



Narrative review

Management of bilateral paralysis of the vocal cords

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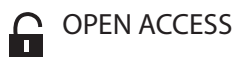
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Manejo de la parálisis bilateral de las cuerdas vocales

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Abstract

Vocal cord paralysis is a pathology within the field of otorhinolaryngology that can progress to the point of causing interference with breathing, compromising the airway, manifesting complications such as dyspnea at rest and laryngeal stridor, especially when there is bilateral paralysis in the paramedian or intermediate position, becoming a medical emergency. The objective of this narrative review is to analyze the different treatments known for the management of bilateral vocal cord paralysis (BVCP). A search was conducted in the PubMed database, including original articles, randomized studies, systematic reviews, and books in Spanish and English. The treatment of vocal cord paralysis is focused on achieving a balance between breathing and phonation, ensuring the patency of the airways and their adequate phonatory functions.

Keywords

Vocal Cord, Vocal Cord Paralysis, Dyspnea.

Resumen

La parálisis de las cuerdas vocales es una enfermedad dentro de la especialidad de otorrinolaringología que puede evolucionar hasta causar interferencia para la respiración, comprometiendo la vía aérea, manifestándose complicaciones tales como disnea en reposo y estridor laríngeo, en especial cuando hay parálisis bilateral en posición paramediana o intermedia, convirtiéndose en una emergencia médica. El objetivo de esta revisión narrativa es analizar los diferentes tratamientos conocidos para el manejo de la parálisis bilateral de las cuerdas vocales. Se realizó una búsqueda en la base de datos PubMed, se incluyeron artículos originales, estudios aleatorizados, revisiones sistemáticas y libros en inglés y español. El tratamiento de la parálisis de las cuerdas vocales se enfoca en lograr un equilibrio entre la respiración y la fonación, garantizando la permeabilidad de las vías respiratorias y sus adecuadas funciones fonatorias.

Palabras clave

Cuerdas vocales, Parálisis de Cuerdas Vocales, Disnea.

Introduction

Bilateral vocal cord paralysis (BVCP) is a disease that involves severe airway compromise and may manifest with symptoms such as dyspnea at rest or during exercise and stridor due to the paramedian position of both vocal cords. In some cases, the intermediate position of the cords may cause aspiration, which may lead to an emergency and ultimately require a tracheostomy.ⁱ

In BVCP, the medial and paramedial position of the vocal cords may contribute to airway narrowing, a level of the glottis

and manifests with inspiratory dyspnea. For years, iatrogenic lesion of recurrent laryngeal nerves during thyroidectomy was considered the most frequent cause of BVCP, occurring in approximately 1 % of this surgical procedure. This complication is more common in surgeries performed for neoplasia, retrosternal goiters, and in patients with a history of multiple thyroid surgeries, with an incidence ranging from 20 % to 30 %.ⁱⁱ Other causes of BVCP include esophageal surgery, vocal cord trauma during intubation, open neck trauma, tracheal surgery, and viral neuritis.ⁱⁱⁱ

This potentially life-threatening disease requires not only the administration of corticosteroids but also intubation as short-term symptomatic therapy, as well as surgical intervention, including tracheostomy. Among the most common surgical methods implemented in BVCP are posterior cordectomy, arytenoidectomy, and, more and more commonly, reinnervation. The main objective of surgical treatment is to ensure airway patency while preserving the phonatory and protective functions of the larynx.ⁱ

This narrative review study included original articles, randomized studies, systematic reviews, and books in English and Spanish, published between January 1, 2020, and July 1, 2024, in which the different known treatments for managing bilateral vocal cord paralysis were analyzed.

