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Videostroboscopic expert evaluation of the larynx with running objective voice measurement at the same time gives more secure results than videos alone.

A prospective case-control clinical study of consecutive patients with laryngeal complaints compared with normal persons and patients before and after treatment.

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Abstract

1. Introduction

In our recently published Cochrane review on laryngo-pharyngeal reflux no evidence of the effect of proton pump inhibitors was found (1). The critics from the medical industry for the lack of treatment effect of proton pump inhibitors were related to the lack of evidence of the videostroboscopy (1). Therefore we suggest a combination of videostroboscopy and voice analysis at the same time. *The aim was to obtain a statistical significant evidence of the videostroboscopic picture made in combination with voice analysis.*

2. Material and methods

Digitized patient videostroboscopies for several seconds were stored with on line measurement of speech (reading the story: the North win and the sun) and intonation of a sustained /ah/ for 4 seconds. They were compared with normal controls. The parameters for analysis of the videostroboscopies were based especially on the shape of the arytenoids with a score of abnormality 1-5, and the vocal cords. The voice analysis of all patients and normal clients included jitter% and shimmer% with standard deviations in relation to the intonated mean fundamental frequency in running speech and during intonation of the /ah/, with means and standard deviations. A mean closed quotient of the glottogram was also made on all.

3. Results and conclusion

The primary statistical analyses were related to how the evidence of the videostroboscopic pictures were made better by the supplementary on line voice analysis.

The secondary statistical analyses were related to how the evidence of the videostroboscopic pictured with on line voice analysis could show differences between patients and normal persons.

The third aspect was the analysis of how treatment of laryngeal disorders affected the combined videostroboscopic picture and voice analysis.

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1. Introduction.

In our recently published Cochrane review on laryngo-pharyngeal reflux, by far the most often seen laryngeal disorder, no evidence of the effect of proton pump inhibiters was found (1). Only an estimated 25% of dyspeptic patients consult a general practitioner about symptoms related to the upper gastrointestinal tract (2). Most patients buy over the counter medication. Despite the well documented involvement of the bacteria Helicobacter Pylori as a contributing factor in the pathogenesis of dyspepsia few studies have investigated the role of these bacteria (2). In an overview of the literature for an invited presentation of the mucosal barrier of the upper airway papers were reviewed. The papers did not involve the specific laryngeal pathologies related to the mucosal barrier, as e.g. for the pharynx (3).

It has been shown that the statistical agreement between experts was only .59 for video laryngoscopies (4). This is of course a problem for a firm with a practical and theoretical experience of effect of proton pump inhibitors on the larynx, they have again made a protocol to show the effect (ClinicalTrials.gov Identifier: NCT00170001, supported by Astra).

There is also a firm that can show some effect of sodium alginate on gastro-oesophageal reflux, may be with an effect on the laryngopharyngeal reflux (5). A project was set up and accepted by the Danish research foundation (6) and further developed in a coordinated relation to several ear-nose-throat departments to study the effect of the various medications. A survey of the recent investigations of empiric treatment of laryngo-pharyngeal reflux showed that mostly only videolaryngoscopy, symptom scores and in one third of the studies also 24-hour dual-probe pH monitoring was used. The problem with scores is that averaging is difficult, no linear connection being ensured. The pH monitoring is only related to the lower oesophagus. In two out of 15 studies acoustical analysis was referred to (7).

Based on the discussions and the recent literature on laryngopharyngeal reflux it is suggested that a novel approach to evidence based studies of laryngo-pharyngeal reflux is made. Therefore we suggest a combination of videostroboscopy and quantitative voice analysis at the same time, not only qualitative as earlier suggested (8,9). The aim was to obtain statistical significant

evidence on a higher level than with the videostroposcopic picture or voice analysis alone, especially to document treatment effect, not only of proton pump inhibitors but also of sodium alginate and other treatments. The shape (especially oedema) of the arytenoids and the vocal cords were mainly evaluated in the videostroboscopy and the jitter/ shimmer and glottis closure time in the glottogram were the acoustical parameters.

2. Material and methods

Patients complaining of a laryngeal disorder were consecutively analysed in a period of 4 months. The intention to treat was the general approach in a clinical setting in an ear-nose-throat clinic in a medical center in the central Copenhagen.

