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The voice of patients with laryngeal carcinoma after oncosurgery

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Abbreviations: Fo - Fundamental frequency, Hz - Hertz

ABSTRACT

The voice of patients indicated for surgical procedures in treating of dysphonia is already damaged before the operation. The problem, which exists at the level of glottis patients usually try to solve by compensative mechanisms. The quality of voice after the interventions in larynx depends on the type and width of resection, disturbance of physiological phonation mechanisms, and ability to establish optimal phonation automatism. The damage of laryngeal structure, especially its glottic part and vocal cords as its central part, no matter if they are just fibrous or they are partially or totally absent, leads into the development of substitutive phonation mechanisms. The most frequent substitutive mechanisms are: vestibular, ventricular, and chordoventricular phonation. There are some variations of these phonation mechanisms, which are conditioned not only by applied surgical technique, but as they are also individual characteristics, they can be the consequence of applied rehabilitation methods. The diagnosis of voice condition before and after the oncosurgical procedure is done by: laryngostroboscopy, subjective acoustic analysis of voice, and objective acoustic analysis of voice (sonography or computer analysis of acoustic signal). The most of laryngeal carcinomas appear in glottic region, so the function of phonation imposes itself as the objective parameter to measure the quality of life after the oncosurgery of larynx. That is the reason why according to the priority, it is just behind the principle of "oncologic radicalism". Phonation as the most complex laryngeal function seems to have secondary importance. All known operative techniques, especially partial resections, have the preservation of phonation as their goal.

KEY WORDS: *Laryngeal Neoplasms; Voice; Laryngectomy; Phonation*

INTRODUCTION

The malignant laryngeal tumors were rarely diagnosed in 19th century. Just after the cigarettes mass-production started in the beginning of 20th century, they became more frequently diagnosed (1). Phonomicrosurgical resection of small glottic carcinoma is very successful in 90% to 95% of patients, but in case of advanced tumor of the vocal cords, it cannot replace other surgical procedures.

Therapeutic indications are pointed at removing of the malignant tumor at first, but also at the preservation of other functions larynx has, as well as to try to solve the problem of voice disorder, which appears after the tissue resection or total removal of larynx (2).

The voice of patients indicated for surgical procedures in treating of dysphonia is already damaged before the operation. The problem, which exists at the level of glottis patients usually try to solve by compensative mechanisms. The quality of voice after the interventions in larynx depends on the type and width of resection, disturbance of physiological phonation mechanisms, and ability to establish optimal phonation automatism (3).

In the conditions after the surgical procedures at vocal cords, maybe as nowhere in human body, that the unity of organic and functional is reflected. If we should give advantage to one of these two we could enter the magic circle, out of which, according to Vukaöinovic (4), there is just one exit that is both organic and functional, especially when therapy is considered.

The damage of laryngeal structure, especially its glottic part and vocal cords as its central part, no matter if they are just fibrous or they are partially or totally absent, leads into the development of substitutive phonation mechanisms (5). Depending on performed surgical method and condition in larynx after the operation, there is a different adaptation of some structures at creation of voice.

After the partial vertical laryngectomies Mandell et al. (6) found by videostroboscopic examination that in the vibrating part of resected larynx contralateral false vocal cord comes first, second is the contralateral arytenoid mucosa, and third is contralateral true vocal cord. In the group of patients with arytenoidectomy, the most frequent location of vibration is contralateral arytenoid mucosa, and in the group of patients without arytenoidectomy, mostly vibrated is the contralateral false vocal cord. The best quality of voice is achieved with the participation of true vocal cord, then with the vibration of false vocal cord, and at the end by vibration of arytenoid mucosa.

The common characteristic of almost all findings after the phonosurgical interventions are the signs of hyperkinesis at the level of larynx, so the task of vocal rehabilitation is to establish the phonation automatisms as close to normal as possible. The most frequent substitutive phonation mechanisms are vestibular, ventricular, and cordoventricular. There are some variations of these phonation mechanisms, which are conditioned not only by applied surgical technique, but also by individual characteristic, and can be the consequence of applied rehabilitation methods as well. The change of fundamental frequency is also characteristic, especially after oncosurgical procedures, in men to higher and in women to lower level (7,8). As reported by Jovic (9), reconstructive laryngeal surgery demands three anatomic units necessary for normal functions of laryngeal rests (10): (1) cricoid ring for undisturbed respiration; (2) the possibility of constriction of the mobile part necessary for phonation; and (3) the valve system which has sensitive and motor innervation necessary

for deglutition. Crevier-Buchman et al. (11) emphasize that in patients after supracricoid partial laryngectomy with cricohyoidoepiglottopexy, in creation of neoglottis, cricoarytenoid and suprahyoid part of epiglottis participate by their approximation.

