




Vocal fold paresis: Medical specialists' opinions on standard diagnostics and laryngeal findings

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Abstract

Purpose There is still no clear consensus on the diagnostic value of specific laryngeal findings in patients with suspected vocal fold paresis (VFP). The aim of the study was to establish expert opinion on criteria for the diagnosis of VFP in Europe.

Methods A cross-sectional survey using the questionnaire introduced by Wu and Sulica for US American experts was addressed to laryngeal experts in Germany, Austria, and Switzerland and in a second survey wave to members of the European Laryngological Society.

Results 100 respondents returned survey 1 (response rate 47.2%). 26% worked at a university department. 28% regularly used laryngeal electromyography (LEMG). A pathologic test results in LEMG was considered to have the strongest positive predictive value for VFP ($79 \pm 23\%$), followed by a decreased vocal fold abduction ($70 \pm 29\%$), decreased vocal fold adduction ($61 \pm 34\%$), and atrophy of the hemilarynx ($61 \pm 31\%$). The multivariate analysis showed the predictive value of LEMG was estimated lower by respondents from non-university hospital ($\beta = -16.33$; confidence interval (CI) = -25.63 to -7.02 ; $p = 0.001$) and higher in hospitals with higher frequency of VFP patients per months ($\beta = 1.57$; CI = -0.98 to 2.16 ; $p < 0.0001$). 30 ELS members returned survey 2 (response rate, 8.4%). Their answers were not significantly different to survey 1.

Conclusions The laryngology experts in Europe rely on LEMG for diagnosis of VFP like the US American experts, but paradoxically only a minority uses LEMG frequently. Next to LEMG, motion abnormalities were considered to have the best predictive value for the diagnosis of VFP.

Keywords Neurolaryngology · Vocal fold paresis · Vocal fold motion · Vocal fold immobility · Vocal fold paralysis · Laryngoscopy · Laryngostroboscopy · Laryngeal electromyography · Survey

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Introduction

Vocal fold paresis (VFP) includes a wide spectrum of motion impairment of different etiology that can range from nearly imperceptible hypomobility to obvious paralysis [1]. Symptoms of unilateral VFP are often nonspecific. Therefore,

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laryngoscopy and stroboscopy are important diagnostic tools for any patient presenting with voice or laryngeal symptoms. An acute paralysis can be identified by a gross vocal fold hypomobility. Later on, elements of hyperfunction can mask the underlying VFP. Then again, also other disorders can sometimes mimic or create a visual asymmetry when a true paresis may not present with typical symptoms of a paralysis [1]. Asymmetry in vocal fold motion may also be without clinical significance [2]. Voice researchers have not yet developed a clear-cut outcome measure for VFP [3]. To initiate the establishment of standards for the diagnostics of VFP, Wu and Sulica conducted a survey with expert laryngologists on their opinion on diagnostic methodology and criteria for VFP [2].

To better understand the experts' opinion in Europe, the same questionnaire was now used to survey laryngeal experts in the Germany-speaking countries such as Germany, Austria, and Switzerland. In a second step, members of the European Laryngological Society (ELS), i.e. laryngeal experts of other European countries were surveyed with the same questionnaire.

Materials and methods

Study design and setting

This cross-sectional study was carried out by the Department of Otorhinolaryngology, Jena University Hospital, Jena, Germany. Approval for the study was obtained through the local ethics committee and informed consent was obtained from all study participants.

Selection of the participants

Data were gathered from a survey mailed to ENT physician and phoniatriest entitled "Survey about neurolaryngology in departments of otorhinolaryngology, phoniatics, and voice units". The survey was sent out in two waves (survey 1 and survey 2). First, the survey was posted to all hospitals in German-speaking countries with an ENT department or department of phoniatics (Germany, Austria, Switzerland). The letters were addressed to the responsible expert laryngologist or phoniatician in the department. The addresses were asked at the ENT societies of the three countries. This first wave of the survey was conducted from January to March 2016. s, the survey was distributed via e-mail by the European Laryngological Society (ELS; <http://www.elsoc.org>) to their members. German-speaking countries were excluded. The European survey was conducted from May to October 2016. The surveys were conducted anonymously.

Survey instrument

The survey from Wu and Sulica was used [2]. It is a 29-item, 4-part questionnaire characterizing responders' experience, training and practice setting (part 1), assess diagnostic strategy (part 2), evaluate opinion regarding the positive predictive value of various laryngoscopic signs (part 3), and evaluate option regarding the sensitivity of laryngeal electromyography (LEMG; part 4). For the German survey, the original English version of the questionnaire of Wu and Sulica was translated and validated in accordance with international standards [4].