Discussion

Vocal cord paralysis refers to the immobility of vocal cords, while paresis implies an alteration in their mobility. Both conditions can be caused by processes that directly affect the vocal cord (scarring or tumors) due to neuropathies of the nerves that control its motor function, such as the vagus nerve, recurrent laryngeal nerve (RLN), and superior laryngeal nerve (SLN). They can also be associated with central neurological problems, such as ictus tumors or multiple sclerosis, and systemic diseases, such as amyotrophic lateral sclerosis or Guillain-Barré syndrome.^{iv}

Symptomatology

The presentation and symptoms of bilateral paralysis will depend on the underlying etiology and the position of the vocal cords. If the vocal folds are paralyzed in a more medial position, stridor and respiratory symptoms may predominate, or the patient may be asymptomatic. At the same time, the voice may remain normal, and episodes of aspiration will not occur. In contrast, the airway will be largely patent if the vocal cords are paralyzed in a more lateral position. However, it may not be able to close adequately, which may manifest with significant vocal complaints, shortness of breath, and risk of aspiration or asphyxia, but with fewer respiratory or stridor-related symptoms.^{iv}

BVCP is an uncommon cause of respiratory distress in children; investigating the etiology and clinical features of vocal cord paralysis in this group provides useful information for diagnosis, management, and prognosis.

The natural history of BVCP depends on its etiology, which includes trauma,

neurological disorders such as Arnold-Chiari malformation, hydrocephalus, and cerebral palsy, hypoxia, iatrogenic causes (e.g., related to intubation or surgery), idiopathic/unknown, or history of birth trauma. The clinical presentation varies, ranging from mild inspiratory stridor to catastrophic airway compromise.^{iii,v,vi}

Preoperative evaluation

A comprehensive evaluation of the functional status of the neuromuscular apparatus of the larynx is necessary for the correct and timely diagnosis of BVCP. To perform surgical intervention successfully, the cause and origin of the lesion must be identified. A nasopharyngolaryngoscopy is also important (Figure 1).

El-Sobki *et al.* mention that voice can be assessed using the vocal disability index, which consists of 30 items equally distributed in three domains related to voice disorders: the functional domain, which describes the impact of the disorder on the patient's daily activities; the organic domain, which assesses the patient's perception of laryngeal discomfort and phonation characteristics; and the emotional domain, which reflects the patient's affective response to the vocal disorder. These describe the impact of voice disorders on daily activities, emotional responses to voice, self-perceived laryngeal discomfort, and characteristics of vocal emission.ⁱⁱⁱ

In patients with vocal cord paralysis lasting between four weeks and six months, it will be necessary to perform laryngeal electromyography to obtain prognostic information.^{vii,viii} It is important to mention that bilateral alteration of vocal fold movement, with hypomobility or immobility, reduces the glottic opening area, which consequently increases airway resistance, induces persistent stridor and dyspnea that will worsen with inflammatory conditions of the upper airway. An accurate diagnosis and adequate treatment are necessary as this condition may progress to acute respiratory failure.^{ix}

Iwai *et al.* describe a case associated with posterior cervical laminoplasty. A possible cause of this disease was an intraoperative hyperflexed neck position, which probably induced a mechanical pinching of the larynx, resulting in swelling and edema of the vocal cords and paresis of the NLR.^x

Choi *et al.* described a case in which a 36-year-old multiparous woman underwent an emergent cesarean section due to polyhydramnios and active labor at 35 weeks of gestation, delivering a girl, who cried weakly, presented cyanosis, chest retraction, and stridor. Laryngoscopic examination revealed

