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Postoperative Vocal Cord Paralysis in Patients with Preoperative Unilateral Recurrent Laryngeal Nerve Injury: A Case Report and Review of the Literature

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Abstract

Airway injury is one of the common complications after endotracheal intubation under general anesthesia. According to the US Closed Claims Database, the larynx is the most common site of airway injury during endotracheal intubation, accounting for one-third of all airway injuries. Common laryngeal injuries include traumatic granuloma, hematoma, and vocal cord paralysis, but only 20% of cases are related to intubation difficulties [1]. Granuloma or hematoma can often be detected using visual equipment for a definitive diagnosis. Vocal fold paralysis is not easily identified during extubation and often causes upper respiratory tract obstruction or even aspiration pneumonia [2,3]. In severe cases, it can be life-threatening. Vocal fold paralysis is mainly manifested as a disorder of vocal fold adduction or abduction. In patients with complete vocal fold paralysis, the vocal fold is often fixed in the paramedian position. The causes of vocal fold paralysis can be roughly divided into three categories: recurrent laryngeal nerve injury, cricoarytenoid joint dislocation, and glottic edema [4]. This article reviews the literature on vocal cord paralysis after surgery in a patient with preoperative recurrent laryngeal nerve injury, analyzes the causes of its occurrence, and explores the diagnosis and prevention procedures for similar cases.

Keywords

Vocal Cord Paralysis, Recurrent Laryngeal Nerve Injury, Cricoarytenoid Joint Dislocation, Glottic Edema, Postoperative Airway Complication, Arytenoid Dislocation

Introduction

Vocal cord paralysis is a rare but serious complication following general anesthesia, especially in patients with a history of recurrent laryngeal nerve injury. In such cases, even standard airway management may lead to bilateral vocal cord dysfunction, resulting in airway obstruction or respiratory distress. This article presents a case of postoperative dyspnea in a patient with preoperative unilateral recurrent laryngeal nerve injury and reviews relevant literature to explore underlying causes, diagnostic methods, and preventive strategies.

Case Report

Clinical Data:

A 59-year-old female patient weighing 43 kg and 160 cm in height diagnosed with 1. thoracic spinal canal

occupying 2. post-thyroidectomy underwent "T3 intraspinal space-occupying resection + T3 nerve root adhesiolysis + T3 spinal cord adhesiolysis + T3 laminectomy" under general anesthesia.

The patient underwent physical examination in the local hospital before surgery, and MRI showed that the nodule in the spinal canal of the T3 vertebral plane was about 6*8 mm in size. Review of the patient's medical history revealed that the patient had undergone total thyroidectomy in a local hospital more than 10 years ago. It was difficult to speak half a year after operation. The patient had shortness of breath symptoms after catching a cold nearly half a year ago. The diagnosis was recurrent laryngeal nerve injury after surgery.

The preoperative physical examination, blood tests, electrocardiogram, pulmonary function test, and echocardiography were normal and airway assessment revealed no abnormalities. Routine anesthesia induction and maintenance were performed on the patient. Midazolam 2 mg, penehyclidine hydrochloride 0.5 mg, sufentanil 15 μg, cisatracurium 6 mg were used for anesthesia induction and then 7.0 #enhanced endotracheal tube was inserted smoothly. Routine monitor including oxygen saturation, heart rate, noninvasive blood pressure, and pulse rate are used. Remifentanil 0.1 μg/kg/min–0.18 μg/kg/min and propofol 4 mg/kg/h were continuously pumped for anesthesia maintenance. The operation lasted for 4.7 h. The tube was successfully extubated after operation. The patient returned to the ward safely after surgery.

At 5 PM on the first day after surgery, the patient was found to be lethargic and the muscle strength of both lower limbs was grade 0. CT three-dimensional imaging scan of thoracic vertebrae showed scattered gas accumulation in T1–4 adjacent cervical thoracic canal and surrounding soft tissues. Emergency thoracic subcutaneous and epidural gas drainage was planned under local infiltration anesthesia by neurosurgeon and anesthetist do monitored anesthesia care.