The stored digitized videostroboscopies for several seconds were analysed at the same visit as a stored reading of a standard text (the North win and the sun) and an intonation of a sustained /ah/ for 4 seconds. The parameters for analysis of the videostroboscopies were based on the shape of the arytenoids and especially oedema, an abnormality ranging from 1-5, including and the vocal cords, degree 5 being the maximal abnormal arytenoids and vocal cords and degree 1 normal arytenoids and vocal cords. The voice analysis of all with normal (1) or deviant parameters (2-5) as for the videolaryngoscopies, included jitter% and shimmer%. Standard deviations were calculated in relation to the intonated fundamental frequency during intonation of the sustained /ah/. A closed quotient% of the glottogram was made on all. For the text analysis the mean frequency, loudness, Qx in the glottogram and standard deviations were made. The SAS statistical system and advice was used.

The primary statistical analyses were related to how the evidence of the videostroboscopic pictures was better by the supplementary on line voice analysis. The normal videolaryngoscopies included grade 1 of the expert evaluation of the arytenoids and vocal cords. These were compared with the groups of deviation, and with jitter % shimmer % and closed quotients in the glottogram of the sustained tone as well as analysis of the text.

The secondary statistical analyses were related to how the evidence of the videostroboscopic pictures with on line voice analysis could show differences between pathological and normal voices. Divisions of the arytenoids and vocal cords degree 1 versus the degree 2-5 were made.

The third aspect was the analysis of how treatment of laryngeal disorders that involved the arytenoids and the vocal cords affected the combined videostroboscopic picture and voice analysis.

3. Results

In this study 373, consecutive digitized videostroboscopies were analysed for abnormality of the arytenoid regions and vocal cords, especially oedema, prospectively during 4 months. A significant difference was found between groups for the closure time in the glottogram for sustained /ah/ $p<0.05$ (Wilcoxon test) (Table 1).

If a differentiation is made between normal videostroboscopies (grade 1) and abnormal ones (grade 2-5) a significant difference is found for the closure, Qx% of the sustained tone /ah/ $p<0,0001$ (Welch ANOVA). A standard deviation less than 6,5 suggests that the voice is normal and over 12,7 that it is pathological.

During reading of a text a standard deviation of frequency variation of less than 6,9 normality can't be rejected, and abnormality when more than 11,1. If the Qx% during reading of a standard text is less than 6,5 again normality can't be rejected and if higher than 11,55 abnormality (Table 2).

77 patients were analysed before and after medical treatment in the same period in the groups of (nearly all) grade 2-4. No significant change was found for the jitter % and shimmer% with paired t-test. For Qx% there was a better closure: 4,6% (43,8 to 48,4% with a significance of $p=0,0008$ (paired t-test), For the reading of a standard test the regularity of frequency% was reduced with 1,98% ($p=0,053$) the regularity of loudness% with 1,7% ($p=0,004$) and the Qx% had a change to the better of 2,56% ($p=0,044$) analysed with paired t-tests. A combined evaluation of the videostroboscopies and the voice analysis gives a better evaluation of the voice even if the shapes do not change much, the correlation of standard text and Tone taken into account. (Table 3).

4. Discussion

In this study subjective complaints were not focused upon. They consist of complaints of pain in the throat and larynx related swallowing problems as well as mucus in the throat, hoarseness at singing or speaking, dyspnoea, acid taste in the throat and many other symptoms.

The *overall complaint of the patient was that the area of the larynx "did not function"*. Our job is to make it function again. For all a minimal patient introduction to the function was made, also called - medical voice advice (10). Basic research on voice was necessary in the previous generation out of which came the routinely used phonetograms and videostroboscopy synchronised with electroglottograpy. This study can be seen as a suggestion for a quantitative follow-up (8,9,11). The relationship between normality and pathology could be further and much more effectively illucidated if the principles of evidence including quantitative measures necessary in pathology were better understood in physics. A combined approach as suggested of visual and acoustical parameters is one solution as for definition of inclusion criteria for clinical trials (12).

The medical people, in the area of laryngology, the ear-nose-throat specialists, focus on evidence. It is absolutely necessary to understand the demand of evidence as in other serious areas of patient pathology. Some of the money used for basic science should be used here fore or the funds should be bigger, defining research of normality versus research on pathology of the voice.

In our study we have shown a better definition of normality comparing videostroboscopy with the voice parameters of jitter, shimmer and especially closure time of the vocal cord as measured with electroglottography. For all these parameters no other evidence based studies exist. There is a long way to go to elucidate normality

in laryngology. Still the parameters were detected and the use made in pathology.

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5. References

1.Hopkins C, Yousaf U, Pedersen M. (2006). Acid reflux treatment for hoarseness (review). The Cochrane Library. Issue 2.

