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A Review on Vocal Cord Palsy: Complications and Management

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Vocal cord paralysis is a multifaceted problem that affects people of all ages and is initially diagnosed by various healthcare providers. It is a common condition that occurs due to the obstruction of nerve impulses from the brain to the voice box. It ranges from slight hoarseness to fatal, life-threatening complications. To get to the exact diagnosis, determining the etiology of paralysis is essential. For restoration of normal function, accurate diagnosis has proven to be helpful. Vocal cord paralysis (VCP) is a. reasonably common condition caused by a vagus nerve or its recurrent laryngeal nerve branch disease process. The nerve's longer length causes increased vulnerability. Peripheral lesions to the vagus are responsible for 90% of VCP (Vocal cord paralysis). Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like stroke, CNS tumors, and systemic diseases like ALS, Guillain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, adenoidectomy, cordotomy, reinnervation, and gene therapy are used. For this narrative review, a literature search was undertaken using "unilateral and bilateral vocal cord palsy" and "dysphagia" in the Pubmed, Medline, and Embase databases. Bilateral vocal cord paralysis is a problematic and distressing condition that affects both adults and children. Surgical procedures

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such as tracheostomy, adenoidectomy, cordotomy, and laryngeal reinnervation have been used to treat this condition successfully. Treatment modalities should be individualized according to the patient's clinical features and physician's expertise.

Keywords: Vocal cord palsy; vocal cord; paralysis; speech; larynx.

1. INTRODUCTION

Vocal cord paralysis is a clinical condition in which the nerve impulses that are being carried to the voice box (larynx) are hampered, hence leading to the immobility of the vocal cord muscles. One of the significant functions of the vocal cords, also known as vocal folds, is to enable one to speak and breathe. This capacity to talk or even breathe Is compromised by vocal cord paralysis. They protect the airway by preventing foreign objects such as food, drink, and even saliva from going down the windpipe (trachea) and causing choking. Vocal cord palsy is a potentially fatal consequence of various pediatric operations. While there is a wealth of information in the literature on the outcomes of children who have had their vocal folds paralyzed due to cardiac or thyroid surgery, there is a shortage of comparable data on children who have had their vocal folds paralyzed as a result of neurologic tumor treatment [1]. Immobility of the vocal folds can be unilateral or bilateral, partial or total [2].

2. SYNONYMS

The following terminologies are used to indicate the same condition:

1. Vocal cord paralysis
2. Recurrent laryngeal nerve paralysis
3. Vocal fold paralysis
4. Laryngeal paralysis
5. Vocal fold Immobility

2.1 Anatomy

The larynx is located between the third and the sixth cervical vertebrae in front of the hypopharynx. During swallowing and phonation, it travels vertically and anteroposteriorly. It can also be moved from side to side passively, causing a grating feeling known as laryngeal crepitus. The larynx of an adult finishes at the lower border of the C6 vertebra [2].

2.1.1 Laryngeal cartilages

The laryngeal cartilages are divided into three pairs and three unpaired cartilages.

Paired: Cuneiform cartilages, Arytenoid cartilages, Corniculate cartilages

Thyroid cartilage, Circoid cartilage, and Epiglottis cartilage are unpaired.

Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like stroke, CNS tumors, and systemic diseases like ALS, Guillain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, arytenoidectomy, cordotomy, reinnervation, and gene therapy are used [3].

2.1.2 Laryngeal joints

Cricoaytenoid joint performs rotatory and gliding movements, thus adducting and abducting the vocal cords.

Cricothyroid joint: This is a synovial joint. Cricoid cartilage rotates in a transverse axis at these joints and passes transversely through them.

2.1.3 Laryngeal membranes and ligaments

Membranes and ligaments linked to structures outside the larynx are extrinsic membranes and ligaments. These are the following:

Thyrohyoid membrane, Cricotracheal membrane, Hyoepiglottis ligament
Membranes and ligaments that unite within the larynx are intrinsic membranes and

2.1.4 ligaments. These are the following

Quadrangular membrane, Cricovocal membrane Thyroepiglottic ligament, Cricothyroid ligament.

2.1.5 Laryngeal muscles

Two types of muscles are intrinsic, help in attachment of laryngeal cartilages to one another

and extrinsic, through which the larynx is attached to its surrounding structures.

Intrinsic muscles comprise abductors (posterior cricoarytenoid), adductors (lateral cricoarytenoid, inter arytenoid, thyroarytenoid), tensors (cricothyroid, vocalis), and muscles working on the laryngeal inlet: openers (thyroepiglottic), closers (thyroepiglottic) (inter arytenoid, aryepiglottic).