Routine monitoring was performed after admission to the operating room. The operation was started after local infiltration with 2% lidocaine in prone position. 75 minutes later, the surgeon suggested that general anesthesia was required for thoracic subcutaneous and epidural gas incision for puncture pumping can't completely exhaust the gas. Using modified rapid sequential induction method, propofol 30 mg, sufentanil 10 μg, and scoline 50 mg were injected intravenously. An ID 7.0 mm reinforced endotracheal tube with wire was successfully inserted under video laryngoscope. No abnormality was found during intubation. Anesthesia was maintained with cisatracurium and 2% sevoflurane during the operation, and the operation was successfully completed.

The patient recovered well after 15 minutes of spontaneous respiration (tidal volume: 339 ml, frequency: 15 bpm, end-tidal carbon dioxide: 35 mmHg), able to raise head according to instructions, then extubated. Because the duration of surgery was short, and there was no abnormality in vocal cords observed by video laryngoscope during intubation, we did not visualize the vocal cords using video laryngoscopy during extubation.

After extubation, the patient developed obvious laryngeal sounds, three concave signs, able to answer questions simply, but complaining of slight dyspnea. At this time, mask oxygen inhalation was 5 L/min, finger pulse oxygen saturation was 100%, heart rate was 100 bpm, blood pressure was 120/80 mmHg, and auscultation breathing sounds in both lungs were clear and symmetrical.

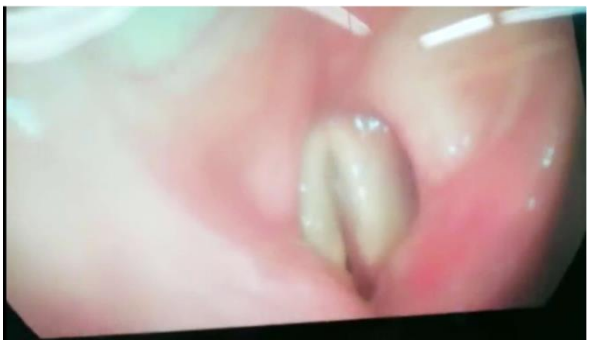

Fig-1: Fiberoptic Bronchoscopy Revealed Bilateral Vocal Cord Fixation

Mask oxygen inhalation, sputum suction and methylprednisolone 80 mg intravenous injection were

given. After observation for 20 min, the symptoms were not improved. Blood gas analysis showed PH: 7.2, PO_2: 158.1 mmHg, PCO_2: 67 mmHg, and other indicators were normal. Fiberoptic bronchoscopy was performed, and transnasal endoscopy was performed to expose the glottis. Bilateral vocal cord fixation and glottis opening restriction were found, as shown in **(Fig-1)**.

After consultation by otolaryngologists, it was highly suspected that the patient had bilateral vocal cord movement restriction. Considering the patient's dyspnea, which may be further aggravated and life-threatening, the anesthesiologist, otolaryngologist and neurosurgeon agreed to intubate the patient conservatively after communication with the patient's family. If the tube could not be extubated later, the otolaryngologist should be contacted for tracheotomy.

Therefore, the improved rapid sequence induction method was still used, propofol 50 mg and skolin 50 mg were intravenously administered, and then tracheal intubation was performed. The glottis was slightly more open after muscle relaxants were administered under video laryngoscope, see **(Fig-2)**. The patient was taken back to the neurosurgical ward with endotracheal tube for further monitoring.

