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Chapter

Vocal Cord Paralysis

Shaili Priyamvada

Abstract

Vocal cord paralysis can be due to neurogenic cause, trauma due to surgery, or mechanical fixation of the cords. Diagnosis of the underlying cause leading to paralysis of the vocal cords is important. Most commonly, there is paralysis of recurrent laryngeal nerve. Treatment depends on the cause and whether the cord paralysis is unilateral or bilateral. Unilateral paralysis patients usually present with change in voice, regurgitation, and difficulty in swallowing. One-third of them show spontaneous recovery, due to compensatory movement of opposite healthy vocal cord. Speech therapy is useful during initial conservative management period. In rest of the cases, vocal cord medialization procedures are performed. As for bilateral vocal cord paralysis which is troublesome entity, patients present with severe symptoms of respiratory distress, stridor, and aspiration. Voice is usually normal in bilateral paralysis cases but change in pitch, poor intensity, and voice fatigue are the complaints. The primary objective is to relieve patients’ dyspnea. There are different treatment options available for bilateral vocal cord paralysis such as tracheostomy, arytenoidectomy, cordectomy, botulinum toxin injection, re-innervation procedures. All these procedures have been applied in with varying success. Unilateral cord paralysis is more common and has better prognostic outcomes as compared to bilateral vocal cord paralysis.

Keywords: vocal cord paralysis, change in voice, stridor, tracheostomy, arytenoidectomy

1. Introduction

Larynx plays role in phonation, respiration, airway protection, prevention of aspiration, and swallowing. The extrinsic muscles are associated with swallowing, while the prime function of intrinsic muscles is respiration and phonation.

Vocal cord refers to the immobility of vocal cord. It can be unilateral or bilateral. Both can be due to diseases affecting the vocal cord itself such as tumor or scarring; or due to paralysis of recurrent laryngeal nerve or superior laryngeal nerve.

The most common causes include laryngeal or extralaryngeal cancers, iatrogenic trauma during neck, thyroid gland, or chest surgery, and various neurogenic conditions (e.g., amyotrophic lateral sclerosis and closed head injury) [1–4].

Vocal cord paralysis is most commonly unilateral. The affected vocal cords do not adduct or abduct properly causing voice disorder. Along with that there might be difficulty in swallowing. As for bilateral paralysis, breathing difficulty, choking, and aspiration are there along with voice change. The incidence of the bilateral vocal cords paralysis comprises around one-third of all vocal cord paralysis cases [2].
It requires interprofessional team of otolaryngologists, radiologists, and speech therapists in the evaluation and management of vocal cord paralysis.

2. Positions of vocal cords

Five positions of vocal cords are described traditionally (Table 1; Figure 1). The position of the vocal cords may not correlate with the severity and site of the lesion and, thus, is not a reliable indicator. As re-innervation occurs the position of the vocal cord often changes.

Median position: Vocal cord is in midline position such as in phonation. It may occur in recurrent laryngeal nerve (RLN) paralysis.

Paramedian position: Vocal cord is 1.5 mm away from midline. It occurs in strong whisper in a healthy person. It may occur in RLN palsy.

Intermediate (cadaveric): This is the neutral position of vocal cords. Abduction and adduction occur from this point. Vocal cord lies 3.5 mm away from midline. This occurs when there is combined paralysis of RLN and SLN.

Slight abduction: Vocal cord is 7 mm away from the midline. It occurs during quite respiration and paralysis of adductors.

<table>
<thead>
<tr>
<th>Position of vocal cords</th>
<th>Location of the cord from midline</th>
<th>Healthy</th>
<th>Diseased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>Midline</td>
<td>Phonation</td>
<td>RLN paralysis</td>
</tr>
<tr>
<td>Paramedian</td>
<td>1.5 mm</td>
<td>Strong whisper</td>
<td>RLN paralysis</td>
</tr>
<tr>
<td>Intermediate (cadaveric)</td>
<td>3 mm, this is the neutral position of vocal cords.</td>
<td>Paralysis of both RLN &amp; SLN</td>
<td></td>
</tr>
<tr>
<td>Gentle abduction</td>
<td>7 mm</td>
<td>Quite respiration</td>
<td>Paralysis of adductors</td>
</tr>
<tr>
<td>Full abduction</td>
<td>9 mm</td>
<td>Deep respiration</td>
<td>—</td>
</tr>
</tbody>
</table>

Table 1.
Position of vocal cords from midline in healthy and diseased individuals.