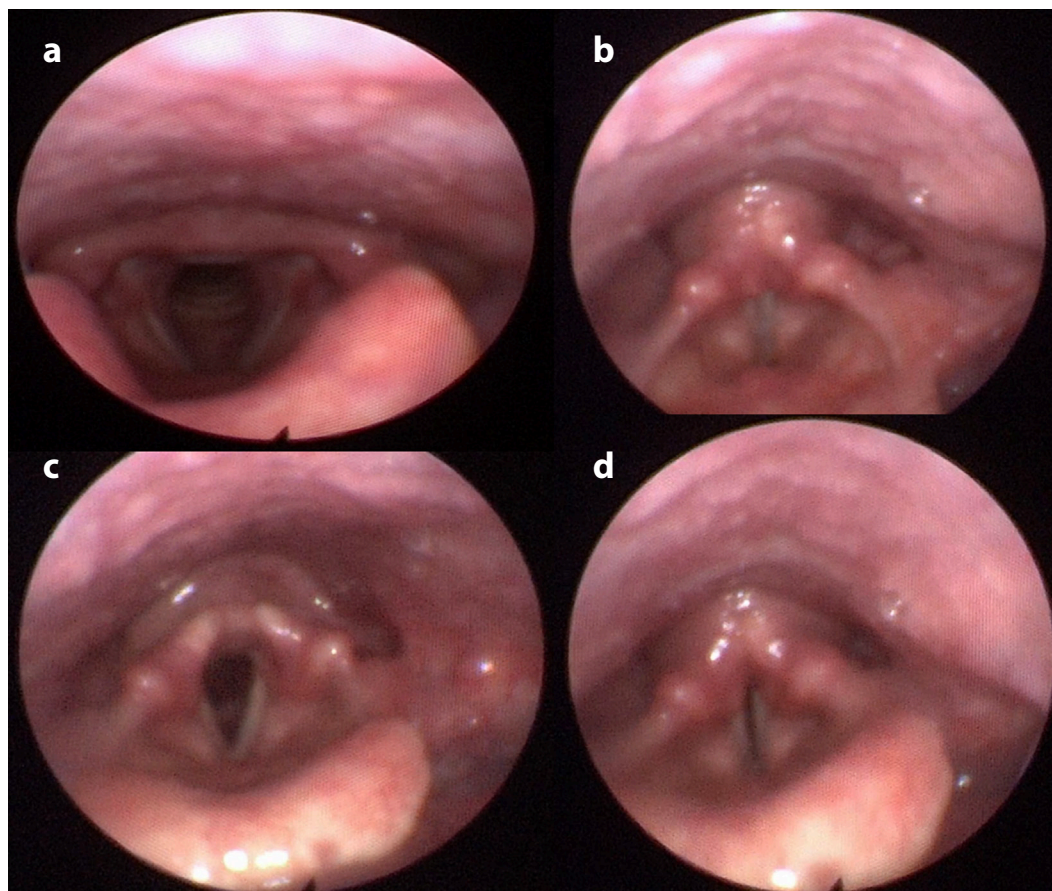


Figure 1. Findings on nasopharyngolaryngoscopy (a) Normal position of the normal vocal cords in abduction during breathing (b) Normal position of the normal vocal cords in adduction during phonation, (c) Bilateral vocal cord paralysis in abduction, (d) Bilateral vocal cord paralysis in adduction.

Source: Otorhinolaryngology Service, Specialties Clinic of the Salvadoran Insurance Institute, Social Security (ISSS).

BVCP. When the baby was 40 days old, a tracheotomy was performed to alleviate persistent stridor and oral feeding difficulties.^{xi}

Yamada *et al.* described a case of meningeal carcinomatosis due to adenocarcinoma of the left lung of four years' evolution in an 84-year-old man who developed dysphagia, hoarseness, and BVCP.^{xii} In another study, Diaz-Perez *et al.* described the case of a patient with acute BVCP as a manifestation of acute stroke who developed dysphagia and hoarseness.^{xiii}

Led to acute respiratory failure and urgent tracheotomy.^{xiii} This evolution occurred due to a combination of an acute left vocal cord paralysis from a lateral bulbar stroke and a pre-existing chronic bilateral right vocal cord paralysis due to a previous surgical injury to the recurrent laryngeal nerve.^{xiii}

Paralysis secondary to viral infections has a good prognosis, and it is important to establish an early pharmacological treatment once the cause is known. In paralysis with high suspicion of viral infection, imaging tests, neurological examination, and lumbar puncture to analyze cerebrospinal fluid and rule out encephalitis will be performed; in addition, an attempt will be made to identify the causal agent by Polymerase Chain Reaction

(PCR) tests of the most common viruses in blood and cerebrospinal fluid.^{xiv}

Treatment

The treatment of BVCP aims to achieve a balance between improving breathing and preserving the voice. In classical terms, it was described that following a wider glottic area implied incomplete closure and worsened quality, which was the main criterion for developing transoral endolaryngeal techniques.ⁱⁱ

Posterior chordectomy consists of resectioning the posterior one-third or two-thirds of the vocal cord, with a consequent increase in the glottic area, leaving the anterior portion for phonation. El-Sobki *et al.*, showed an improvement in maximum phonation time (MPT), mainly when performing laser-assisted posterior cordectomy, and a lack of worsening of voice quality and aspiration scores.ⁱⁱⁱ