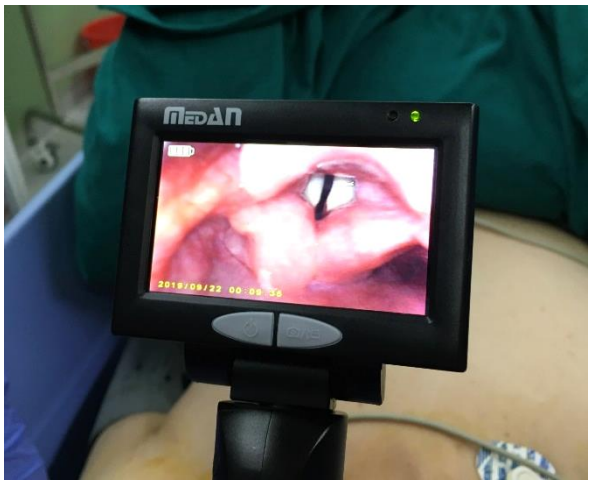

Fig-2: Glottis Opening After Muscle Relaxants

On the first day after surgery, the patient was conscious and recovered from spontaneous breathing. He was using a ventilator to assist breathing, and the sedation drugs were gradually reduced. An otolaryngologist consulted and said that the patient had high spinal cord damage. Currently, the movement of the chest, waist and lower limbs is limited, and the patient is unable to complete choking, and there is a history of re-intubation due to weakened glottic activity. It is recommended to continue sedate and ventilator support as well as hormonotherapy. After a comprehensive evaluation, extubation or tracheotomy should be considered for shutdown.

On the second day after operation, neurosurgeon prepared bedside tracheotomy bag and extubated trachea. After extubation, vital signs of patient were stable and spontaneous respiration was slightly weak.

On the sixth day after operation, patient's general condition was fair, consciousness was clear, vital signs were stable, muscle strength of both lower limbs was grade 1–2, light sensation of left lower limb gradually recovered, deep sensation of right lower limb disappeared, and patient was transferred to lower hospital for further treatment.

Comprehensive consideration of the patient's postoperative conditions, it was judged that the patient had difficulty breathing after extubation due to glottic paralysis caused by unilateral recurrent laryngeal nerve injury before operation combined with postoperative glottic edema.

Discussion

The patient experienced post-extubation dyspnea after two endotracheal intubation general anesthesia within 2 days. The main causes of post-extubation dyspnea were: 1) pulmonary ventilation function: respiratory center, respiratory muscle strength, respiratory tract patency; 2) pulmonary gas exchange: respiratory membrane, ventilation blood flow ratio. See **(Fig-3)** for specific judgment and treatment process.

After the operation anesthesia, the patient's grip strength recovered and nodded and opened her eyes according to instructions. The spontaneous respiration recovered well, excluding dyspnea caused by central depression, suggesting that the most likely cause of ventilation dysfunction was impaired respiratory tract patency. After auscultation ruled out abnormal conditions of lower respiratory tract patency, it was preliminarily judged that the abnormal conditions of the patient were located in upper respiratory tract.