![Diagram showing different positions of vocal cords](image-url)
Vocal Cord Paralysis
DOI: http://dx.doi.org/10.5772/intechopen.104406

*Full abduction:* Vocal cord in 9 mm away from midline such as in deep respiration.

3. **Etiology of vocal cord paralysis**

Causes of vocal cord paralysis include

1. Supranuclear—stroke, tumor, meningitis, or head injury. Diffuse emboli in cerebral cortex may cause sustained abduction (aphonia) or inappropriate adduction (inspiratory stridor).

2. Nuclear—lesions of Nucleus ambiguus in medulla, usually associated with other lower cranial N. paralysis, stroke, tumors, motor neuron disease, poliomyelitis, syringobulbia.


4. Low vagal lesions or RLN: Most common cause, refer **Table 2**.

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
<th>Both</th>
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</thead>
<tbody>
<tr>
<td>Neck trauma</td>
<td>1. Neck Accidental trauma</td>
<td></td>
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<tr>
<td>Benign or malignant thyroid disease</td>
<td>Benign or malignant thyroid disease</td>
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<tr>
<td>Thyroid surgery</td>
<td>Thyroid surgery</td>
<td></td>
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<tr>
<td>Carcinoma cervical esophagus</td>
<td>Carcinoma cervical esophagus</td>
<td>Thyroid surgery</td>
</tr>
<tr>
<td>Cervical lymphadenopathy</td>
<td>Cervical lymphadenopathy</td>
<td>Carcinoma thyroid</td>
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<tr>
<td>Subclavian artery aneurysm</td>
<td>2. Mediastinum</td>
<td>Carcinoma cervical esophagus</td>
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<td>Carcinoma apex right lung</td>
<td>Bronchogenic carcinoma</td>
<td>Cervical lymphadenopathy</td>
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<tr>
<td>Tuberculosis of cervical pleura</td>
<td>Carcinoma thoracic esophagus</td>
<td></td>
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<tr>
<td>Idiopathic</td>
<td>Aortic aneurysm</td>
<td></td>
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<tr>
<td></td>
<td>Mediastinal lymphadenopathy</td>
<td></td>
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<td></td>
<td>Enlarged left auricle</td>
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<tr>
<td></td>
<td>Intrathoracic surgery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Idiopathic</td>
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</tr>
</tbody>
</table>

**Table 2.**

*Causes of recurrent laryngeal nerve paralysis (low vagal trunk or RLN).*
5. Systemic causes: Diabetes mellitus, diphtheria, typhoid, lead poisoning, amyotrophic lateral sclerosis (ALS), Guillain-Barre syndrome (GBS).

6. Idiopathic—In around 30% of cases.

4. Unilateral vocal cord paralysis

4.1 Epidemiology

Studies on comparison of patient demographics show no statistically significant difference in age, gender, or duration of symptoms. About one-third of UVCP cases are neoplastic in origin, one-third are post traumatic and one-third are idiopathic. Viral neuronitis probably accounts for most idiopathic cases. Paralysis of the left vocal cord is reported to be 1.4–2.5 times more than right [5].

4.2 Pathophysiology

RLN damage is the most common cause of vocal cord paralysis. Combined paralysis of RLN and SLN is also possible and is seen post-thyroidectomy surgeries due to iatrogenic trauma.

To understand the pathophysiology of vocal cord paralysis, it is of importance to know the origin and course of vagus nerve and its branches as they give rise to laryngeal sensory and motor supply.

Vagus nerve has two nuclei—nucleus ambiguous and dorsal nucleus of vagus. Nucleus ambiguous is situated in medulla and gives origin to motor efferent fibers to soft palate, pharynx, and larynx. Dorsal nucleus of vagus is an autonomic nucleus, which gives general efferent visceral fibers that supply smooth muscles and glands of trachea and bronchi, heart, and abdominal viscera.