Statistical analysis

Participants' characteristics and outcome variables were analyzed with IBM SPSS statistics software (version 23.0) for medical statistics. Data are presented as mean \pm standard deviation (SD) if not otherwise indicated. Descriptive frequencies and cross-tabulations were calculated. The Kolmogorov–Smirnov test showed that the data was not normally distributed. The non-parametric Mann–Whitney *U* test was used to compare metric variables in subgroups. The Chi-square test was used to compare nominal data of subgroups. To analyze factors independently associated with proportion of patients receiving laryngeal electromyography, a multivariate linear regression analysis was performed. Only factors with significant association in univariate analysis were included in the multivariate linear regression analysis. Due to the limited number of participants in survey 2, the multivariate analysis was only performed for survey 1. *p* values of 0.05 or less were considered significant.

Results

Study participants

A total of 212 surveys were distributed to German-speaking hospitals (survey 1), and 100 surveys were returned (response rate, 47.2%). There was no difference in the participation of university/non-university hospitals ($p=0.151$) or of the three German-speaking countries ($p=0.189$) between the group of responders and non-responders. A total of 356 surveys were sent to all ELS members (survey 2), and 30 surveys were returned (response rate, 8.4%). Due to the low response rate by the ELS members and lack of data of the non-responders of the ELS, the European data are presented separately.

The participants of the German-speaking countries (survey 1) came from Germany ($n=80$; 80%), Austria

($n = 12$; 12%), and Switzerland ($n = 8$; 8%). Twenty-six (26%) worked in a university department. 49 (49%) had a phoniatics section within the ENT department or department of phoniatics. 28 (28%) answered that they perform laryngeal EMG. The proportion of laryngology in daily care was given with $31.2 \pm 18.6\%$ (median 28; range 4–93). The physicians indicated to see 37.4 ± 58.8 patients (median 24; range 2–400) with hoarseness/voice-related complaints per month and to see 4.4 ± 6.2 new patients (median 3; range 0–40) with VFP per month. The proportion of adult patients was estimated with $78.1 \pm 17.8\%$ (median 81; range 6–100). University department had more frequently a phoniatics section ($p < 0.0001$), had LEMG more frequently available ($p < 0.0001$), saw more patients with hoarseness ($p < 0.0001$), with VFP per month ($p < 0.0001$) than non-university hospitals (Table 1).

The participants of the European survey (survey 2) came from 19 countries. Half of the participants came from Spain ($n = 4$), Belgium ($n = 3$), France ($n = 3$), UK ($n = 3$), and Italy ($n = 2$). Twenty-five participants (83.3%) worked at a university department. 66.7% had a phoniatics section within the ENT department or department of phoniatics. Thirteen (43.3%) practiced LEMG. The proportion of laryngology in daily care was given with $63.7 \pm 20.9\%$ (median 62.0; range 16–99). The physicians indicated to see 52.38 ± 52.13 patients (median 40.0; range 7–250) with hoarseness/voice-related complaints per months and to see 5.00 ± 5.63 new patients (median 3.0; range 1–30) with VFP per month. The proportion of adult patients was estimated with $78.69 \pm 9.60\%$ (median 78.5; range 65–100).

Survey 1: results in German-speaking countries

The respondents indicated that laryngoscopy (47.5%) and videostroboscopy (51.2%) are the most important diagnostic tools in VFP. Only 1.3% stated that LEMG is the most important tool. Table 2 summarizes the answers of

the participants regarding the predictive value of laryngoscopic findings and LEMG in VFP patients. LEMG was considered to be most predictive, followed by abnormalities of vocal fold motion. Indirect signs such as contact lesions and pseudocysts, were not considered highly diagnostic of VFP. The opinions on the predictive value of the different laryngological findings and diagnostics were not different between university departments and non-university departments (Supplement Table 1). The univariate analysis (Supplement Table 2) showed that the proportion of patients receiving LEMG was higher in university than in non-university hospitals ($p < 0.0001$), in hospitals with own department of phoniatics or section of phoniatics within the ENT department ($p = 0.027$), and in departments with more VFP patients per month ($p = 0.004$). The only factor that was associated with a higher estimation of the predictive value of LEMG was the number of patients seen with hoarseness per month within the department ($p = 0.027$). The multivariate analysis on independent factors with association to a higher proportion of patients receiving LEMG (Table 3) revealed that questionnaires from non-university hospital had a lower probability ($\beta = -16.33$; CI = -25.63 to -7.02 ; $p = 0.001$) and from hospitals with higher frequency of VFP patients per months ($\beta = 1.57$; CI = -0.98 to 2.16 ; $p < 0.0001$) had a higher probability to be associated with a higher estimation of the predictive value of LEMG.

