thought to be a manifestation of reduced muscular tone in a denervated vocal fold). By necessity, that determination involves using the contralateral side as a control, ie, the side with the "normal tone." In many cas-

es, however, this side may also be affected, making the assumption of unilaterality erroneous. Despite this problem, there were many cases in which the reviewer correctly predicted that the paresis was unilateral, but the predicted side (ie, distribution of involvement) was incorrect.

Relying solely on laryngoscopic findings to predict VFP continues to be problematic. Other studies have shown that 25% to 40% of patients had LEMG findings that were not predicted by their laryngoscopic examination.[2,3] Although vibratory asymmetry is fairly predictive of VFP (83% of cases in our study), determining the distribution (left/right/bilateral) of the paresis is very poorly predictive.

Interpretation of videostroboscopic examinations is by nature subjective. We have observed that vibratory asymmetry can sometimes be difficult to detect on routine stroboscopy. The best method of accentuating asymmetry is to have the patient phonate at a modal or low fundamental frequency at a high intensity. In addition, extinguishing any secondary supraglottic muscular tension seems to be beneficial, as this allows for the differential tension of the true vocal folds to be observed. Last, recording the examination and playing it back in slow motion, or performing frame-by-frame analysis, is yet another method to aid in the detection of vibratory asymmetry.

CONCLUSIONS

The videostroboscopic finding of vibratory asymmetry in mobile vocal folds is a reliable predictor of VFP in most cases. However, the ability of expert reviewers to determine the distribution (left/right/bilateral) of the paresis using videostroboscopic findings is poor. This finding highlights the value of LEMG in arriving at a correct diagnosis in this clinical situation.

REFERENCES

1. Merati AL, Shemirami N, Smith TL, Toohill RJ. Changing trends in the nature of vocal fold motion impairment. Am J Otolaryngol 2006;27:106-8.

2. Heman-Ackah YD, Barr A. Mild vocal fold paresis: understanding clinical presentation and electromyographic findings. J Voice 2006;20:269-81.

3. Koufman JA, Postma GN, Cummins MM, Blalock DP. Vocal fold paresis. Otolaryngol Head Neck Surg 2000;122:537-41.

4. Simpson CB, Cheung EJ, Jackson CJ. Vocal fold paresis: clinical and electrophysiologic features in a tertiary laryngology practice. J Voice 2009;23:396-8.

5. Altman KW. Laryngeal asymmetry on indirect laryngoscopy in a symptomatic patient should be evaluated with electromyography. Arch Otolaryngol Head Neck Surg 2005;131:356-60.

6. Rubin AD, Praneetvatakul V, Heman-Ackah Y, Moyer CA, Mandel S, Sataloff RT. Repetitive phonatory tasks for identifying vocal fold paresis. J Voice 2005;19:679-86.

7. Sulica L, Blitzer A. Vocal fold paresis: evidence and controversies. Curr Opin Otolaryngol Head Neck Surgery 2007;15:159-62.

8. Koufman JA. Evaluation of laryngeal biomechanics by fiberoptic laryngoscopy. In: Rubin JA, Sataloff RT, Korovin GS, Gould WJ, eds. Diagnosis and treatment of voice disorders. New York, NY: Igaku-Shoin, 1995:122-34.