



A Combined Endolaryngeal Approach for Bilateral Vocal Fold Immobility: Microlaryngoscopic Submucosal Cordotomy and Endo-Extralaryngeal Triple-Suture Lateralization

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Abstract

Bilateral vocal fold immobility (BVFI) is a challenging clinical entity for laryngologists. The voice may be nearly normal but mostly there is a severe inspiratory deficiency. The patients may need surgical interventions primarily for life threatening dyspnea. While treating the dyspnea, dysphonia appears to be a problem to a certain extent. Providing a serviceable voice and prevention from further surgery for relapsing dyspnea, a balance is needed. Various techniques have been introduced for surgical management of BVFI. A modified approach in order to balance between dyspnea and dysphonia was performed on a BVFI patient and is presented in this report.

Keywords: Bilateral vocal fold immobility; Posterior Cordotomy; Laterofixation; Inspiratory stridor

Introduction

Because of the complex innervation and re-innervation of the larynx [1] a typical paralytic condition seen in extremities may not reveal in laryngeal functions after nerve injury. Bilateral laryngeal nerve injury may be a life threatening clinical entity which can be managed under emergency conditions. It is important to make a distinction between cricoarytenoid joint fixation and loss of innervation in order to proceed for treatment bilateral vocal fold immobility (BVFI). Laryngeal electromyography and palpation of the arytenoid may help for this distinction. Surgical trauma (i.e. thyroidectomy) is the most common cause of BVFI [2].

Depending on its functional situation, BVFI mostly needs surgical intervention(s) basically starting with tracheotomy. Voice and breathing are in an inverse relationship in the management of BVFI. From the aerodynamic-biomechanical standpoint, hoarseness seems to be inevitable to some extent in procedures which change the endolaryngeal geometry surgically in BVFI patients. Several methods have been introduced; unilateral total ventriculocordectomy [3], arytenoidectomy [4,5], posterior cordectomy [6] and laterofixation [7,8].

Surgical management of BVFI should be planned to make a critical balance between dyspnea and dysphonia. Mostly, the surgical interventions create irreversible structural and functional alterations to some extent. In case of undesirable results such as overcorrection of airway and resulting aphonia, it may not be possible to provide a serviceable voice again. In such a situation, tracheotomy with a fenestrated tracheotomy cannula may even be more favorable. Treatment plan then may be started from minimally invasive procedures.

Case Presentation

A fifty three years old female was referred to our clinical vocology unit with inspiratory stridor. She has been operated for nodular thyroid disease 6 years ago. After total thyroidectomy, her prominent problem has been severe stridor especially at night during sleep. Her breathing deficiency got worse in the last year and she was not able to manage her daily life which was Grade 4 on MRC Scale (Medical Research Council's Breathlessness Scale) [9].

The patient was hospitalized and a combined operation was performed under general anesthesia. After direct microlaryngoscopy, a mucosal incision was made medially and parallel to the superior arquate line. Submucosal dissection of Reinke's space was extended to the subglottic border of the

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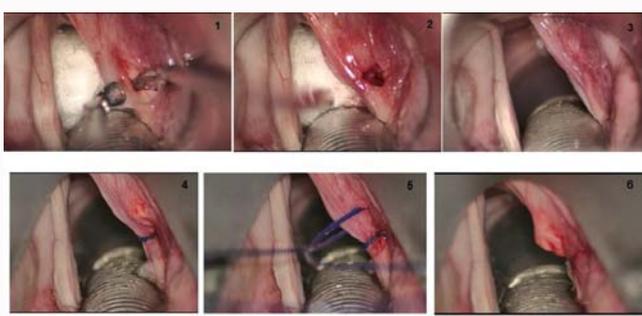


Figure 1: The operation procedure. Upper line from left: 1: Superolateral incision of vocal folds mucosa and dissection of mucosa to the inferior border of vocal ligament. 2: Truncation of vocal ligament and TA muscle until the muscle is drawn away anteriorly. 3: Suturing the mucosa with 8/0 vicryl. 4-6: Suture laterofixation by Lichtenberger's needle carrier. The first suture was placed 2 mm anteriorly to the vocal process. Others were placed posteriorly to the first suture.