Elevators (stylopharyngeus, salpingopharyngeus, palatopharyngeus, and Thyrohyoid) and secondary elevators (stylopharyngeus, salpingopharyngeus, palatopharyngeus, and Thyrohyoid) are two types of extrinsic muscles (mylohyoid, digastric, stylohyoid, and geniohyoid). Sternohyoid, sternothyroid, and omohyoid are all depressors.

2.1.6 Cavity of larynx

Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like stroke, CNS tumors, and systemic diseases like ALS, Guillain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, adenoidectomy, cordotomy, reinnervation, and gene therapy are used.

2.1.7 The mucous membrane of the larynx

Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like stroke, CNS tumors, and systemic diseases like ALS, Guillain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, adenoidectomy, cordotomy, reinnervation, and gene therapy are used.

Mucous glands can be found throughout the mucous lining, but they are most abundant on the posterior portion of the epiglottis, the posterior half of the aryepiglottic folds, and the saccules. The vocal folds do not have any mucus glands.

2.1.8 Structures of the Vocal cords

These are lined by Stratified squamous epithelium. Under this theory is lamina prepared consists of three layers: superficial, intermediate, and deep.

Intermediate and deep layers form the vocal ligament [4]

2.1.9 Lymphatic drainage

Lymphatics that puncture the thyrohyoid membrane and travel to the upper deep cervical nodes drain the supraglottic larynx above the vocal cord.

Lymphatics that breach the cricothyroid membrane and travel to the laryngeal and paratracheal nodes, then to the lower deep cervical and mediastinal nodes, drain the inflaglottic larynx below the vocal cord. Some arteries pierce the cricotracheal membrane and drain right into the deep cervical nodes in the lower neck.

2.1.10 Nerve supply

Motor supply of all the muscles except cricothyroid muscle is by the recurrent laryngeal nerve. The latter is innervated with external laryngeal

The nerve which is a branch of the superior laryngeal nerve.

Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like stroke, CNS tumors, and systemic diseases like ALS, Guillain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, adenoidectomy, cordotomy, reinnervation, and gene therapy are used.

2.1.11 Spaces of larynx

The larynx has three spaces called pre-epiglottic space of Boyer, paraglottic space, Reinke's space.

2.1.12 Embryological development

The endoderm of the cephalic portion of the foregut forms the laryngeal mucosa. The mesenchyme gives rise to laryngeal cartilages and muscles. The following are the steps in the development of other structures:

Hypobranchial eminence develops into epiglottis and the fourth arch into the upper part of the thyroid cartilage. On the other hand the sixth arch forms various structures, which Include Circoid cartilage, corniculate cartilage, cuneiform cartilage, and intrinsic laryngeal muscles make up the lowest half of the thyroid cartilage. The second arch developed the upper half of the hyoid bone's body, the lesser cornua of the hyoid bone, and the stylohyoid ligament. Finally, the third arch gives way to the bottom half of the hyoid bone's body and the greater cornua.

The superior laryngeal nerve, a branch of the vagus nerve, is the nerve of the fourth arch. The recurrent laryngeal nerve is the sixth arch nerve.

2.1.13 Paediatric larynx

Infants larynx is very different compared to an adult and this is clinically very important.

At rest, the larynx of an infant is located high in the neck, opposite C3 or C4, and during swallowing, it approaches CI or C2. The epiglottis meets the soft palate and forms a nasopharyngeal conduit for nasal breathing

during suckling in this high position. The milk feed goes across the dorsum of the tongue and the sides of the epiglottis separately, allowing breathing and feeding to happen at the same time.

The cartilages of the larynx are fragile and easily collapse. The epiglottis is omega-shaped, with arytenoids covering a major amount of the posterior glottis.

An infant's thyroid cartilage is flat. The cricoid cartilage overlaps it, and the hyoid bone overlaps it as well. When executing a tracheostomy, the cricothyroid and thyrohyoid gaps are narrow and difficult to distinguish as landmarks.

The larynx of an infant is small, and the cricoid cartilage's diameter is smaller than the glottis', making the subglottis the narrowest section. It influences the choice of a paediatric endotracheal tube.

The submucosal tissues of an infant's larynx are rather flexible and can easily oedematize in response to trauma or inflammation, resulting in blockage.