Laccourreye et al. (12) in patients with surgically formed tracheolaryngopharyngeal shunt after Pearson (13) analyzed the voice with subjective and objective parameters. They found statistically significant increase of Fo (preoperative, medium value 110,7 Hz; postoperative, medium value 162.7 Hz), as well as the noise components of voice. Although there existed the significantly lesser number of words spoken in one minute (preoperative 155 Hz; postoperative 97 Hz), they consider that such voice and speech are sufficient for the social contact. The diagnosis of voice condition before and after oncosurgery is performed by: laryngostroboscopy (14,15), subjective acoustic analysis of voice (16-20) and objective acoustic analysis of voice (sonography or computer analysis of acoustic signal) (21-23).

THE MOST OFTEN SUBSTITUTIVE PHONATION MECHANISMS

Cordoventricular voice

It is also called glotto-ventricular voice. It arises by approximation of healthy vocal cord and contralateral ventricular fold, above the diseased-surgically treated vocal cord, as the consequence of striving for compensation of disturbed organic structure or function. We see it mostly after cordectomy or in cases of vocal cord sulcus, but it can appear in other conditions. There is a fast voice fatigue (Figure 1).

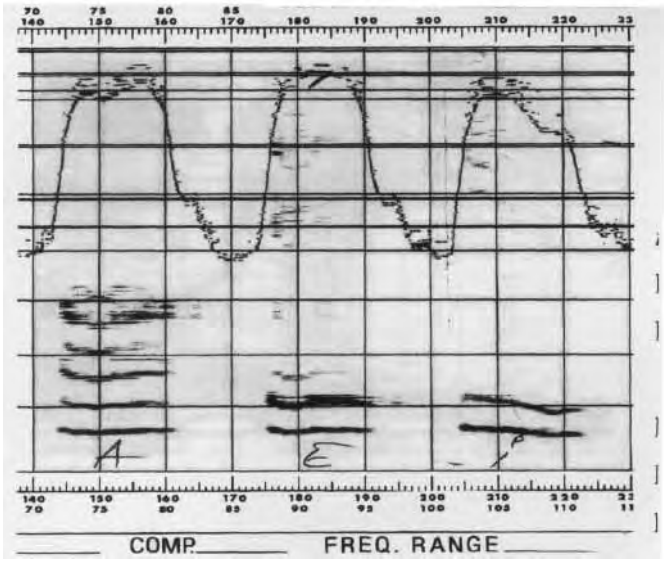

Figure 1. The sonography finding in cordoventricular voice: vowels a, e, and i

Ventricular voice

By the approximation of two ventricular folds, we get the ventricular voice. Glottic approximation deficit caused by disturbance of function (vocal cord movements) or its deficiency or significantly changed structure (massive loss), leads into creation of ventricular voice. The development of ventricular voice exists after oncosurgery (horizontal glottectomy), in recurrent nerve paralysis or fixation of cricoarytenoid joint as in hypertrophy of ventricular folds (congenital or inflammatory).

The existence of ventricular voice is explained by the connection of ventricular folds and stylopharyngeal muscles. As ventricular folds are not supposed to be used for phonation, the voice produced in this way is not of good quality and there is fast fatigue and hyperkinetic stereotype of vibration (Figure 2).

Vestibular voice

Forced movements of aryepiglottic folds, which imitate sphincter function, lead into the development of vestibular voice. Besides, it can arise as the consequence of oncosurgical procedure, in which the most part of larynx is resected and it appears after the loss of function of both vocal cords, because of both laryngeal recurrent nerve paralysis. The voice is