The superior laryngeal nerve arises from inferior ganglion of vagus and descends behind internal carotid artery, and at the level of greater cornua of hyoid, it divides into internal and external branches. The internal branch travels medially along superior laryngeal branch of superior thyroid artery and pierces the thyrohyoid membrane about 1 cm anterior to greater cornu and about 1 cm above ala of thyroid cartilage. The nerve then runs submucosally in the lateral wall of pyriform fossa. It provides sensory innervation to the mucosa above the true vocal cords. The external branch runs along the posterior aspect of superior thyroid artery and proceeds inferiorly along oblique line of thyroid. As it reaches inferior constrictor muscle, it sends a branch and then passes deep to sternothyroid muscle to reach the cricothyroid muscle. It innervates the cricothyroid muscle (essential in changing the pitch of the voice). Isolated superior laryngeal nerve lesions are rare and it is usually part of combined paralysis. It results in loss of sensation above the level of true vocal cords and a husky voice.

On the right side, RLN arises from vagus in front of subclavian artery in lower part of neck, and it traverses below the subclavian artery after emerging from vagus nerve. RLN is derived from sixth arch and is displaced by arteries of previous arch, which necessitates change in direction and course of recurrent laryngeal nerve. The right recurrent laryngeal nerve stays lateral to the trachea-esophageal groove in the fat plane and comes closure to the groove as it crosses inferior thyroid artery. The left RLN has longer course and from its origin at the anterior surface of arch of aorta to the interspace...
between origin of left common carotid artery and subclavian artery. The nerve loops around arch of aorta distal to ligamentum arteriosum and then enters the neck, and lies deeper in the trachea-esophageal groove. Rest of the course is in similar on both sides, as RLN reaches the suspensory ligament of thyroid gland and lies on either medial or lateral from within. Then, it divides to supply the intrinsic muscles of larynx. Left RLN is more prone for injury as it has a longer course and injury most commonly occurs in the region of trachea-esophageal groove during thyroid or any other neck surgery.

There are two theories to explain the position of vocal cord in cases of cord paralysis. Semon's law states that in the sequence of position of the vocal cords in slowly progressive organic central lesions, motor nerve fibers supplying the abductors of vocal cords become involved much earlier than adductors. Wegner and Grossman hypothesis explains the median and paramedian position of cords after RLN palsy, on the basis that cricothyroid muscle that receives supply from superior laryngeal nerve takes over & it has adductor and tensor function.

4.3 History and physical examination

Patients with unilateral cord paralysis present with a sudden onset of change in voice, that is, dysphonia and/or transient aphony. In addition to dysphonia, a significant proportion of patients present with swallowing difficulties, weak cough reflex, and regurgitation. Poor exercise tolerance with shortness of breath on minimal exertion is observed in many patients with UVCP in spite of normal lung function.

It is important to obtain elaborate history including the symptoms and signs pertaining to head and neck cancer. History of pain during swallowing, hemoptysis, neck nodes, referred ear pain, and significant weight loss should be asked. Past medical history including heart or lung disease, smoking, tobacco chewing, and alcohol consumption status are all important indicators of potential malignant disease. Clinical evaluation of the patient should include a complete otolaryngological examination, with particular attention to inspection and palpation of the neck. Flexible nasal endoscopy of the oropharynx and glottis helps forming the diagnosis. Assessment of voice quality can be graded with GRBAS scale (Grade, Roughness, Breathlessness, Aesthenia, Strain) [6], which has frequently shown the voice to be worse in such patients.

4.4 Evaluation

4.4.1 Flexible videolaryngoscopy

Flexible laryngoscopy of the glottis is the most useful method of evaluating appearance and movement of vocal cords. It is easily performed in the outpatient setting and can be combined with videostroboscopy to obtain a detailed overview of vocal cord movements (Figure 2).

4.4.2 Videostroboscopy

Videostroboscopy uses the same equipment as videolaryngoscopy combined with a microphone and flashing strobe light. During speech production, our vocal cords move at a very high speed, too fast to be perceived by naked human eyes. Stroboscopy is used to “slow down” the movement to study the detailed vocal cord movements such as amplitude, mucosal wave, vibratory pattern. It is a gold standard test in cases of voice disorders (Figure 3).
4.4.3 Imaging

A *chest X-ray* can be useful in cases of mediastinal or lung lesions and to read features of aspiration pneumonia. *CT scanning* is the most favored investigation. CT from skull base to diaphragm is adviceable in order to study the complete course of RLN. MRI can be used an alternative to CT scan when exposure to ionizing radiation is a concern but it has high false-positive rates.
Neck and laryngeal ultrasound can be used to assess vocal cord movement and investigate surrounding pathologies. However, ultrasound does not yield the same anatomical definition as CT requires an experienced ultrasonographer and is less reliable in obese patients.