Qazi *et al.* mention that the main objectives of the CO₂ laser-assisted posterior cordectomy procedure are to avoid tracheostomy while preserving voice and swallowing function. Over the years, they have

shown that the procedure is effective and safe with acceptable results in voice and swallowing, since acceptable voice quality was eventually obtained four to five months after the operation.^{xv}

Jackowska *et al.*, found that cordectomy by CO₂ laser microlaryngoscopy is a simple procedure that improves respiratory function and allows decannulation in patients with BVCP. However, factor such as advanced age (> 66 years), comorbidities (diabetes, gastroesophageal reflux disease), multiple thyroid surgeries, and the performance of a tracheotomy below the cricoid cartilage decrease the likelihood of successful decannulation.^{xvi}

The vocal fold suturing procedure allows for widening the anterior commissure of the vocal folds while keeping the laryngeal mucosa generally intact. This technique subsequently offers a permanent glottis enlargement or decannulation effect with a single surgical episode. In addition, using arytenoid release for cricoarytenoid articulation fixation has resulted in significant advances in final surgical outcomes, improving both ventilation and phonation and reducing the need for revision surgery.^{iii,viii}

Habaza *et al.* described that the suture lateralization technique widened the interglottic distance at the suture site ($p < 0.001$). Decannulation was completed in three out of four tracheostomized patients. The optimal location of the suture insertion points resulted in less in-tracheostomy manipulation of the cords and a shorter operative time.^{xvii}

Vocal cord later fixation is a cost-effective alternative procedure to tracheostomy pending recovery, as is unilateral and bilateral posterior transverse cordectomy; both approaches are associated with a 95.1 % decannulation rate and adequate airway volume but with worsening voice quality. Arytenoidectomy involves total or partial removal of the arytenoid cartilages in the larynx. Unilateral/bilateral partial arytenoidectomy data have reported a lower decannulation rate (83%) and better voice quality than cordectomy.^{viii}

In the pediatric population, BVCP is one of the main causes of stridor and airway obstruction that can arise idiopathically as a result of birth trauma or in lesions of the central nervous system, such as Arnold-Chiari malformation. Lateralization of the vocal cord suture is reversible and has less morbidity than other surgical interventions for bilateral vocal cord immobility; however, optimal suture placement is vital and challenging.^{xix} New techniques in pediatric patients will be described later.

Bilateral selective vocal cord reinnervation aims to restore both vocal cord tone and abductor movements in patients with bilateral vocal cord paralysis. Puxeddu *et al.* state that the posterior cricoarytenoid muscles were reinnervated using the right C3 phrenic nerve root through the greater auricular nerve graft. In contrast, through transverse cervical nerve grafts, adductor muscle tone was restored bilaterally using the thyrohyoid branches of the hypoglossal nerve. After a minimum follow-up of 48 months, all patients were successfully released from tracheotomy and recovered normal swallowing.^{xx}

Standardized unilateral non-selective and bilateral selective reinnervation surgeries are viable alternatives to static procedures currently under evaluation in prospective studies. Cervical loop neorrhaphy to the RLN allows long-lasting vocal recovery and satisfactory results, potentially superior to medialization and thyroplasty, by maintaining the viscoelastic properties of the vocal cords and preventing their atrophy. Bilateral selective reinnervation shows potential for recovery of inspiratory abduction with improved respiratory function without vocal impairment.^{xxi}

In the pediatric population, bilateral selective laryngeal reinnervation holds promise as a treatment option for children with bilateral vocal cord immobility. It has the potential to restore both abductor and adductor vocal cord motion. This procedure offers an effective strategy for airway management and restoration of dynamic laryngeal function.^{xxii}

Although surgical treatment can improve respiratory quality and, consequently, the quality of life of patients with BVCP, completely normal phonation and respiratory parameter values are not achieved with any of the methods. Dysphagia and aspiration are feared complications after arytenoidectomy surgery.ⁱⁱ

Al Omari *et al.* describe the outcome of 18 patients with tracheostomy secondary to BVCP, managed by transoral laser reconstructive microsurgical techniques and followed up for one to five years, all had tracheostomy at presentation due to bilateral true vocal fold immobility and stridor, and were treated by transoral laser reconstructive microsurgery with arytenoidectomy and vocal fold lateralization. All patients were successfully decannulated eight weeks after surgery.^{xxiii} The pediatric population with BVCP may present with stridor and respiratory distress requiring tracheotomy. In a study by Windsor *et al.*, endoscopic anteroposterior cricoid division

with balloon dilation procedure has been described as an alternative to tracheostomy in these patients.^{xxiv} This procedure is safe and may effectively eliminate airway symptoms in selected infants with bilateral vocal cord paralysis, avoiding the need for tracheostomy; however, more research is needed in this population.^{xxiv}

