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ORIGINAL ARTICLE

Phonatory compensation in patients with larynx cancer after CO_2 laser cordectomy

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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ABSTRACT:

Introduction: CO_2 laser endoscopic cordectomy is the method of laryngeal cancer treatment. The type of cordectomy (I–VI) depends on the extent of the tumor. Endoscopic laser surgery provides more satisfactory phonation conditions in comparison to open surgical procedures.

The aim: The aim of the study was to classify phonatory compensation mechanisms after CO2 laser cordectomy using the HSDI.

Material and methods: The study included 30 men treated and diagnosed at the Department of Otolaryngology and Department of Clinical Phonoaudiology and Logopedics, Medical University of Bialystok. The control included 30 men with no pathological changes in the larynx. Type III, IV and Va CO_2 laser cordectomy have been for glottis cancer treatment. Postoperative evaluation has been conducted 6 months after the surgery. HSDI has been used in larynx visualization.

Results: Type I compensation occurs most frequently in patients after type III cordectomy. Advanced glottis cancer, as an indication for type IV and V cordectomy, leads to epiglottic hyperfunction and phonation involving vestibular folds – type II and III compensation. Type IV compensation is most frequent in type IV cordectomy.

Conclusions: The type compensation is connected with the extent of glottis resection. In cordectomy including anterior commissure and the part of opposite fold (type Va), supraglottic hyperfunction with the participation of vestibular folds (type II and III compensation) has been recorded. Transmuscular cordectomy (type III) most often resulted in type I compensation. Type III-Va cordectomy caused reduction or absence of MW, decrease in amplitude and aperiodicity of vibrations in HSDI.

KEYWORDS: cordectomy, glottis cancer, high speed digital imaging, laryngeal compensation

ABBREVIATIONS

ELS – European Laryngological Society
HS – High-Speed
HSDI – High Speed Digital Imaging
MW – Mucosal Wave

INTRODUCTION

Larynx cancer is the most common cancer of the head and neck [1, 2]. It occurs mainly in men in the 4–5 decade of life, smoking and abusing alcohol. The etiology of laryngeal cancer is also influenced by work in harmful conditions and co-morbidities, e.g. gastro-intestinal reflux disease, HPV infection, laryngeal papillomas [1, 2, 3, 4, 5]. Postoperative voice quality is crucial for the choice of therapeutic method. Surgical procedures, larynx microsurgery (conventional or CO_2 laser) [5, 8, 9, 10] and radiation therapy are applied in the treatment of early glottis cancer. Treatment rates for patients with early glottis tumors using a CO_2 laser are similar to radiotherapy [8, 11, 12, 13, 14], and the choice of laryngeal cancer treatment method depends on histopathological diagnosis, diversity, location and the extent of cancerous infiltration [15, 16, 17, 18, 19, 20]. CO_2 laser endoscopic cordectomy is the method recommended for the treatment of early laryngeal cancer (T1a, T1b, T2N0M0). The classification of endoscopic laser cordectomy according to ELS modified in 2007 distinguishes 9 types of cordectomy [11, 7, 21, 22]. Type III consists of transmuscular cordectomy involving the vocal fold with part of the vocal muscle (T1a), type IV involves the complete removal of the vocal fold with muscle and the cartilaginous internal of thyroid cartilage (T1a with infiltration of the vocal muscle), type Va includes also the anterior commissure and the fragment of the opposite vocal fold (T1a and T1b). Glottal closure after CO_2 laser cordectomy may occur between scar and healthy vocal fold, vestibular fold on the operated side and healthy vocal fold, both vestibular folds or aryepiglottic folds (sphincter mechanism) [4, 23, 24].

AIM OF THE STUDY

The aim of the study was to classify laryngeal compensation mechanisms after CO2 laser cordectomy in patients with advanced glottis cancer using the HSDI visualization technique.