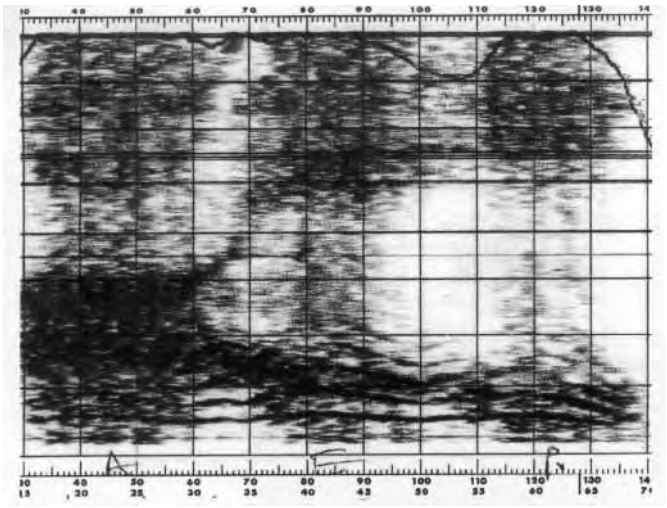

Figure 2. The sonography finding in ventricular voice: vowels a, e, and i

compensated by involvement of the structures mentioned above. In rare cases, the vocal cords are intact, and the patient uses vestibular voice, like after the lung injury or prolonged intubations. The voice is created with great effort along with fast fatigue and hyperkinetic stereotype of vibration. (Figure 3: The sonography finding).

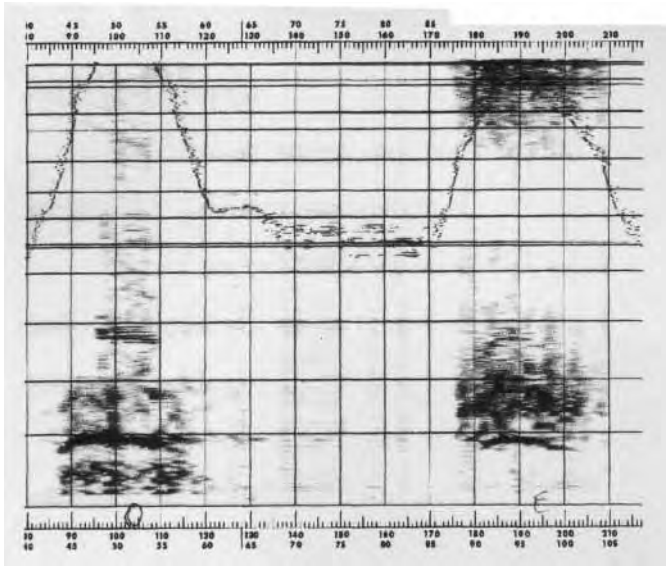

Figure 3. The sonography finding in vestibular voice: vowels o and e

PHONIATRIC DIAGNOSTICS

The findings of laryngo(strobo)scopy

In cordoventricular compensation, laryngoscopy usually shows an incomplete approximation between the vocal cord and contralateral ventricular fold, while videostroboscopy shows vocal cord vibrations: asymmetrical, asynchronous, and irregular. Ventricular folds rarely vibrate, and there is a hyperkinetic stereotype of phonation.

In patients with ventricular voice, laryngoscopic finding shows incomplete approximation of ventricular folds, while vocal cords, if present, are hidden underneath them. Videostroboscopy shows asymmetrical, asynchronous, and irregular vibrations with decreased amplitudes. In cases of vestibular compensation, laryngoscopically there is incomplete contact between epiglottic base and aryepiglottic folds and interarytenoid mucosa. Videostroboscope shows that interarytenoid mucosa vibrates.

The findings of subjective acoustic analysis of voice

Subjective acoustic analysis of voice in patients with cordoventricular voice shows a significant degree of hoarseness and breathiness, while sonography shows significant presence of noise, with changed harmonic structure. In patients with ventricular compensation

subjective acoustic analysis of voice shows heavy hoarseness and breathiness with significant decrease of voice pitch. When there is a vestibular voice, subjective acoustic analysis of voice, determines significant hoarseness and breathiness.

The findings of objective acoustic analysis of voice (sonography)

Sonographic findings in cordoventricular compensation (Figure 1) are characterized by shortening of harmonics (incomplete harmonics) and decreased number of harmonics as well as great distance between harmonics along with the presence of noise (24).Sonographic findings in ventricular voice (Figure 2) are characterized by poor harmonic structure and presence of a lot of noise, which completely covers harmonic components (24). Sonographic findings in vestibular compensation (Figure 3) are made of rare harmonics and lots of noise (24).

CONCLUSION

The success of laryngeal oncosurgery is primarily estimated by the removal of pathologic process. The most of laryngeal carcinomas appear in glottic region, so the function of phonation imposes itself as the objective parameter to measure the quality of life after oncosurgery of larynx. That is the reason why according to the priority, it is just behind the principle of "oncologic radicalism". Phonation as the most complex laryngeal function seems to have secondary importance. All known operative techniques, especially partial resections, have the preservation of phonation as their goal.

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