Stroboscopy for benign laryngeal pathology in evidence based health care

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Abstract

Background and aims: Voice disorders are common. The aim of this study is to evaluate the diagnostic value of stroboscopy for voice disorders related with benign pathology and apply results in evidence based health care.

Methods: Prospective study. Tertiary care hospital. Voice Clinic. One hundred and fifty consecutive patients with an initial diagnosis of benign laryngeal disease or dysphonia of no clarified cause (normal laryngoscopy) were examined stroboscopically and studied prospectively until a final diagnosis was reached. Sixty-six men, eighty women and four children met the selection criteria for the study and had adequate follow-up. The initial laryngoscopic diagnosis was compared to the stroboscopic diagnosis. The diagnostic value of stroboscopy was rated at a scale of 0 to 3. A score 3 describes the diagnostic value of stroboscopy in the cases where the stroboscopic examination resulted to a change of the therapeutic modality offered to the patient.

Results: For one third of the study’s population the diagnostic value of stroboscopy was very significant, since it established the laryngeal pathology responsible for the voice disorder (28.8%) and for a small number of patients it changed the choice of treatment (4.7%). For about one third of the cases (32.2%) stroboscopy offered additional information regarding the cause of dysphonia. The diagnostic value of stroboscopy correlated with the type of laryngeal pathology.

Conclusions: Patients expected to benefit from stroboscopic examination are patients with small lesions of the vocal fold edge, dysphonic patients with unremarkable indirect laryngoscopy, and professional voice users. Hippokratia 2012, 16, 4: 324-328

Key words: stroboscopy, voice disorders, dysphonia, diagnosis, health care, evidence based

Introduction

Stroboscopy constitutes part of a multidimensional approach which has been adopted in the systematic study of voice disorders¹. Its clinical value has been reported to be the improved diagnosis of benign vocal fold lesions, vocal fold scars, muscle tension dysphonia and early invasive lesions²-⁴. Voice disorders are common⁵. In most of the cases patients are treated by non voice specialized otolaryngologists. Diagnosis is the basis of treatment decisions. Previous studies have demonstrated a significant inter-observer variability in the diagnosis by non voice specialists viewing laryngoscopic videos⁶. This variability can be reduced by stricter definitions of diagnoses, training in voice clinics and use of improved diagnostic technology⁷. Treatment of voice disorders should aim to satisfy each patient’s unique vocal requirements. Severe dysphonia influences an individual’s health related quality of life and effective treatment, based on the correct diagnosis, improves patients’ perceptions about their quality of life⁸. Health service organisational issues influence the access of patients to voice specialists and to improved diagnostic technology. Billing and reimbursement guidelines differ between different countries but cost - conscious health services globally are attempting to base decisions on indications of cost effective use of diagnostic modalities. The diagnostic value of any examination in clinical practice is based on the ability to offer added information in a valid, repeatable, practical, cost-effective way. Stroboscopy is more time consuming than standard indirect laryngoscopy⁴. Stroboscopes are available in voice clinics, the examination is performed by voice specialists and is not reimbursed in our health system. The aim of this study was to evaluate the diagnostic value of stroboscopy in clinical practice when treating patients with benign laryngeal pathologies, so that access to specialized diagnostics can be offered in a cost effective manner.

Participants and methods

Participants to the study were all consecutive patients attending the Voice or the ENT Clinic of a tertiary care hospital over a year, with a prior laryngoscopy that yielded a diagnosis of benign laryngeal disease or dysphonia with normal laryngoscopic findings. Laryngoscopy had been performed with laryngeal mirror, laryngeal telescope or flexible rhinopharyngolaryngoscope by board
certified Otolaryngologists. Patients with dysphonia of non clarified etiology due to difficult indirect laryngoscopy were excluded from the study since in these cases flexible laryngoscopy alone often established the diagnosis. Exclusion criteria were a recent endotracheal anaesthesia and a change of the patients’ voice according to their perception since the initial examination.

One hundred and fifty consecutive patients with an initial diagnosis of a benign lesion (nodules, cyst, polyp), laryngitis, vocal fold oedema, Reinke’s oedema, muscle tension dysphonia, neurogenic dysphonia, vocal fold atrophy, spasmodic dysphonia, mutational dysphonia, and dysphonic patients with normal laryngoscopy were studied prospectively. Our study population consisted of 66 men, 80 women and four children. The adult patients’ age ranged from 18 to 84 years (mean: 51.4, SD: 16.9). The children were 6 years old (two children), 10 and 11 years old.