Survey 2: results in Europe

The respondents indicated that laryngoscopy (35.7%) and videostroboscopy (57.1%) are the most important diagnostic tools in VFP. Only 3.6% stated that LEMG is the most important tool. Supplement Table 3 summarizes the answers of the European participants regarding the predictive value of laryngoscopic findings and LEMG in VFP patients. Like in the German-speaking countries, LEMG was considered to be the most predictive diagnostic test, followed by

Table 1 Comparison of the characteristics of university departments versus non-university department in Germany, Austria and Switzerland (survey 1)

Parameter	University department	Non-university department	<i>p</i>
Phoniatics section/dept			
Yes	24	25	< 0.0001
No	2	49	
Performing LEMG			
Yes	17	11	< 0.0001
No	9	63	
Proportion laryngology/day (%)	36.9 ± 22.7	29.3 ± 16.7	0.161
Patients with hoarseness/month	76.9 ± 103.3	24.5 ± 22.8	< 0.0001
New patients with VFP/month	8.3 ± 10.2	3.0 ± 3.2	< 0.0001
Proportion adult patients (%)	69.5 ± 21.5	81.0 ± 15.5	0.018

Significant *p*-values in bold

Table 2 Survey 1: opinion of the ENT experts German-speaking countries regarding the positive predictive value of laryngological findings and test results in vocal fold paresis (VFP)

Parameter	<i>M</i> ± <i>SD</i> (%)	Median (range) (%)
Pathologic test results in LEMG	78.80 ± 23.40	86 (7–100)
Decreased vocal fold abduction	69.58 ± 29.06	79 (0–100)
Decreased vocal fold adduction	60.62 ± 33.57	75 (0–100)
Atrophy of the hemilarynx	60.57 ± 31.30	66 (0–100)
Unilateral supraglottic hyperfunction	47.81 ± 29.05	49 (0–100)
Alteration/impairment of arytenoid rotation	46.99 ± 29.08	43.5 (0–100)
Decreased tone of the vocal fold	40.01 ± 25.82	38 (0–100)
Height difference of the vocal folds	38.87 ± 27.85	36 (0–100)
Glottic axis deviation	35.18 ± 28.21	25 (0–100)
Asymmetric amplitude of the mucosal wave	34.00 ± 28.17	25 (0–100)
Glottic insufficiency	33.31 ± 27.03	24 (0–100)
Asymmetric phase of the mucosal wave	32.02 ± 26.22	25 (0–100)
Slow/sluggish motion	31.48 ± 30.51	18 (0–100)
Asymmetric frequency of the mucosal wave	30.09 ± 25.90	24 (0–100)
Bilateral (symmetric) supraglottic hyperfunction	18.81 ± 19.44	12 (0–84)
Presence of a contact lesion	11.69 ± 14.22	7 (0–93)
Presence of a pseudocyst	8.67 ± 13.04	5 (0–93)

M mean value, *SD* standard deviation, *LEMG* laryngeal electromyography

Table 3 Factors independently associated with proportion of patients receiving laryngeal electromyography (LEMG) in German-speaking countries (survey 1) in the multivariate linear regression ($R^2 = 0.391$)

Parameter	β	SE	95% CI	<i>p</i>
Hospital				
University	Reference			0.001
Non-university	-16.33	4.68	-25.63 to -7.02	
Phoniatrics				
Yes	Reference			0.292
No	4.27	4.02	-3.72 to 12.25	
No. pts VFP/month				
< Median	Reference			< 0.0001
> Median	1.57	0.30	0.98 to 2.16	

SE standard error, CI confidence interval, VFP vocal fold paresis

Significant *p*-values in bold

abnormalities of vocal fold motion including the decreased tone of the impaired vocal fold. In accordance to the first survey wave, indirect signs such as contact lesions and pseudocysts, were also not considered to have highly diagnostic value for VFP.

Discussion

The present study underlines that patients with VFP account for an important part of the clinical workload in an ENT department. VFP was diagnosed eight times in a typical month in a university department in Germany, Austria and

Switzerland. This is exactly the same prevalence reported by Wu and Sulica for US American laryngology experts [2]. The prevalence was still high for the European laryngologists with five VFP patients per month and three per month for the non-university departments in the German-speaking countries. The participants of both surveys stated as the US American colleagues did before that the diagnosis of VFP principally relied on laryngoscopy and/or stroboscopy. The respondents seem to know that LEMG is the best instrument to diagnose a laryngeal paresis objectively and that LEMG has a high predictive value for the outcome of VFP [5–7]. Nevertheless or paradoxically, the respondents felt that some mainly subjective laryngoscopic parameters related to abnormalities of vocal fold motion are sufficient to make the diagnosis of VFP.