4.4.4 Lab tests

Routine serological testing only aids in the diagnosis of a particular etiology. There is no strong evidence of them in helping form a diagnosis. Serum tests can be used in suspected inflammatory or infectious UVCP, with common tests including rheumatoid factor, antinuclear antibodies, serum ACE, lyme titer, and erythrocyte sedimentation rate (ESR).

4.4.5 Laryngeal electromyography

Laryngeal electromyography can be used as a prognostic tool. It is an office-based procedure. A percutaneous EMG needle is inserted through the anterior part of neck to the muscles of the larynx and their electrophysiological evaluation is done. Although growing in popularity, the test is not widely available.

4.5 Treatment/management

Patients with UVCP are initially treated with speech therapy. A “watchful waiting” period of 6 to 9 months is observed for spontaneous motion recovery by the opposite healthy vocal cord, as there is no definitive guidelines on how long a clinician should wait before surgical intervention.

The aim of surgery in cases of unilateral cord paralysis is cord medialization. The different surgical options are as follows:

Intracordal injection or injection thyroplasty—this involves injection of a substance to the affected vocal cord, moving it medially to make better contact with the opposite vocal cord. Different materials have been used in injection thyroplasty, for example, autologous fat, teflon, collagen, gelfoams, calcium hydroxy-apatite, methylcellulose, and hyaluronic acid; however, no high-quality evidence exists confirming the ideal material [7]. Teflon has previously been used, but this has fallen out of favor due to the formation of granulomas.

Type 1 Isshiki thyroplasty is a medialization procedure wherein a window is cut into the thyroid cartilage, and the vocal cord moved medially by the use of an implant such as silastic prosthesis. Like injection thyroplasty, there are numerous implant materials available. Arytenoid rotation procedures such as adduction and arytenopexy can be performed concurrently, and voice outcomes are reported to be good at 1 and 3 years post-operatively [8].

Dynamic procedures like nerve-muscle pedicle transfer with superior belly of omohyoid muscle along with its nerve(ansa hypoglossi) and vessels is implanted into thyroarytenoid muscle. Ansa cervicalis-recurrent laryngeal nerve anastomosis has also been used with good results on voice outcomes.

Type 1 Isshiki thyroplasty has a greater long-term benefit over injection techniques, and there is a growing body of evidence that long-acting injectable materials have comparable longitudinal outcomes [9]. Surgical intervention should be considered after a trial of conservative management, with the technique used based on surgeon experience and patient preference.
4.6 Prognosis

Around one-third of patients of UVCP will experience motion recovery, due to the compensatory action of the opposite vocal cord [10]. Laryngeal electromyography is an useful tool to track prognosis in patients with persistent dysphonia [11].

4.7 Complications

The adverse effect on voice and swallowing can have a significant detrimental impact on the patient’s quality of life. Incomplete closure of the glottis can also lead to a risk of aspiration, and despite being rare, this can lead to life-threatening aspiration pneumonia. In particular, patients who rely on their voice for a living (teachers, singers, secretaries) may suffer significant psychological and financial difficulty as a result of UVCP.

4.8 Enhancing healthcare team outcomes

The interprofessional team approach is better in diagnosing and managing cases of UVCP. Otolaryngologists can diagnose it with elaborate history, clinical examination, and flexible video laryngoscopy. Radiologists can aid in diagnosis through the study of the course of nerve involved or mediastinal lesion through CT/MRI imaging. Management can be done with speech therapy with the support of speech and language therapists and surgical treatment for those patients by otolaryngologists who do not respond to initial therapy.

5. Bilateral vocal cord paralysis

The most common presentation of bilateral vocal cord paralysis is stridor [12]. These patients typically present with respiratory distress. In addition to considerable airway obstruction, bilateral vocal cord paralysis presents with symptoms common in unilateral vocal cord immobility such as ineffective cough, aspiration, recurrent pneumonia, reactive airway disease, and feeding difficulties [13, 14]. Voice and cry may be fairly normal in children with bilateral vocal cord paralysis [15].