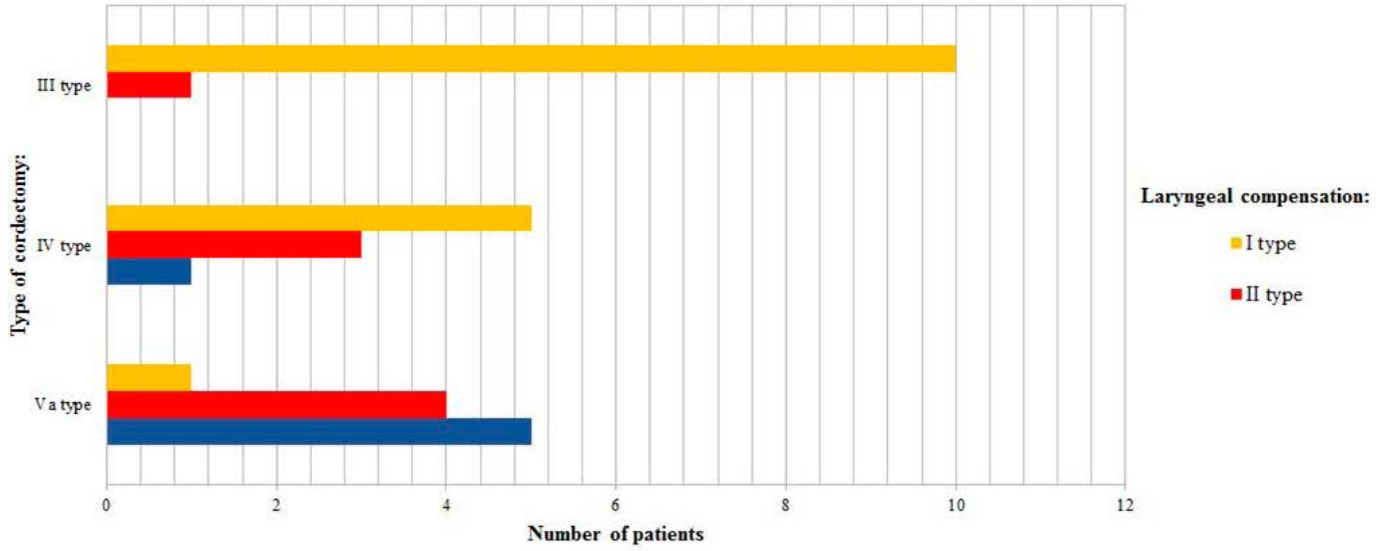

Fig. 1. Distribution of patients and types of CO2 laser cordectomy.

MATERIAL AND METHODS

The study group – Group I – consisted of 30 men aged 61 to 72 years. The average age was 67 years. Patients underwent surgical treatment at the Department of Otolaryngology in 2010–2018 and were diagnosed at the Department of Clinical Phonoaudiology and Logopedics, Medical University of Bialystok. Type III, IV and Va laser cordectomy has been performed in the study group regarding clinical stage of glottis tumor. Control group – Group II – consisted of 30 men aged 38 to 76 years. The average age was 64 years. The men were non-smokers, revealed no pathological changes in the larynx, no gastrointestinal and pulmonary diseases and did not use voice professionally.

Larynx imaging has been conducted using a HS camera with 90° rigid optics and HSDI by R. Wolf in the HRES ENDOCAM 5562 system.

Regularity, type of compensatory glottal closure as well as symmetry, vibration synchronization and MW morphology have been analyzed. The assessment has been conducted 6 months after the surgery. Patients have not been treated with radiation therapy.

RESULTS

In Group I of patients, 3 types of laryngeal compensation have been recorded:

- type I – closure of healthy vocal fold with postoperative scar,
- type II – closure of healthy vocal fold with vestibular fold of the operated side,
- type III – both vestibular folds closure.

In patients after type III laser cordectomy, the most common laryngeal compensation was the closure of the healthy vocal fold with the postoperative scar – type I compensation (33%, n = 10), in 1 patient the closure between healthy vocal fold and the vestibular fold on the operated side has been recorded (3%, n = 1) – type II compensation. In this group of patients, no phonation with vestibular folds (type III compensation) has been found. In patients after type IV cordectomy, type I compensation (17%, n = 5) has been recorded most frequently, type II has been observed in 3 patients (14%, n = 3). The compensation involving vestibular folds has been found in 1 patient (3%, n = 1). In CO_2 laser cordectomy type Va, the most common compensation mechanism was vestibular phonation – type III (17%, n = 5). Type II compensation has been observed in 4 patients (14%, n = 4), and type I compensation in 1 patient (3%, n = 1).

In the examined group (Group I) in all patients (100%, n = 30) a decrease in amplitude, irregularity and aperiodicity of vocal fold vibrations, reduction or absence of MW and pathological glottal closure were recorded with HSDI technique. In Group II – control group, regular (symmetrical) vibrations have been observed in all patients (100%, n = 30) with the presence of physiological MW and normal amplitude, as well as complete glottal closure.

DISCUSSION

In 2008, Motta et al. [25] indicated the existence of difficulties in assessing the correlation between the quality of postoperative voice and the type of applied surgical treatment. He highlighted that proper voice quality in patients with glottis cancer depended on the lesser extent of the surgery. According to Sjogren et al. [26] and Soliman et al. [27], after type I and II cordectomy, the lack of glottal closure, reduction of MW and features of vestibular compensation are recorded. In the study group (Group I), the type of laryngeal compensation, classified as type III, has been registered in 5 patients (17%) after type Va laser cordectomy and in 1 patient (3%) after type IV cordectomy.