A detailed medical and voice use history was obtained by all patients. The patients were first examined with constant light rigid laryngoscopy by the same examiner who then performed the stroboscopy (rigid and when indicated flexible rhinopharyngo-laryngoscope). The laryngoscopic findings were recorded to the form appearing in Table 1. Stroboscopy included examination during sustained phonation of the vowels /e/ and /i/ at the patient’s habitual loudness and pitch and during loudness and pitch scales, short phonation followed by inhalation,

Table 1: Laryngoscopic examination.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glottis morphology at inspiration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morphology and movement of arytenoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocal fold morphology: upper surface - vocal fold edge - anterior commissure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustained vowel phonation /e/, /i/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>False vocal folds - ventricles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: The phonetory measures of the study’s population.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPT</td>
<td>&lt;10 seconds for 8 patients</td>
</tr>
<tr>
<td>VHI</td>
<td>1 to 104 (mean: 37, SD: 27.3)</td>
</tr>
<tr>
<td>GRBAS dysphonia rating</td>
<td>0 to 3 (mean: 1.4, SD: 1)</td>
</tr>
</tbody>
</table>

MPT: Maximum Phonation Time, VHI: Voice Handicap Index.

Table 3: Stroboscopic value for different pathologies. Kruskal-Wallis analysis of variance by rank.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocal fold cyst</td>
<td>5</td>
<td>88,90</td>
</tr>
<tr>
<td>Muscle tension dysphonia</td>
<td>5</td>
<td>85,50</td>
</tr>
<tr>
<td>Vocal fold atrophy</td>
<td>14</td>
<td>69,18</td>
</tr>
<tr>
<td>Nodules</td>
<td>28</td>
<td>59,07</td>
</tr>
<tr>
<td>Vocal fold polyp</td>
<td>15</td>
<td>48,40</td>
</tr>
<tr>
<td>Chronic laryngitis</td>
<td>8</td>
<td>41,69</td>
</tr>
<tr>
<td>Vocal fold paresis</td>
<td>14</td>
<td>39,79</td>
</tr>
<tr>
<td>Reinke’s edema</td>
<td>16</td>
<td>28,38</td>
</tr>
</tbody>
</table>

Table 4: The stroboscopic diagnoses in patients with unremarkable laryngoscopy.

<table>
<thead>
<tr>
<th>Stroboscopic diagnosis</th>
<th>n</th>
<th>DVS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle tension dysphonia</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Vocal fold oedema</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Vocal fold atrophy</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Vocal fold cyst</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Scar</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Nodules</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Vocal fold paresis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Superior laryngeal nerve paralysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Spasmodic dysphonia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Normal (vocal fatigue)</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*DVS: diagnostic value of stroboscopy
and coughing. Phonation during connected speech, and singing were evaluated with flexible endoscope stroboscopy. The Maximum Phonation Time (MPT) was measured, dysphonia was rated with the use of the GRBAS scale and the patients were invited to complete the Voice Handicap Index (VHI). Patients submitted to microlaryngoscopy had an operative diagnosis and a pathology report to formulate the final diagnosis. The pathologists were not blind to the operative diagnosis. Patients who followed a conservative treatment were re-evaluated regarding response to treatment. They were included to the study if they had at least one follow-up examination (for conditions not expected to change) or a follow-up period more than three months. The diagnostic value of stroboscopy was rated at a scale of 0 to 3: 0, no diagnostic contribution; 1, stroboscopy contributed additional diagnostic information regarding the cause of dysphonia; 2, stroboscopy changed the initial diagnosis or was instrumental in establishing the diagnosis and 3, stroboscopy resulted to a change of the therapy offered to the patient. Stroboscopic examinations were performed with the AT-MOS Endo-Stroboscope 6 (ATMOS, Germany), a 90° Wolf laryngostroboscope (Wolf, Germany), a 70° Storz laryngeal telescope (Storz, Germany), and the ENF-P4 (Olympus, USA) rhinopharyngolaryngoscope.

**Statistical analysis**

Statistical analysis was performed with the SPSS.11.5 for Windows. Descriptive statistics regarding age, sex, smoking, VHI, MPT of the study population were performed. The diagnostic value of stroboscopy was calculated for the patients as a group. Comparison of the diagnostic value of stroboscopy for different pathologies was performed with the use of Kruskal – Wallis test.