5.1 Epidemiology

As bilateral vocal cord paralysis occurs most commonly after iatrogenic trauma to recurrent laryngeal nerve, there is history of recent thyroid surgery in these patients. The incidence of the bilateral vocal cords paralysis comprises around one-third of all vocal cord paralysis cases. Bilateral cord paralysis is slightly more common in females, and it is attributed to the fact that thyroid diseases are more common in them as compared to males. Idiopathic bilateral paralysis cases show no gender preponderance and incidence is equal in both males and females.

5.2 Pathophysiology

RLN damage is the most common cause of bilateral vocal cord paralysis. Combined paralysis of RLN and SLN is also possible and is seen post-thyroidectomy surgeries due to iatrogenic trauma.
Bilateral vocal cord paralysis can be caused by injury to the vagus nerve near its origin or anywhere along its course or injury to its branches RLN and SLN through neck, thorax, and abdomen. Injury to the RLN is most common, classically leaving the vocal cords in a median position in case of bilateral vocal cord paralysis. Injury to the SLN will lower the pitch of the voice and can lead to a bowing deformity of the vocal cords due to a loss of tone from the denervated cricothyroid muscles. A high vagal injury can leave the cord in a nearly fully abducted position.

5.3 History and physical examination

A bilateral vocal cord paralysis patient most commonly presents with breathing difficulties such as stridor, increased work of breathing, and aspiration. It can be life-threatening and immediate measures have to be taken to secure the airway. Voice in bilateral paralysis is usually of good quality but of limited intensity, changed pitch, and with voice fatigue. Any recent history of URI, any neck or mediastinal surgery or trauma, malignancy, radiation therapy, and a thorough past medical history should be obtained. A thorough physical examination is done, with an emphasis on the head and neck and lung examination.

Clinical diagnosis can be made based on flexible fiber-optic laryngoscopy, where the vocal cord position can be noted and observed to be immobile. If the diagnosis is still uncertain, video stroboscopy and bronchoscopy can provide additional information about motion wave of the vocal cord vibrations and rule out subglottic and tracheal pathology, such as subglottic stenosis or tracheomalacia.

5.4 Evaluation

The investigations that aid in diagnosis are as follows:

Flexible videolaryngoscopy: It is essential part of the initial physical examination and is performed with the patient awake in the office to assess vocal cord movement. Direct laryngoscopy and bronchoscopy are reserved for patients when there is any doubt about the diagnosis and patients with lung pathology, to visualize the lower airway. This procedure also allows palpation of the arytenoid joints to rule out fixation of vocal cords (Figure 4).

Laryngeal electromyography: This is an office procedure performed to determine the innervation status of the laryngeal muscles after a neurogenic injury. It is also useful as a prognostic tool during the recovery period.

Figure 4. Videolaryngoscopy pictures showing bilateral vocal cord paralysis.
Imaging of the recurrent laryngeal nerve

CT is the most commonly employed investigation, though MRI can also be used. The area from brainstem to mediastinum is imaged to study the origin and entire course of vagus nerve and its branches RLN and SLN and detect pathology.

Lab tests: Blood investigations depend upon history and overall medical scenario of the patient. Antineutrophil cytoplasmic antibody test, thyroid function tests, tubercular skin tests, uric acid levels, rheumatoid factor test, serum K+, Ca+, Na+, antinuclear antibody tests, and erythrocyte sedimentation rate can all be considered.

5.5 Treatment

In bilateral cord paralysis, patient adequate airway must be re-established. Common surgical options for management include tracheostomy, arytenoidectomy, and cordotomy. Laryngeal re-innervation techniques and botulinum toxin (Botox) injections into the vocal fold adductors have also been used with varying success rates. More recently, there has been research on neuromodulation, laryngeal pacing, gene therapy, and stem cell therapy. These newer approaches have the potential to recover the vocal cord movement without any anatomical destruction. However, clinical data are limited for these new treatment options, and more interventional studies are needed. These areas of research are expected to provide dramatic improvements in the treatment of bilateral cord paralysis in future.