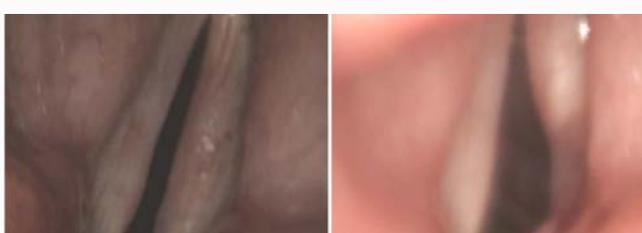


Figure 2: The preoperative and postoperative (1st year) endoscopic views of the BVFI patient.

vocal ligament. The vocal ligament and the thyroarytenoid muscle were truncated from its origin from the arytenoid cartilage. Muscle immediately retracts away to the anterior direction and forms a bulk for future phonation at the anterior glottis. It is important to truncate the muscle with its two bellies (i.e. thyrovocalis and thyromuscularis) with the vocal ligament. Then the mucosal incision was sutured by 8/0 vicryl in order to prevent granuloma formation. The Lichtenberger suture instrument was then used for suture lateralization of the posterior glottis. To decrease the risk of long-term soft tissue loosening, three sutures were placed leaving 2 mm space in-between. The first suture was placed 2 mm posteriorly to the tip of vocal process. The second one was placed to the level of the vocal process. These two sutures were aimed to provide an opposite vector to lateral cricoarytenoid (LCA) muscle. The last suture was placed to the posterior membranous glottis for closing the tissue gap which was left by the truncated TA muscle (Figure 1).

Postoperatively, one year follow-up showed no dyspnea or inspiratory stridor for daily life conditions. Despite a moderate hoarseness (i.e. breathy voice) patient's vocal communication was not affected except in noisy environment. In the early postoperative period, there was a moderate to severe anterior glottic edema but posterior glottis was prominently open; the steroid medication was given perorally and no tracheostomy was needed. After edema was resolved, the MRC scale of breathlessness became grade 1 for the patient. Mucosal defect was completely healed in the first week and no granuloma formation was determined. Swallowing was not affected, no aspiration was determined possibly because the arytenoid bulk was left on site. Patient's one year follow-up did not show re-narrowing of the posterior glottic gap (Figure 2).

Preoperatively, maximum phonation time was calculated as

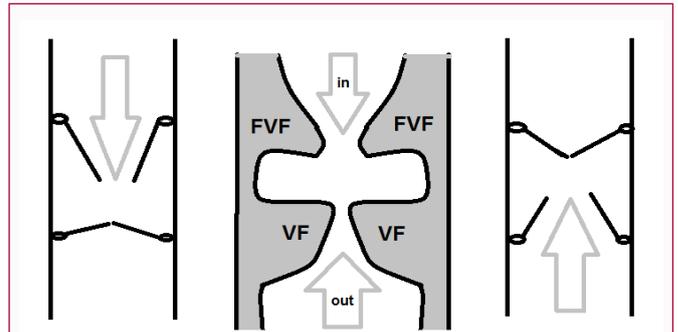


Figure 3: Schematic representation of double-valve function of larynx. FVF: False Vocal Fold, VF: Vocal Fold, arrows point the direction of airflow.

3 seconds, it decreased to 2 seconds in postoperative assessment. Interestingly, functional (F), physical (P), and emotional (E) parameters in Voice Handicap Index (VHI) showed remarkable improvement. Preoperative VHI results were F17, P19 and E15. Postoperative findings were F9, P7 and E5. It was possibly due to deleterious effects of preoperative dyspnea to communicative skills.