**Results**

A considerable number of patients had more than one laryngoscopic finding. The diagnostic value of stroboscopy was evaluated for the main diagnosis and the additional findings of stroboscopy. A great proportion of the study’s population had moderate dysphonia. The phonometry measures appear in Table 2. The percentage of smokers was 25.33% of the participants, whereas the national surveys show that one in two adults in Greece is smoking. For 39.3% of participants laryngopharyngeal reflux was identified as a contributing aetiological factor (23 had a confirmatory pH monitoring). For 23 patients submitted to microlaryngoscopy pathology results provided the final diagnosis. The definitive diagnosis was indental to the stroboscopic diagnosis for all of our patients. The follow-up ranged from one to 15 months (mean: 5, SD: 3.7 months).

For one third of the study’s population stroboscopy established the diagnosis (43 patients, 28.8%) by identifying the etiology of dysphonia or changing the initial diagnosis. For an additional number of patients it changed the choice of treatment (7 patients, 4.7%). For about one third of the cases (48 patients, 32.2%) stroboscopy offered additional information regarding dysphonia. One third of the patients examined (51 patients, 34.4%) had no benefit from the stroboscopic examination. One patient had an early invasive lesion.

The diagnostic value of stroboscopy differed considerably depending on the pathology (Table 3). It was greater for the following pathologies: sulcus vocalis, vocal fold cysts, scars, muscle tension dysphonia, vocal fold atrophy, psychogenic dysphonia and nodules.

In patients with an initial diagnosis of vocal fold nodules stroboscopy contributed to the characterisation of nodules based on the presence of uninterrupted mucosal wave. Stroboscopy changed the diagnosis in 6 patients who were found to have vocal fold oedema, polyp, and sulcus vocalis.

The stroboscopic diagnoses in patients in whom laryngoscopy failed to reveal any pathology appear in Table 4. Scars of the vocal folds were missed in two patients. One had a small scar whereas the other had an extensive scar involving the entire length of the vocal fold edge, with absence of the mucosal wave. Three patients had a sulcus vocalis confirmed during microlaryngoscopy in two of them.

**Discussion**

**Synopsis of key findings**

This study evaluated the clinical value of stroboscopy in a cohort comprising of every consecutive patient with a voice disorder examined in a single institution, excluding cancer. The participants’ recruitment process led to the absence of acute laryngeal pathology. This is in accordance with clinical practice since in our health system videostroboscopy is not part of the otolaryngologic examination in the emergency care.

For one third of the study’s population stroboscopy established the laryngeal pathology responsible for the voice disorder or changed the initial diagnosis. The choice of treatment was changed for 4.7% of the study population. For one third of the participants stroboscopy offered additional information regarding dysphonia. The clinical value of this additional information depends on many factors, including each patient’s vocal needs and profession, and the individual treatment outcome expectations and therefore cannot be easily quantified.

**Strengths of the study**

The present study was prospective. Stroboscopic examination was performed to every consecutive patient regardless of the diagnostic adequacy of the indirect laryngoscopic examination. All stroboscopic examinations were performed by a single trained examiner to overcome interjudge reliability issues. Follow up was adequate to confirm the stroboscopic diagnoses on the grounds of treatment outcomes.

**Methodological issues**

All examinations were performed by the same physician, not blinded to the history or the voice of the patient.
Although these factors are recognised to induce bias to the diagnosis\(^1\), they affected both the laryngoscopic and the stroboscopic examination.

The use of rigid endoscopes for videostroboscopy alters the natural phonatory mechanisms\(^3\) but recorded images are superior to fiberoptic recordings\(^4\). This limitation applies to laryngoscopy and stroboscopy alike. In this study flexible stroboscopy was performed for the evaluation of the movement of the supraglottal structures, the study of muscle tension dysphonia and the observation of the larynx during connected speech and singing.

Most of the studies examining the diagnostic value of stroboscopy were conducted in University ENT Departments by physicians experienced in the evaluation of voice disorders\(^2\)\. Recruitment of patients in tertiary care hospitals could be a source of selection bias that increased the measured diagnostic value of stroboscopy, since many dysphonic patients with easy diagnosis are treated in smaller hospitals or in the private sector.

The stroboscopic diagnosis is compared to indirect laryngoscopic diagnosis, as the standard laryngoscopic examination for the evaluation of the clinical value of stroboscopy\(^3\)\. Verification of the diagnosis is based on the operative or histologic diagnosis although standard histologic diagnosis is also qualitative. The distinction between small polyps and nodules with the optical microscope and the usual eosin-hematoxylin stain is not straightforward\(^6\) and it has been shown that the blind histologic diagnoses of benign lesions changed in 25 - 30% of the cases when the pathologists obtained additional information (history, operative diagnoses)\(^6\).