Tracheostomy is the most common procedure performed in patients with bilateral vocal cord to establish a secure airway. It is potentially reversible without long-term sequelae. Although tracheostomy remains the standard in bilateral cord paralysis cases, it is associated with reduced quality of life, chronic care burden, cost, psychosocial impairment, and increased mortality. Endoscopic techniques have been shown to be more cost effective as compared to tracheostomy in the management of permanent bilateral vocal cord paralysis [16]. Although several alternative procedures have been developed to manage bilateral vocal cord paralysis, they all have the ability to produce permanent changes of the larynx that may predispose patients to lifelong aspiration and dysphonia postoperatively. Arytenoidectomy is an irreversible procedure where there is an endoscopic removal of the arytenoid cartilage to expand the glottic chink transversely, for adequate airway. It is either performed on its own or in combination with vocal fold resection, referred to as arytenoid cordectomy. In current scenario, it is performed using CO2 laser or KTP-532 laser, which aids in precision, achieving better hemostasis and reducing postoperative edema. Arytenoidectomy has positive results in terms of augmenting ventilation but some patients may experience worsening dyspnea after the procedure, which can be permanent. Arytenoidectomy can also lead to scarring and granuloma formation. In such cases, multiple surgical revisions are needed. Endoscopic plasma coblator can also be used to perform arytenoidectomy. Cordotomy is another endoscopic surgical procedure to enlarge the glottic chink to attain adequate airway. An incision is made in the vocal cord, ligament, and the thyroarytenoid muscle posteriorly at the attachment to the arytenoid. Revision cordotomy can be required in up to 30% of patients secondary to reduced glottic diameter from scarring or granulation tissue formation [17]. The most common complication associated with cordotomy was altered voice quality due to vocal fold damage [18]. Laser endoscopic cordotomy is preferred now, as compared to an arytenoidectomy, in vocal cord paralysis cases as it is less invasive and reduces the incidence of aspiration. Also, overall voice outcomes are also better than arytenoidectomy.
Botulinum toxin injection to adductor muscles provides transient improvement in symptoms for approximately three to 6 months at a time, requiring repeated injections for longer-lasting relief.

Reinnervation techniques are technically challenging and require experienced surgeons in its use for the procedure to be a success. The goal here is to establish vocal cord abduction through the restoration of the activity of the posterior cricoarytenoid (PCA) muscle. While it enables the return of spontaneous vocal cord abduction, it does not affect adduction. Gene therapy and stem cell therapy are in preclinical stage but hold promising for treatment in future.

5.6 Prognosis

In adults, spontaneous recovery of idiopathic vocal cord paralysis can occur as early as 12 months following the onset. It is expected in 55% of patients, but full recovery can be very protracted. The prognosis for complete spontaneous recovery is far worse in bilateral vocal cord paralysis than unilateral. Recovery depends upon the underlying etiology.

5.7 Complications

Bilateral cord paralysis can lead to the following complications: Stridor, airway obstruction, dyspnea, poor cough reflex, aspiration, bronchopneumonia due to aspiration, difficulty in swallowing, feeding difficulties, and failure to thrive in children & voice fatigue. In addition to this, in the long-run arytenoid granuloma formation and chondritis may occur.

5.8 Enhancing healthcare team outcomes

Bilateral vocal cord paralysis is a challenging and troublesome entity. Tracheostomy, cordotomy, and arytenoidectomy all have been applied with positive outcomes in bilateral cord paralysis cases. Management should be individualized based on the patient’s clinical presentation and the surgeon’s expertise.

6. Paralyzed versus fixed cord

Vocal cord fixation is immobility of vocal cords due to scarring or due to mass effect, involvement of muscles, and joints or the nerve as in case of malignancy. Cord fixation can also be due to rheumatoid arthritis. There may be obvious swelling around cricoarytenoid joint, cord is immobile and fixed, its position does not correspond to any of the described anatomical positions of vocal cords, and aryepiglottic folds are normal. There is no change in position on applying pressure passively on arytenoids, which is in contrast to vocal cord paralysis. Also, in cases of fixation there is absence of any neurological symptoms and signs. In cases of vocal cord paralysis, aryepiglottic folds are paralyzed and pushed aside, cord is fixed to median or paramedian position, but there is no fixation of the joint and it is mobile on manipulating passively. Also, cord paralysis is purely a neurological condition in contrast to cord fixation.
7. Laryngeal paralysis in children

Vocal cord paralysis presents more commonly as stridor in neonates and children. It can be unilateral or bilateral in children, unilateral being more common. Vocal cord paralysis is the second most common cause of stridor in pediatric population following laryngomalacia and accounts for 10% of all congenital anomalies of larynx. Murty et al. estimate the incidence of bilateral vocal cord paralysis to be 0.75 cases per million births per year. Congenital vocal cord paralysis should be part of the differential diagnosis for an infant with respiratory distress. In up to 48–62% of neonates and children with bilateral vocal cord paralysis, spontaneous recovery of vocal cord function can occur, but the prognosis rests with the overall health of the child and any concomitant medical problems [19].

