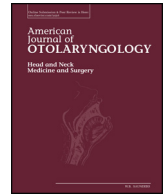




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Widening of posterior glottis through rotation of the arytenoid on its axis: Report of nine cases

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ABSTRACT

Introduction: Bilateral vocal folds' immobility is a challenge in laryngology. Multiple procedures have been proposed to improve breathing by statically enlarging the glottal airway, what also results in loss of voice and aspiration. We proposed a technique to enlarge the posterior glottis by rotating the arytenoids on its axis, imitating the function of the posterior cricoarytenoid muscle, with the objective of evaluating the results regarding decannulation, voice quality, and bronchoaspiration.

Methods: This study is a clinical case series of patients with bilateral vocal fold paralysis who underwent an arytenoid rotation surgery at a single tertiary university care institution between 2011 and 2017. Data were prospectively collected and was complemented with information from medical charts. Patients were assessed for decannulation, dyspnea, posterior glottic opening, quality of voice, and swallowing disorders.

Results: Nine patients were included in the study. Out of three patients who required tracheostomy, two were successfully decannulated. Six patients reported a significant improvement in their dyspnea, while four patients reported a worsening of their voice. The stroboscopy evidenced a posterior glottic opening of at least 7 mm in six patients. Eight patients had no aspiratory symptoms, and the acoustic analysis showed that only one patient has a normal voice.

Conclusion: The arytenoid rotation on its axis by imitating the posterior cricoarytenoid muscle preserves the physiological functions of the larynx, which allows sufficient opening of the posterior glottis for breathing, and could alter in a lesser extent the anterior glottis to maintain a good quality of voice and swallowing.

1. Introduction

Vocal folds' immobility is the term used to describe the restricted movement of vocal folds secondary to mechanical fixation or neurological involvement. The mobility of the vocal folds may be decreased or absent, and it may be unilateral or bilateral [1]. Bilateral vocal folds' immobility is one of the most challenging clinical problems encountered in the practice of laryngology, and its main symptoms are airway obstruction, voice change, aspiration, and swallowing disturbances [2, 3].

The first surgical procedures carried out to relieve airway obstruction in these patients were external approaches such as cordectomy, arytenoidectomy, and arytenopexy. Endoscopic approaches were also described, which became technically easier with the advent of laser

surgery [2, 4, 5]. Additionally, Woodson et al. [4–6] described the arytenoid lateralization through fixation of it.

Nevertheless, all of these procedures improve breathing by statically enlarging the glottal airway which also results in loss of voice, aspiration and recurrent pneumonia, due to a deficient closure of the glottis during phonation and swallow [2]. Therefore, a better functional result could be achieved if the dynamic function of the glottis is preserved with the opening for breathing, imitating the role of the posterior cricoarytenoid muscle (PCA) with the arytenoid rotation on its axis.

Two basic concepts underlie the arytenoid rotation in its ability to restore the dynamic function of the glottis. On the one hand, paralyzed vocal folds are rarely entirely denervated, as a substantial residual muscle function is preserved, especially in adductor muscles [6]. On the other hand, the cricoarytenoid joint is multiaxial which results in

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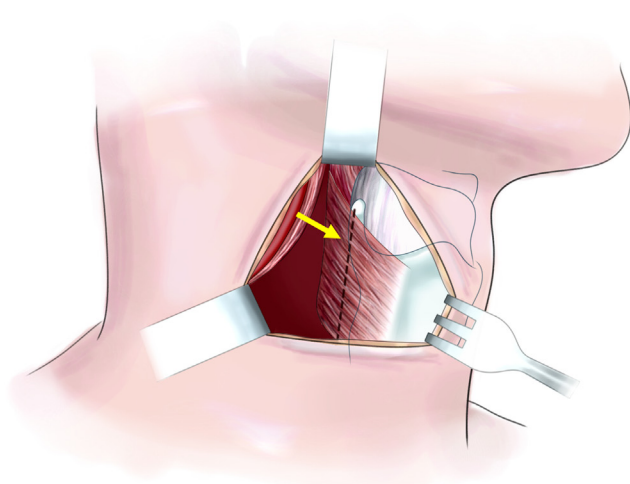


Fig. 1. Transection of the lower constrictor muscle of the pharynx (yellow arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

adduction and abduction occurring in different axes. Therefore, providing traction simulating the contraction of the PCA muscle, the closure of the glottis is not excluded during phonation and swallow [4, 6].