The larynx of an infant goes through two growth spurts. The larynx increases in width and length throughout the first three years of life, obviating the necessity for airway surgery in certain congenital defects. When the thyroid angle expands during puberty, the second growth spurt begins. The length of the vocal cords lengthens, resulting in puberty-related voice alterations (see puberphonia). The larynx progressively falls to adult level as the neck grows, with the vocal cords lying face to face with C5.

Females' vocal cords are 6 mm thick in childhood, while males' vocal cords are 8 mm thick. In adult females, it rises to 15-19 mm, while in adult males, it rises to 17-23 mm.

In the treatment of children with vocal cord palsy, the chance of late spontaneous repair or compensation is critical. As a result, there is no need to rush into surgical procedures to permanently lateralize the vocal chords or arytenoids [5].

2.2 Physiology of Larynx

There are four important functions that are performed by the larynx. These include protection of lower airways, phonation, respiration, fination of the chest.

2.2.1 Protection of lower airways

Voice production develops secondarily once this function emerges phylogenetically. Sphincteric closure of laryngeal aperture, suspension of respiration, and the cough reflex are three ways the larynx protects the lower esophageal passages.

When food is ingested, three sphincters close: (i) the laryngeal inlet (aryepiglottic folds, tubercle ofepiglottis, and arytenoids, which close the laryngeal inlet almost entirely), (ii) false cords, and (iii) real cords, which close the glottis. As a result, no external substance can enter the larynx unless it is ingested or mistakenly vomited.

When food comes into touch with the posterior pharyngeal wall or the base of the tongue, a reflex triggered by different flibres of the ninth nerve temporarily stops breathing.

When an external particle comes into touch with the respiratory mucosa, cough is a vital and strong mechanism for dislodging and expelling it. The larynx is properly referred to as the "watch dog" of the lungs since it "barks" when a foreign visitor enters.

2.3 Phonation

The larynx is similar to a wind instrument. The mechanism that produces voice is as follows:

First is the vocal cords are kept in an adducted attitude. Secondly the exhaled air from the lungs is compressed by the thoracic and abdominal muscles, resulting in infraglottic air pressure. Finally, the air force opens the vocal cords and is released as little puffs, vibrating the cords and producing sound, which is amplified by the mouth, throat, nose, and chest.

This sound is converted into speech by the modulatory activity of the lips, tongue, palate, throat, and teeth. The pitch of sound is determined by the frequency at which the vocal cords vibrate, whereas the intensity of sound is determined by the air pressure produced by the lungs.

2.4 Respiration

The larynx controls airflow into the lungs. During inspiration, the vocal chords abduct, and during expiration, they adduct.

2.4.1 Fixation of the chest

When the larynx is secured, the chest wall is stabilised, allowing the thoracic and abdominal muscles to function optimally. Digging, tugging, and climbing all require this function.

A fixed thoracic cage against a fastened glottis is also required for coughing, vomiting, defecation, micturition, and childbirth.

2.5 Etiopathogenesis

A vagus nerve or its recurrent laryngeal nerve branch disease process causes vocal cord paralysis (VCP). Although indirect laryngoscopy is commonly used to make the clinical diagnosis, the pathophysiology is more elusive. The source of the problem could be in the thorax, neck, or cerebral space. Because the nerve's longer length presents increased vulnerability, particularly within the mediastinum, more often, the left recurrent laryngeal nerve branch is damaged [6].

Inappropriate vocal cord motion causes partial airway blockage, which is known as vocal cord dysfunction [7]. Patients may have respiratory difficulty, which is frequently misdiagnosed as asthma. Exercise, psychological issues, airborne irritants, rhinosinusitis, gastroesophageal reflux disease, and the use of certain medicines can all induce vocal cord dysfunction. Among the possibilities include asthma, angioedema, vocal cord tumours, and vocal cord paralysis. Pneumofunctional testing with a flow-volume loop and flexible laryngoscopy are excellent diagnostic procedures for confirming vocal cord dysfunction [8].

The commonest cause of VCP in hospitalised patients is surgical trauma, particularly thyroidectomy. Before VCP is termed idiopathic, the potential of a neoplasm must be excluded. VCP can also be caused by a benign thyroid tumour. Radiation-induced cranial nerve paralysis in patients with head and neck cancer may also play a role [9].