According to Ledda et al. [28], satisfactory phonation results depend on the laryngeal compensation mechanism. The authors found almost complete glottal closure, similar to physiological

in patients after type I cordectomy. In their opinion, excision of the anterior commissure or a large part of the vocal muscle causes scarification and stiffening of the vocal fold with limited or no MW, which causes incomplete glottal closure and significant impairment of voice quality [28]. Similar results have been obtained in the group of patients who underwent cordectomy of type III, IV and Va.

In the study group, MW reduction or absence, decrease in amplitude, irregularity and aperiodicity of vocal folds have been recorded, which is consistent with the results of Haddad et al. [8]. These authors also observed the occurrence of vibration aperiodicity and amplitude variation, which affected the results of the acoustic evaluation of voice. Zeitels et al. [29] believes that the extent of resection deteriorates the quality of voice due to the absence of complete glottal closure and escape of air lost for phonation and loss of vocal fold strength.

According to Sjogren et al. [30] no significant differences in the assessment of voice quality parameters in patients treated with surgery and radiotherapy are observed. Stoeckli et al. [30] recorded similar results in their research.

Soliman et al. [27] and Haddad et al. [8] believe that the quality of voice after treatment of glottis tumors will never be the same as before the disease because of disturbed vibration of the vocal fold resulting from the resection of part of the tissues. McGuirt et al. [31] and Michel et al. [32] noticed that the roughness of voice increases in proportion to the amount of tissue removed and depends on the compensatory mechanisms produced. Less significant mass of the vocal fold causes an increase in the patient's fundamental frequency. According to McGuirt et al. [31], compensatory mechanisms affect the motility and strength of voice organ structures, which is confirmed by visualization techniques [33, 34].

In order to improve the postoperative voice quality in patients with advanced glottis cancer, speech therapy should be applied, and in the case of severe dysphonia, caused by the lack of development of compensatory mechanisms, phonosurgical procedures. Ledda et al. [25] recommends the use of hyaluronic acid to improve glottal closure after extensive procedures within the glottis.

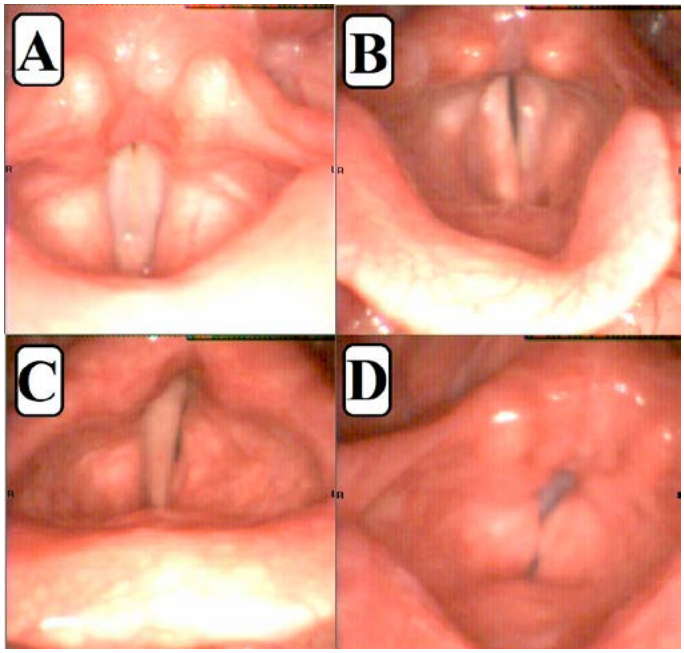

Fig. 2. High Speed Digital Imaging (HSDI): A – physiological larynx image, B – type I of laryngeal compensation (type III cordectomy), C – type II of laryngeal compensation (type IV cordectomy), D – type III of laryngeal compensation (type Va cordectomy).

CONCLUSIONS

1. The type of laryngeal compensation depends on the extent of glottis resection resulting from the type of cordectomy performed;

2. In cordectomy extended by anterior commissure and the fragment of the opposite fold (type Va), supraglottic hyperfunction with the participation of vestibular folds (type II and III of phonation compensation) is recorded;

3. Transmuscular cordectomy involving part of the vocal muscle (type III) most often causes type I of laryngeal compensation;

4. In type III–Va cordectomy in advanced glottis cancer, a reduction or absence of MW, decrease in amplitude and aperiodicity of vibrations in HSDI is observed.

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