Given the previous physiological foundations, we evaluated the functional results, regarding decannulation, voice quality, and bronchoaspiration, using a surgical technique to enlarge the posterior glottis by rotating the arytenoids on its axis, imitating the function of the posterior cricoarytenoid muscle in nine patients with the diagnosis of bilateral vocal cord paralysis. The primary outcomes were defined as the requirement of tracheostomy and the posterior glottis opening, while the secondary end-points were defined as definite decannulation rate, final dyspnea status and final voice quality evaluated by acoustic analysis and the voice handicap index.

2. Methods

2.1. Setting and data source

The present study is a clinical case series of patients with bilateral vocal fold paralysis (BVFP) who underwent an arytenoid rotation surgery, performed from January 2011 to March 2017 at la Fundacion Valle del Lili (FVL), University Hospital. FVL is a tertiary university hospital affiliated with the ICESI University School of Medicine. It is a 511-bed hospital that functions as a referral facility for the entire southwest region of Colombia. The FVL Institutional Review Board approved the study protocol (protocol number: 874).

Data were prospectively collected and was complemented with information from FVL medical charts.

2.2. Patients and follow-up

We included all adult patients who underwent an arytenoid rotation surgery. Patients were excluded if they had rapidly progressive neurological disorders, diabetes mellitus, posterior glottic stenosis, chronic obstructive pulmonary disease, or chronic laryngitis.

Informed consent was obtained from all the patients included in the study. We recorded relevant demographic and clinical information.

Patients with a diagnosis of BVFP were scheduled for the procedure. Two airway surgeons performed the arytenoid rotation surgery. We registered intraoperative information, the etiology of the bilateral vocal cord paralysis and data about the initial evaluation (voice handicap index-VHI [7] and British medical research council scale for dyspnea-MRC [8]). We also recorded data about previous treatments, surgical procedure details, postoperative and post-discharge outcomes.

During follow-up, patients were assessed for dyspnea (MRC), posterior glottic opening, vocal folds' positions, and the fundamental frequency with a stroboscopy. Also, the quality of voice was tested with acoustic analysis and the VHI. Finally, they were evaluated by a phonaudiologist for voice and swallowing disorders.

Acoustic analysis was performed by recording twice a prolonged vowel / a / with a dynamic microphone connected to an M-Audio soundboard, with a sampling frequency of 44,100 Hz on 16 bits. Anagraf software was used.

2.3. Surgical procedures

Initially, a laryngeal endoscopy is done, a transverse cervical incision is performed in the fold of the inferior border of the cricoid, and soft tissues are elevated. Then, dissection of strap muscles, thyroid cartilage, and cricoid cartilages are performed, identifying the cricoid lamina. The lower constrictor muscle of the pharynx is transected (Fig. 1) to raise the thyroid ala, which exposes the hypopharynx (Fig. 2). Subsequently, the arytenoid cartilage and the posterior cricoarytenoid muscle are exposed by retracting the hypopharynx. A permanent suture in X is placed through the muscular process of the arytenoid head to the lamina of the cricoid (Fig. 3). Endoscopic evaluation evidences the opening of the posterior glottis (Fig. 4). Finally, hemostasis is performed, vacuum drainage is placed, musculocutaneous plane and skin are closed.

3. Results

A total of nine patients were included in the study, of which three were male. Age ranged from 42 to 81 years, and half of the patients were older than 59 years old.

Seven patients had a history of total thyroidectomy with bilateral lesion of the recurrent laryngeal nerves, and two patients had a history of prolonged orotracheal intubation with subsequent laryngotracheal stenosis that required surgical management for laryngotracheal reconstruction, with bilateral vocal fold paralysis as a consequence. Table 1 presents the study group.

During the initial assessment, none of the patients had received treatment for BVFP. Two patients were admitted with a previous tracheostomy, eight presented some degree of dyspnea according to the BMC scale, and seven reported some degree of dysphonia according to the VHI scale. Table 2 presents an overview of dyspnea and voice scales, before and after the arytenoid rotation.

All patients were surgically treated with arytenoid rotation. During

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