It should be considered that it is possible to injure the RLN and develop a clinical quagmire during thyroid gland surgery due to the alteration of vocal cord motility in the form of a paradoxical spasm. The treatment of these patients presents particular difficulties.^{xxv} Steroids are often used for the treatment of vocal cord paralysis after thyroid surgery. In a study by Donatini *et al.*, the study found that a single intravenous injection of four milligrams of dexamethasone administered within ten minutes following a loss of signal during neuromonitoring in thyroid surgery exerts a therapeutic effect that prevents vocal nerve paralysis and the need for staged thyroidectomy.^{xxvi}

Surgery for BVCP is currently not standardized and is highly variable. Postoperative and revision surgery complications are frequent and are related to the patients' drinking habits (alcohol) and the etiology of BVCP.^{xxvii}

Laryngeal synkinesia may develop after a unilateral lesion or BVCP. It is a movement disorder due to misdirected reinnervation after an RLN lesion. Syncynetic reinnervation occurs when adductor axons from the RLN reinnervate the abductor muscle (posterior cricoarytenoid) or when abductor axons reinnervate the adductor muscles (thyroarytenoid, lateral cricoarytenoid, and interarytenoid muscles). It has been reported that Botox treatment may delay the need for definitive surgical treatment, and, for those with a tracheotomy, some may achieve decannulation without surgery.^{xxviii}

As already mentioned, BVCP is the second most common cause of neonatal stridor. Its management is a controversial issue, and over the years, several surgical procedures have been proposed to improve the glottic breathing space, some previously described. As an innovative management, Zhao *et al.* proposed a new technique of percutaneous endoscopic suture lateralization for BVCP in newborns in China, which was performed under general anesthesia with 3.0 mm endotracheal intubation using the improved technique of needle-directed percutaneous placement of a 4-0 Prolene® suture without the use of specialized equipment.^{xxix}

Trozzi *et al.* have proposed another technique, endoscopic lateroabduction of the aritenoids, after complete airway endos-

copy, where the endolaryngeal thread guide instrument (ETGI) is guided through the laryngoscope and placed under the vocal process apophysis. Here, a non-absorbable or long-term absorbable suture thread (2.0 or 0 -Prolene®/2.0-PDS II) is passed through the hole in the needle tip and then pulled back into the laryngeal space, the ETGI can be removed; the two corresponding ends are then knotted and fixed under the skin in a small incision.^{xxx}

Postoperative evaluation

In their study, El-Sobki *et al.* describe the initiation of feeding six hours postoperatively with semisolids. Clear liquids were started 24 hours postoperatively, and if aspiration occurred, patients were asked to rotate the neck to the nonoperative side while drinking. Patients were usually allowed to start oral fluids 24 hours postoperatively, with the same swallowing precautions for 48 hours, approximately one week postoperatively. In addition, administration of anti-reflux therapy was indicated for three months. Patients continued postoperative follow-up at one week, then at two weeks, one month, three months.^{iii,v}

The limitations of this study are the limited bibliography available worldwide on the different treatments known for the management of BVCP in the last five years, which makes it difficult to obtain more detailed information on this disease, and it is therefore suggested that more studies be published in the future.^{iii,vi}

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Conclusion

Despite the existing modern high-tech diagnostic technologies and the variety of surgical methods for the treatment of this condition, the problem of diagnosis, treatment, and rehabilitation of patients suffering from BVCP remains a serious challenge for physicians who require further investigation of this pathology.

The evidence in the selected studies shows a consistent effect in favor of surgical treatment, improving respiratory function and decannulation, and with little loss in voice quality or swallowing; however, none of the surgical techniques described

showed better respiratory and functional outcomes than the others. The decision as to which surgery to perform should still be made based on the otolaryngologist's criteria, considering the patients' needs or preferences and seeking to improve their quality of life.

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