65% of the laryngology specialists of university department had LEMG available, but only 15% of the participants working in non-university departments. Showing their focus on laryngology, 43% of the ELS members practiced LEMG. In comparison, only 21% of the US American experts regularly used LEMG. Neurology still seems to be a young subdiscipline of laryngology. Although LEMG is recognized as a valuable diagnostic tool for more than 60 years now, many laryngologists still do not routinely use LEMG. This may be due to a persisting lack of agreement on methodology, interpretation, validity, and clinical application of LEMG [8]. To overcome some of these uncertainties, the US American Neurology Study Group, the American Association of Neuromuscular and Electrodiagnostic Medicine, and the Committee on Neurology of the ELS, have independently published recommendations for

the performance and interpretation of LEMG results [8–10]. Furthermore, the Committee on Neurolaryngology of the ELS is giving instructional courses on LEMG every year and has shown that hands-on courses on LEMG helped to support the use of LEMG [11]. Furthermore, to promote multimodal learning an interactive webpage (<http://www.lemg.org>) providing videos and animations, and the possibility to discuss cases with other experts was established. If LEMG is performed in a standardized way, the results seem to be highly reproducible [12]. It was also proposed that more neurophysiologists should be involved in LEMG groups. Even expert neurophysiologists are challenged by LEMG and do not perform LEMG alone. Therefore, a multidisciplinary approach of neurolaryngologists and neurophysiologists using LEMG together might help to promote LEMG [13].

Next to LEMG, the majority of experts rely on altered motion characteristics, but also on parameters like atrophy of the hemilarynx or supraglottic hyperfunction. Certainly, decreased or no motion of the vocal fold are key features of VFP. But there are no data available confirming that parameters such as atrophy of the hemilarynx or supraglottic hyperfunction are reliable for diagnostics of VFP. Recently, first prospective data on the predictive value of laryngoscopic/stroboscopic parameters were published. Ipsilateral axis deviation, thinner or shorter vocal fold, bowing, reduced movement, reduced kinesis, and phase lag seem to be reliable diagnostic parameters for VFP with a maximal accuracy of 89.5% [14]. Interestingly, the respondents of the present study but also the participants of the US American survey did not rely very much on glottic axis deviation or asymmetric phase of mucosal wave (cf. Supplement Table 3). It might be that these parameters are not sufficiently known even amongst specialists. This is showing us that a clinical guideline for the treatment of VFP with clear recommendations and accurate information on the grade of evidence is urgently needed like it is established for diagnostics of patient with facial paresis [15].

The inter-rater reliability to rate a reduction of vocal fold movement by laryngostroboscopy seems to be high [16]. However, the experience of the rater might be important: A senior laryngologist accurately diagnosed the side of paresis in 89.5% of cases, whereas trainees correctly predicted the side of paresis in only 63.1% [16]. On the other hand, general otolaryngologists and fellowship-trained laryngologists both show a high inter-rater (95%) and intra-rater (99%) reliability to evaluate vocal fold motion abnormalities by flexible laryngoscopy [3]. What is missing are prospective data on LEMG findings. Older retrospective analyses of large data sets in total of > 1000 patients have shown that can objectify the clinical suspicion of a VFP in about 83–96% of the cases [17, 18]. Newer but also retrospective data is showing that LEMG is at best implemented with laryngostroboscopy

when not only the thyroarytenoid muscle (TA), but also the cricothyroid muscle (CTA) posterior cricoarytenoid muscle (PCA) is recorded [19, 20]. For instance, LEMG of the PCA seems to be better in proving a recurrent nerve lesion than LEMG of the TA alone [20].

Conclusion

Laryngology experts consider LEMG as a good tool for the diagnosis of VFP, prior to laryngostroboscopy parameters. Nevertheless, they mainly perform only laryngostroboscopy in clinical routine when dealing with a patient with suspected VFP. The reasons are unclear but might be related to the acquisition cost, the time consuming performance, the not at all preventable inconvenience for the patient, the uncertainty how to interpret the LEMG results, and the limited relevance for the further treatment. Actually, several detailed LEMG guidelines are published helping to interpret and classify the results in a standardized matter. In contrast, detailed guidelines on the reliability of laryngostroboscopy are missing leading to a misinterpretation of the accuracy of many laryngostroboscopy parameters beyond abnormalities of the vocal fold movement. Till now, the exact differentiation between a partial VFP and e.g. a presbyphonia has limited impact on the choice of treatment options. The roll of LEMG will perhaps change in the future, when more specific neuro- and electrophysiological treatment options become available.

Compliance with ethical standards

Conflict of interest All authors have indicated that they have no conflict of interest.

Ethical approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The survey and its data analysis were approved by the local Ethical Committee (Ethical Committee, Jena University Hospital, Germany, No. 2018-1071-Bef).

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