Stroboscopy in Detection of Laryngeal Dysplasia Effectiveness and Limitations

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Summary: Vocal fold pathology changes the appearance and vibratory patterns observed during stroboscopic examination, but a strict correlation between the vibratory pattern and the dysplasia type does not exist. The aims of this study were to determine the role of stroboscopy in vocal fold dysplasia assessment and to determine whether stroboscopy is the deciding factor when performing laryngomicroscopy with biopsy in suspicious lesions. This prospective controlled study involved 112 patients with laryngeal dysplasia treated over a 2-year period at a tertiary medical center. Patient data and clinical, stroboscopy, laryngomicroscopy, and histopathologic reports were reviewed. During the stroboscopy, glottic occlusion, phase symmetry, periodicity, amplitude, mucosal wave, and nonvibratory segments were followed. Laryngomicroscopy with different types of endoscopic cordectomies (types I–III) was performed as a therapeutic measure, with a 12-month follow-up period. Nonvibrating segments were present in 15.1% of the patients with mild dysplasia and in 38.5% of the patients with moderate dysplasia. In 45.5% of the patients with severe dysplasia (carcinoma *in situ*), nonvibrating segments were absent. The amplitude of vocal fold vibrations in patients with mild dysplasia ($P = 0.03$) was a significant factor indicative of recurrent disease, but none of the stroboscopic signs was significant for the disease progression. Severe dysplasia can be related to both nonvibrating and vibrating vocal fold segments. Stroboscopy cannot be used reliably for classifying laryngeal dysplasia and may indicate the need to perform laryngomicroscopy with biopsy in suspicious vocal fold lesions. The warning factors for recurrence and progression of dysplasia are treatment modality, abnormal amplitude of vibration, and nonvibrating segment.

Key Words: Laryngeal dysplasia–Stroboscopy–Nonvibrating segment.

INTRODUCTION

Despite all the efforts made in discovering and classifying vocal fold lesions, uncertainty exists when determining which lesions are malignant or premalignant. These lesions are usually described as chronic laryngitis, parakeratosis, leukoplakia, erythroplakia, or dyskeratosis. A number of histologic results can be found under the same clinical appearance; therefore, the histologic nature of these lesions is completely unpredictable until a biopsy is performed. Malignant transformation rates range from 6% to 22%, and the rates increase with the severity of the precancerous lesion.[1–3] Therefore, the early detection of these lesions is of paramount importance.

Another difficulty in diagnosing these lesions is that there is no universally accepted histopathologic classification system. In the current literature and clinical practice, there are several widely accepted classification systems: the 2005 World Health Organization (WHO), Squamous Intraepithelial Neoplasia, Laryngeal Intraepithelial Neoplasia, and the Ljubljana Classification of Squamous Intraepithelial Lesions systems. This disparity makes it difficult to compare the diagnostic and follow-up studies. The WHO system uses three tiers of dysplasia: mild, moderate, and severe. Severe dysplasia includes what has been previously reported as noninvasive carcinoma (carcinoma *in situ* [CIS]) and severe dysplasia.[4] The progression and transformation to invasive carcinoma is one of the important outcome measures for intraepithelial lesions. Correlating molecular parameters with clinical outcome was recently suggested as a gold standard for classifying dysplasia. Some authors have stated that any histopathologic classification of this millennium should also depend on additional evidence, such as the genetic and molecular structural changes of the cells that contribute to the malignant transformation.[5]

Stroboscopy is considered to be an important part of diagnosing patients with laryngeal dysplasia. Nevertheless, we must note that a strict correlation between a vocal fold vibratory pattern and a certain type of lesion does not exist. Vocal fold pathology may produce changes in the appearance and vibratory patterns observed during stroboscopic examination. Interpreting the stroboscopic examination involves systematic judgment and describing the different vibratory pattern signs. These signs, which were first identified by Hirano and Bless,[6] included the fundamental frequency and periodicity, amplitude of horizontal excursion, glottal closure, symmetry of bilateral movement, mucosal wave, and nonvibrating portions of the vocal fold. Recently, Kelley et al have attempted to improve or refine the basic stroboscopic rating form and develop criteria to improve the reliability of selected stroboscopic signs.[7] Few studies have indicated which stroboscopic signs are more significant than others in evaluating the vibratory pattern of vocal folds with premalignant lesions. The aim of this study was to determine the importance of stroboscopy in diagnosing vocal fold dysplasia and ascertain if it can reliably estimate a level of dysplasia and be the deciding factor when performing laryngomicroscopy with biopsy. We also wanted to determine whether other factors, such as treatment modality and stroboscopic

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signs, could be used to anticipate if disease recurrence or progression will occur.

MATERIALS AND METHODS

This prospective study included 112 patients who were treated over a 2-year period (between January 1, 2010 and December 31, 2011, with a 12-month follow-up period) in the Clinic for Otorhinolaryngology and Maxillofacial Surgery at the Clinical Centre of Serbia in Belgrade. This study was approved by the Institutional Ethical Committee, and all patients provided written informed consent before their inclusion in the study.