Discussion

Overall success rate for surgical management of BVFI depends on voice and breathing outcome. Various techniques have been described to accomplish a balance between these two important quality of life factors. Larynx is a complicated valve system and functions of larynx are basically executed by that active valve mechanism. Vocal folds function as a unidirectional valve which resists airflow from outside-in. On the other hand, the ventricular folds (i.e. false vocal folds) work oppositely as a unidirectional valve resisting airflow inside-out direction in order to help for thoracic fixation function of larynx (Figure 3).

Aerodynamic and biomechanical approach tells us that the true VFs as the inside-out valve, works properly in BVFI but when it comes to breathing, the valve function leads to an inspiration deficiency. The possible solution lies behind muscular vectors and the functional dominance in glottis. The anterior two-thirds of the glottis primarily comprise the phonatory function whereas the posterior one third serves as the dominant component of the respiratory function of the glottic space. Thus, in order to keep inspiration-phonation-aspiration in balance; three procedural aspects should be taken into consideration:

1. A lateral movement of vocal process in the opposite direction of LCA muscle by suture lateralization. This was done with lateralization sutures which pass around the vocal process of the arytenoid cartilage.
2. Keeping the glottic valve function at the anterior part of glottis for providing mucosal vibration or at least falsetto effect. The vocal ligament and thyroarytenoid muscle with its two bellies were truncated without excision. The body of the muscle was retracted anteriorly to make a narrower anterior glottic space.
3. Prevention from aspiration by leaving the arytenoid bulk on site. Vocal fold lateralization is a simple procedure if especially performed by an endo-extralaryngeal needle carrier. The needle carrier helps to place the suture to an exact point inside the larynx with a single attempt which also minimizes edema and hematoma in laryngeal tissues. Even under the best of circumstances, suture lateralization may result in a severe edema of the lateralized VF and

tracheostomy may be needed in the first week of suture lateralization surgery. We used Lichtenberger's needle carrier in our patient, a meticulous dissection was made to minimize the tissue reaction. No hematoma was observed in postoperative 3 days. Patient has had a moderate dyspnea at the postoperative 5th day because of the edema at the operated side. She was relieved after a short course of intravenous steroid treatment and no tracheotomy was needed.

Long-term results of suture lateralization alone may not provide enough airways possibly because the thread is loosened in time by cutting the soft tissues. Fibrosis in the tissue then may not be enough for a lateralization effect. In order to enhance this effect, lateralization of true and false vocal folds by crossing sutures has been introduced by Katilmis et al. [10]. Because the valve function of the ventricular folds are against expiration (not inspiration), ventricular folds were not included to lateralization procedure in our patient.

Arytenoidectomy, posterior cordectomy/cordotomy (even assisted by laser) on the other hand, may result in granuloma or hypertrophic scar formation which, in advance, may lead to inspiratory stridor [11-13]. In order to prevent revision surgeries due to persistent airway symptoms (re-narrowing scar tissue, granuloma and tissue loosening after the single suture lateralization), we used three sutures to minimize the long-term loosening of the tissues and combined microlaryngeal posterior submucosal cordotomy with suture lateralization for a greater space posteriorly. One year follow-up did not show tissue reactions such as granuloma or hypertrophic cicatrix and airway obstruction as well. The retracted vocal ligament with the muscle was still obvious at the anterior vocal fold.

Conclusion

Microlaryngoscopic submucosal cordotomy combined with endolaryngeal triple suture revealed a favorable long-term follow-up in a BVFI patient. The submucosal cordotomy with minimally invasive dissection prevented further re-narrowing of the posterior glottic region by hypertrophic scar and granuloma formation. Triple suturing (one of which passes around the vocal process) provided effective lateral movement of vocal process. No aspiration was observed and tracheostomy was not needed after the operation. Among various surgical methods for management of BVFI, this new modification seems to provide an effective balance for laryngeal functions. Further studies on large patient groups are needed to confirm the affectivity of the method.

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