2. Goves, Oldring, Kerr, Dallara, Roffe, Powell & Taylor (1998) First line treatment with omeprazole provides an effective and superior alternative strategy in the management of dyspepsia compared to antacid/alginate liquid: a multicentre study in general practice. Alimentary Pharmacology & Therapeutics; vol 12: 147-157.

3. Pechère J, Kaplan E, ed. (2004). Streptococcal Pharyngitis, Optimal Management, Issues in Infectious Diseases. Karger Verlag.

4. Dikkers FG (1991). Intraobserver variation in diagnosis of benign non-neoplastic lesions of vocal folds. The Lancet. Letter; 337 (8745): 866.

5. Dettmar P, Sykes J, Little S, Bryan J (2006). Rapid onset of effect of sodium alginate on gastro-oesophageal reflux compared with ranitidine and omeprazole, and relationship between symptoms and reflux periods. Int J Clin Pract.; March, 60,3: 275-283.

6. Pedersen M, McGlashan J, Bianco E, Beranova A, Gluud C (2003). Vocal fold nodules: a model for a prospective blinded randomized study with control group and statistical adequate follow-up. Union of European Phoniatricians. Toulouse. Abstract FP 07-5.

7. Karkos P., Wilson J (2006). Empiric treatment of laryngopharyngeal reflux with proton pump inhibiters. Laryngoscope; 116 January: 144-148.

8. Pedersen M (Fog) (1977). Electroglottography compared with synchronized stroboscopy in normal persons. Folia phoniatrica;29:191-200.

9.. Pedersen M (Fog) (1977). Electroglottography compared with synchronized stroboscopy in students of music. The study of sound. Tokyo;18:423-34.

10. Pedersen M, Beranova A, Møller S (2003) Dysphonia: medical treatment and a medical voice hygiene approach. A prospective randomised pilot study. European Archives of oto-rhino-laryngology; 261:312-315.

11. Pedersen M(F), Lindskov Hansen H, Lindskov Hansen T, Munk E. (1984). A phonetograph for use in clinical praxis. Acta otolaryngol (Stockholm) S412:138.

12. Pedersen M (2004). Interactions between basic and clinical research, evaluation of vocal cord nodules. Int. Conf. Vocal Fold Physiology and Biomechanics report. Marseille: 137-143.

Table 1

A. Groups of consecutive digitized videostroboscopies evaluated by 2-3 observers on the spot, and voice analyses at the same time based on the pathology/oedema of the shape of the arytenoids in the larynx, grade 1=normal without laryngeal complaints, grade 5=maximal oedema and abnormality and **intonation of a sustained tone /ah/**. Comparison is made with jitter%, shimmer% and glottis closure time, Qx% measured with SPEAD by the firm Laryngograph ltd.

B.Discription of frequency, loudness and glottis closure variation by reading of a **standard text**: the North win and the sun at the same time on the same population.

A:

arytenoids shape 1-5	mean jitter%	Std Dev	mean shimmer%	Std Dev	mean Qx%	Std Dev	N	Comments
1	1,0	1,0	9,2	6,5	47,1	6,5	35	Wilcoxon test:
2	3,4	8,1	7,6	5,3	45,6	14,8	70	common
3	2,6	6,0	7,8	4,9	45,8	11,5	128	mean values
4	5,6	15,4	8,7	7,5	44,6	13,0	129	for jitter% and
5	4,5	7,2	11,8	16,6	47,9	7,9	11	shimmer%
statisctics	-	-	-	-	significant difference between at least 2 groups for Qx% (p<0,05)			

B:

arytenoids shape 1-5	frequency variation%	Std Dev	loudness variation%	Std Dev	Qx%	Std Dev	N	Wilcoxon test:
1	9,0	6,9	15,4	5,1	48,7	5,0	35	Equality
2	13,2	11,9	16,8	6,8	44,7	13,8	70	cannot be rejected
3	12,1	11,4	16,0	4,7	46,4	10,5	128	
4	12,0	10,1	16,4	5,6	46,1	11,7	129	
5	13,8	14,1	18,2	7,8	46,8	4,8	11	

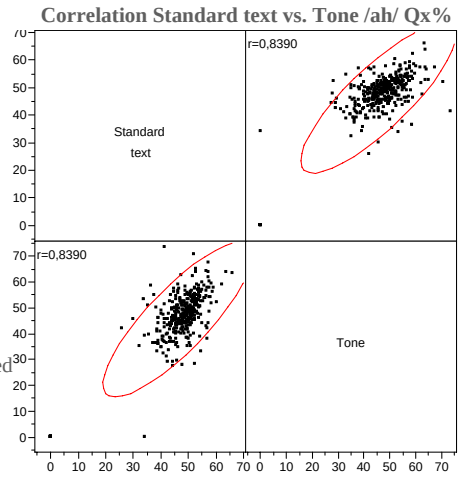
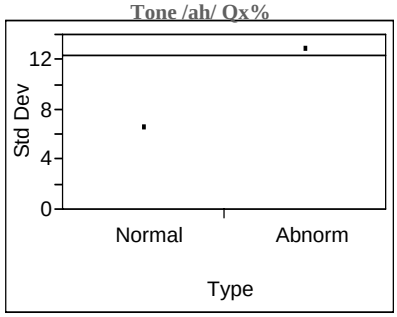