2.6 Evaluation

The follow investigations can help in diagnosis:

Etiology includes scarring due to intubation or inflammatory disorders, iatrogenic causes like surgical traumas, malignancy, CNS pathologies like.

stroke, CNS tumors and systemic diseases like ALS, Guiilain barre syndrome. Vocal cord paralysis can cause consequences such as a weak cough, trouble swallowing, dysphagia, stridor, hoarseness, aspiration risk, granuloma formation, airway blockage, and a lower quality of life. Various treatment modalities like tracheostomy, usage of botulinum toxin, arytenoidectomy, cordotomy, reinnervation and gene therapy are used.

Laryngeal electromyography: This test is performed in the office while the patient is awake to examine the status of the laryngeal muscles' innervation, which can help predict the length of paralysis and recovery potential after a neurologic injury.

An infant's thyroid cartilage is flat. The cricoid cartilage overlaps it, and the hyoid bone overlaps it as well. When executing a tracheostomy, the cricothyroid and thyrohyoid gaps are narrow and difficult to distinguish as landmarks.

The larynx of an infant is small, and the cricoid cartilage's diameter is smaller than the glottis', making the subglottis the narrowest section. It influences the choice of a paediatric endotracheal tube.

The submucosal tissues of an infant's larynx are rather flexible and can easily oedematize in response to trauma or inflammation, resulting in blockage.

The larynx of an infant goes through two growth spurts. The larynx increases in width and length throughout the first three years of life, obviating the necessity for airway surgery in certain congenital defects. When the thyroid angle expands during puberty, the second growth spurt begins. The length of the vocal cords lengthens, resulting in puberty-related voice alterations (see puberphonia). The larynx progressively falls to adult level as the neck grows, with the vocal cords lying face to face with C5 [10].

3. COMPLICATIONS

The following issues can occur as a result of vocal cord paralysis:

Altered voice quality
Weak cough
Swallowing problems
Feeding problems
Hoarseness
Stridor

Dyspnoea
Aspiration danger
Obstruction of the airway
Granuloma Formation is a type of granuloma that is
Chondritis Arytenoid
Tracheostomy is related with a lower quality of life.
Airway fire caused by lasers
Formation of scars

4. MANAGEMENT

Acute episodes are treated with reassurance, breathing coaching, and the use of a helium and oxygen mixture (heliox) [11]. An infant's thyroid cartilage is flat. The cricoid cartilage overlaps it, and the hyoid bone overlaps it as well. When executing a tracheostomy, the cricothyroid and thyrohyoid gaps are narrow and difficult to distinguish as landmarks.

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Imaging is used to study vocal cord palsy, and cord palsy should be considered an indication of a more serious underlying problem. In order to determine the disease process at hand, the reporting radiologist must be knowledgeable with the architecture of the vagus and recurrent laryngeal nerves [12-22].

Other treatment modalities: Tracheostomy, Usage of botulinum toxin, Arytenoidectomy, Cordotomy, Reinnervation, Gene therapy.

5. CONCLUSION

Vocal cord paralysis is a clinical condition in which the nerve impulses that are being carried to the voice box (larynx) are hampered, hence leading to the toughness of the vocal cord muscles. Vocal cord palsy is a potentially fatal consequence of a variety of paediatric operations [13]. Vocal cords play a pivotal role in speaking and breathing , this capacity to talk or even breath is compromised by vocal cord paralysis. The vagus nerve or its recurrent laryngeal nerve branch disease process causes this prevalent ailment. The problem could originate in the thorax, neck, or cerebral cavity. Exercise, mental health concerns, airborne irritants, rhinosinusitis, and gastroesophageal reflux illness are all factors to consider [14]. All of these factors, as well as the infant's thyroid cartilage is flat. The cricoid cartilage overlaps it, and the hyoid bone overlaps it as well. When executing a tracheostomy, the cricothyroid and thyrohyoid gaps are narrow and difficult to distinguish as landmarks.

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The submucosal tissues of an infant's larynx are rather flexible and can easily oedematize in response to trauma or inflammation, resulting in blockage. are the most common presenting complaints in individuals with vocal cord palsy. Patients may present with respiratory difficulty, which is frequently misdiagnosed as asthma. In most of the cases only one vocal cord is paralysed. Adults can recover in as little as 12 months from idiopathic vocal cord paralysis (or vocal cord paralysis induced by non-transecting nerve injury). Inspite of the fact that 55 percent of patients should recover spontaneously, full recovery can take a long time. Bilateral vocal cord paralysis has a far worse prognosis for complete spontaneous recovery than unilateral vocal cord paralysis [15]. Otherwise, the underlying aetiology and general prognosis of this root cause are the most important factors in glottic function recovery.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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