7.1 Etiology

Birth trauma due to vertex or breech delivery and the use of forceps can also lead to RLN injury, though less commonly a bilateral injury [20]. In infants, cardiovascular surgery, including patent ductus arteriosus ligation, and repair of a tracheoesophageal fistula are the common causes of bilateral vocal cord paralysis [21]. Table 3 summarizes causes of congenital vocal cord paralysis.

7.2 History and physical examination

A detailed family and perinatal histories, including prolonged or protracted or forceps-assisted delivery, concurrent congenital conditions and length of any NICU stay, should be inquired. Presenting symptoms in children include stridor, a weak cry, feeding difficulties, failure to thrive, and aspiration. Neonates and children with bilateral cord paralysis are likely to exhibit severe manifestation such as cyanosis and apnea. Bilateral cases usually have good voice because vocal cords are in median or paramedian position with abductor paralysis but can have marked inspiratory stridor and accessory muscles of respiration working.

Diagnosis can be made by awake fiber-optic laryngoscopy and careful evaluation of the larynx by an experienced pediatric otolaryngologist. Laryngomalacia should be considered as differential diagnosis and ruled out during laryngoscopy, which is far more common than bilateral vocal cord paralysis but can have similar presenting symptoms. If the diagnosis is still uncertain, direct laryngoscopy and bronchoscopy can be performed under general anesthesia. This is done with the patient spontaneously

<table>
<thead>
<tr>
<th>Unilateral</th>
<th>Bilateral</th>
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<tr>
<td>More common</td>
<td>Causes</td>
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<tr>
<td>Causes</td>
<td>Hydrocephalus</td>
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<td>Birth trauma</td>
<td>Arnold-chiari malformation</td>
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<td>Intracerebral hemorrhage</td>
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<td>of</td>
<td>Myelomeningocele</td>
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<td>Cerebral agenesis</td>
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<td>heart</td>
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Table 3. Causes of congenital vocal cord paralysis.
breathing so the motion of the vocal cords can be assessed intraoperatively. This also allows lower airway examination to rule out concurrent or alternate pathology such as subglottic stenosis and trachea- or bronchomalacia.

7.3 Treatment

Before surgical treatment is considered, parents are advised to position the child so that he or she is sitting up and to thicken the food in order to manage feeding difficulties and milk regurgitation. If gastroesophageal reflux is suspected, then this should also be treated. In addition, all children with vocal cord paralysis should be seen by a speech pathologist. Greater than 50% of children will undergo spontaneous symptom resolution in the first 12 months of life, though the prognosis is much more guarded for bilateral vocal cord paralysis cases when compared with unilateral [22].

There are no definite guidelines on when to perform surgery and the decision is difficult since in children spontaneous recovery may occur anytime over the years. It should be guided according to the individual case. In general, for cases of bilateral palsy destructive procedures such as cordotomy or arytenoidectomy are advised to be deferred till adolescence.

Tracheostomy is needed and should be performed to improve the airway in bilateral vord paralysis cases, even if spontaneous recovery is expected. Patient can be decanulated once vocal cord recovery occurs.

8. Conclusion

An integrated diagnostic and treatment program is necessary for patients with vocal cord paralysis. Otolaryngologists, speech therapist, and radiologists all play important role in evaluation and management. Treatment strategies should be individualized based on the patient’s clinical presentation and the surgeon’s expertise.

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Conflict of interest

The author declares no conflict of interest.

Abbreviations

<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>RLN</td>
<td>recurrent laryngeal nerve</td>
</tr>
<tr>
<td>SLN</td>
<td>superior laryngeal nerve</td>
</tr>
<tr>
<td>UVCP</td>
<td>unilateral vocal cord paralysis</td>
</tr>
<tr>
<td>CT</td>
<td>computer tomographic imaging</td>
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Updates on Laryngology

MRI magnetic resonance imaging
EMG electromyography
ALS amyotrophic lateral sclerosis
GBS Guillain-Barre syndrome
GRBAS scale Grade, Roughness, Breathlessness, Aesthenia, Strain

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