**Comparisons with other studies**

The diagnostic value of stroboscopy was evaluated in a general voice disordered population because this study intended to relate the findings to issues of health service provision to the general population. Professional voice users represented 12% of the participants, comparable to the percentage in a paper by Woo\(^4\) (10%) whereas Sataloff reported on a population consisting mainly by professional voice users\(^3\). The studies by Sataloff\(^3\) and Casiano\(^2\) were retrospective and involved selection of patients. Selection and exclusion criteria are not clearly stated. Sataloff\(^3\) reported on 60% of the patients examined and 40% of the voice visits during the study period\(^3\). Casiano et al report\(^3\) on all the patients who underwent videostroboscopies over a defined period for whom there was a previous otolaryngologic evaluation at the same institution. The study by Woo was prospective\(^4\).

In the present study one physician performed and evaluated all the stroboscopic examinations. This methodology was also followed in the study by Woo\(^3\). In the study by Casiano et al\(^2\) the laryngoscopic diagnosis was available from the previous ENT examination and stroboscopy was evaluated by the senior authors. In the study by Sataloff et al, it is not clarified who evaluated the laryngoscopic and the stroboscopic examinations\(^3\).

Videostrosbosity is a subjective examination and when attempting to draw quantitative conclusions one should take into account inter-rater reliability.

The stroboscopic examination was compared to laryngeal examinations with varying methodology in different studies. In the study by Woo\(^3\) it is not clarified how the laryngoscopy was performed. Sataloff et al\(^3\) report on the comparison between laryngeal mirror examination and fiberoptic/telescopic stroboscopic examination. Laryngeal telescopic examination with constant light provides better laryngeal images than mirror laryngoscopy. Casiano et al\(^3\) compared constant light laryngoscopy with stroboscopic light examination and report that 90% of the patients who had a change in the diagnosis or additional findings, had this change detected by telescopic evaluation alone\(^2\).

Regarding the diagnostic value of stroboscopy the findings of this study are in agreement with the findings of other studies taking into account the special characteristics of each study population\(^2,3,10\)\. In our study the diagnostic value of stroboscopy was found to be greater for certain pathological conditions: sulcus vocalis, vocal fold cysts, scars, muscle tension dysphonia, vocal fold atrophy with a small gap and nodules. Similar findings were reported by other researchers\(^4,6,10\).

Twenty six out of the 44 patients for whom the diagnostic value of stroboscopy was significant in our study, had an unremarkable laryngoscopy. This finding underlines the unique ability of the stroboscopic examination to shed light to minimal pathology of the vibrating vocal folds undetectable with constant light examination. Small vocal fold scars are diagnosed with stroboscopic examination which reveals disturbance of the mucosal wave propagation and diminished vocal fold vibration\(^3,10,13,21\). The diagnosis of muscle tension dysphonia is based on the presence of characteristic findings during phonation (vowels and connected speech) and the absence of structural pathology\(^13,23\). Stroboscopy has been proven very reliable to rule out the presence of small lesions\(^13,22\).

Videostrosbosity is the most reliable method for the detection of sulcus vocalis\(^4,12,13,27,28\). Slow motion and still image observation of the vibrating free edge of the vocal folds allows visualization of the characteristic morphology even of a smaller sulcus and observation of the diminished amplitude of mucosal wave\(^13,27,28\).

Stroboscopy can discriminate different types of small lesions (nodules, small polyps, cysts) and point to the correct treatment without delay\(^3,12,13\). This is the pathology for which stroboscopy was found to be most valuable in the study by Woo et al\(^3\). This is very valuable for professional voice users who need a prompt and accurate diagnosis and treatment of dysphonia\(^10,26\). For one third of our study population vocal fold pathology was accurately diagnosed laryngoscopically.

**Clinical applicability of the study**

Stroboscopy is valued for its excellent ability to examine the structure and the function of glottis during phonation. It provides information which is not available
with any other diagnostic method. It provides the potential to evaluate the larynx during different phonatory tasks which resemble the habitual speaking or singing, it can be repeated, recorded and has an acceptable cost. Patient referrals and regulation of access to specialized voice care in a cost effective manner can be based on better understanding of the diagnostic value of stroboscopy for patients with benign laryngeal pathologies.

Patients expected to benefit from stroboscopic examination are those with small lesions of the vocal fold edge, the exact type of which could not be determined by indirect laryngoscopy, dysphonic patients with unremarkable indirect laryngoscopy, and professional voice users.

Conflict of Interest
There is no conflict of interest.

References