The following inclusion criteria were applied: the presence of a vocal fold lesion of any grade of dysplasia according to the WHO classification (mild, moderate, and severe dysplasia), a vocal fold lesion on the superior surface and free edge of the membranous part of the vocal fold, lesions ranging in size from 2 to 10 mm and up to 2 mm in thickness, normal motility of the vocal folds and arytenoid, no previous or simultaneous vocal fold lesions (inflammatory, dysplastic, carcinoma, or otherwise), and no previous laryngeal surgery, radiotherapy, or endotracheal intubation. All patient data, including clinical, stroboscopy, and laryngomicroscopy examinations and histopathologic reports were evaluated.

Stroboscopy was performed with the ATMOS Strobo 21 LED, ATMOS Cam 31 DV Data, and Laryngoscope 70° resp. 90° (ATMOS MedizinTechnik GmbH & Co., Lenzkirch, Germany) during modal pitch at comfortable intensity on sustained vowel /i/. The following parameters were rated:

1. glottic occlusion (1, sufficient or 2, insufficient),
2. phase symmetry (1, symmetrical or 2, asymmetrical opening and closing of the other vocal fold mirrors),
3. periodicity (1, regular or 2, irregular successive vibrations),
4. amplitude (1, normal; 2, decreased; or 3, increased),
5. mucosal wave (1, normal with 30–50% lateral travel; 2, increased with lateral travel greater than 50%; or 3, decreased with lateral travel less than 30%),
6. nonvibratory segment (1, presence or 2, absence of nonvibratory segment in the vocal fold or a portion thereof).

Laryngomicroscopy and different types of endoscopic cordectomy with cold instruments (types I–III according to recommended European Laryngological Society (ELS) classification for endoscopic cordectomies)[8] were performed using a Carl Zeiss Surgical OPMI Sensera optical microscope (Carl Zeiss Meditec Inc, Dublin, CA) under general endotracheal anesthesia.

The follow-up period for every patient was 12 months. During this period, a control examination with stroboscopy was performed monthly, and all patients with established recurrent vocal fold lesions on their control examinations underwent a laryngomicroscopy with complete lesion removal and histopathologic analysis. Any histologic progression of the lesions was noted.

PASW Statistics 18 program (IBM Corporation, New York, NY) was used for the data analysis. To determine the statistical significance of change in dynamics between the stroboscopic signs before the treatment and after the follow-up period, the McNemar and the Wilcoxon signed-rank tests were used. To determine a correlation between the chosen predicting factors and dysplasia, a multivariate regression analysis was performed. To assess which of the stroboscopic signs was most useful in predicting the histopathologic outcome and the degree of dysplasia, logistical regression was used. P values <0.05 were considered statistically significant.

RESULTS

The study included 98 males (87.5%) and 14 females (12.5%), with an average age of 55.65 years. There were 105 (93.7%) smokers, 95 (90.5%) of whom were males and 10 (9.5%) were females. Considering histopathologic results according to the WHO classification, 53 (47.3%) patients were classified as mild, 26 (23.2%) as moderate, and 33 (29.5%) as severe dysplasia.

Stroboscopic signs for patients with mild dysplasia before any treatment and after 12 months of follow-up because of recurrent disease are shown in Table 1. Considering phase symmetry, periodicity, amplitude of the vocal fold vibrations, and mucosal wave appearance, there were significant changes in the number of patients before the treatment and after the follow-up (McNemar or Wilcoxon signed-rank test, $P < 0.00$). Nonvibrating segments were present in eight (15.1%) patients before the treatment and in nine (17.0%) patients after the treatment ($P = 1.000$, McNemar test).

Considering the number of patients in the group with moderate dysplasia (Table 2), the changes in glottic occlusion and the presence of nonvibrating segment were not statistically significant, but the changes in the number of patients considering phase symmetry, periodicity, amplitude of vocal fold vibrations, and the mucosal wave appearance were statistically significant (McNemar or Wilcoxon signed-rank test, $P < 0.00$). In the group with moderate dysplasia, nonvibrating segments were present in 38.5% of the patients before the treatment and in 23.1% of the patients after the 12-month follow-up.

The results were similar in a group with severe dysplasia (Table 3). There were significant changes in the number of patients considering periodicity, amplitude of vocal fold vibrations, mucosal wave appearance, and the existence of nonvibrating segments (McNemar or Wilcoxon signed-rank test, $P < 0.00$). In this group, McNemar test could not be performed for the phase symmetry because all patients had asymmetric vibrations of the vocal fold vibrations before the treatment. Nonvibrating segments were present in 54.5% patients before the treatment and in 24.2% of patients after the 12-month follow-up. Most stroboscopic parameters were statistically significantly improved in all three patient groups.

Considering the treatment options, our patients underwent cordectomy types I–III, according to ELS classification for endoscopic cordectomies, the microscopic appearance of the change, and the assessment of the vertical expansion of the lesion (Table 4). Type I cordectomy was performed in 64.1% of the patients with mild dysplasia, 25.4% of the patients with