Table 2

Groups of consecutive digitized videostroboscopies evaluated by 2-3 observers on the spot, and voice analysis at the same time of normal controls: arytenoids shape grade1, without laryngeal complaints versus: abnormal clients with laryngeal complaints, arytenoids shape grade 2-5, measured with SPEAD by the firm Laryngograph ltd.**A**: **sustained tone /ah/. B**: reading of a **standard text:** the North wind and the sun.

A:

arytenoids shape 1	mean jitter% 1	Std Dev 1	mean shimmer% 9,2	Std Dev 6,5	mean Qx% 47,1	Std Dev 6,5	N 35	Comments
shape 2-5	4	10,5	8,2	6,6	45,3	12,7	338	
statistics	-	-	-	-	significant difference for Qx% and standard deviations between normal and abnormal measures, Welch ANOVA p<0,0001			



B:

arytenoids shape 1	frequency variation% 9	Std Dev 6,9	loudness variation% 15,4	Std Dev 5,1	Qx% 48,7	Std Dev 6,5	N 35	normals SD for frequency variation <6,9 abnormal> 11,1
shape 2-5	12,3	11,1	16,4	5,6	46,0	11,4	338	
statistics	p 0,03 *		-		p 0,011 *			normals SD for Qx% <6,5 abnormals >11.4

*p as given (Wilcoxon test)

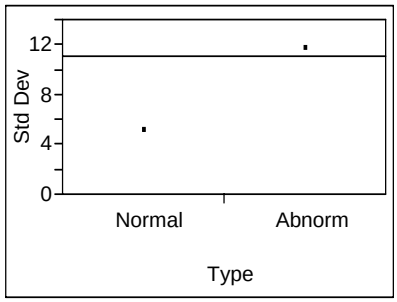


Table 3.

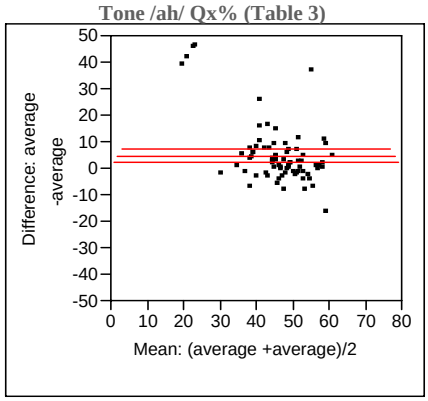
A: 77 patients with examinations before and after treatment, **intonation of a sustained tone /ah/.**

arytenoids abnormality	(shape 5 1 pt.)		(shape 5 3 ptt.)		
shape 4	1. examination	Std Dev	2. examination	Std Dev	N 1st 32/ 2nd.25
mean jitter%	5.7	17.9	1,1	1,1	
mean shimmer%	7,4	5,2	6,8	3,7	
mean Qx%	43,7	14,4	48,1	6,1	
shape 3	1.examination	Std Dev	2. examination	Std Dev	N 1st 26/ 2nd30
mean jitter%	3,8	8,7	1,6	3,0	
mean shimmer%	7,4	3,9	7,3	3,6	
mean Qx%	42,3	14,5	48,1	7,1	
shape 2	1.examination	Std Dev	2. examination	Std Dev	N 1st 16/ 2nd18
mean jitter%	4,9	11,1	2,2	3,3	
mean shimmer%	4,9	8,7	1,6	3,1	
mean Qx%	45,4	7,5	50,3	9,2	

(shape 1 2 ptt.) (shape 1 1 pt).

statistics

For Tone, no significant change was found of jitter% and shimmer% with paired t-test.
For Qx% there was a significant better closure of the glottis of 4,6% (43,8% to 48,4%) with a significance of 0,0008 with paired t-test.
For the reading of a standard text the regularity frequency% was reduced with 1,98% (p= 0,053), the regularity of loudness% with 1,7% (p=0,004) and the Qx% was better with a change of 2,56% (p=0.044) analysed with paired t-tests.



average med 1 decimal 3