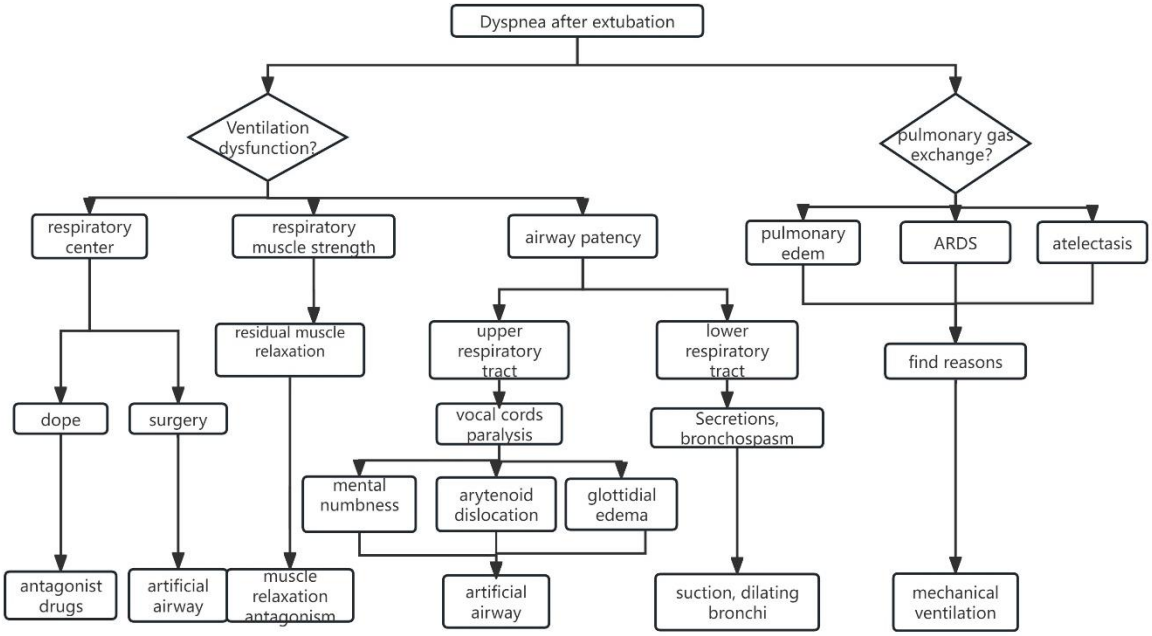

Fig-3: Flow Chart of Judgment and Treatment of Dyspnea After Extubation

Causes of Impaired Upper Airway Patency

Laryngospasm, vocal cord paralysis: 1) recurrent laryngeal nerve injury, 2) cricoarytenoid joint dislocation, 3) unilateral recurrent laryngeal nerve injury combined with glottic edema before operation.

Laryngospasm:

The glottis closure is caused by involuntary spasm of laryngeal muscles caused by stimulation of the superior laryngeal nerve. The common inducement is noxious stimulation or laryngeal inflammation stimulation under light anesthesia, which can be divided into partial and complete laryngeal spasm.

Partial laryngeal spasm is characterized by pig humming or bird singing, visible chest fluctuation, and the three concave signs may not be obvious. Some of them can be relieved by continuous positive pressure ventilation of 100% O_2, and some need propofol or inhaled anesthetics to deepen anesthesia.

Complete laryngospasm is characterized by no fluctuation of thorax and obvious three-concave sign. Propofol or succinylcholine should be used immediately. Tracheal intubation should be used if necessary to maintain respiration [5].

In our case report, the patient was completely awake. Despite oxygen inhalation, sputum suction, and intravenous injection of methylprednisolone 80 mg performed through mask, the symptoms were not improved after observation for 20 min. The possibility of laryngospasm was considered unlikely.

Vocal Cord Paralysis:

1. Cricoarytenoid joint dislocation refers to the arytenoid cartilage annulus losing its normal anatomical position in the joint capsule. The preoperative intubation is smooth without violent intubation operation. The operation duration is relatively short. However, in our case report, considering that the patient was operated in prone position and intubated twice in a short time, it cannot be completely ruled out.

However, when the cricoarytenoid joint is dislocated, the direct laryngoscope shows congestion and swelling of the spoon cartilage mucosa, and the glottic fissure is not an isosceles triangle. Therefore, the diagnosis can be ruled out.

This patient had a history of dysphasia half a year after thyroid surgery before surgery. It was judged that the patient's previous surgery might be complete paralysis of the unilateral recurrent laryngeal nerve, which was fixed in paramedian position. Under this

condition, after a period of compensation of the other vocal cord, the normal vocal cord could cross the midline and close with the other vocal cord, and the vocal cords completely extended during inhalation [2], so in our case, the patient's dysphasia could be recovered after half a year.

Patients with a history of unilateral recurrent laryngeal nerve injury before surgery may have difficulty extubating due to breathing difficulties caused by various reasons.

2. The recurrent laryngeal nerve on the other side is damaged:

After bilateral recurrent laryngeal nerve injury, bilateral laryngeal muscles lose recurrent laryngeal nerve innervation, glottis opening and closing difficulties, resulting in dyspnea or even suffocation. However, in our case, the patient had no risk factors for recurrent laryngeal nerve injury, like surgical site adjacent to recurrent laryngeal nerve, so it was considered that bilateral recurrent laryngeal nerve injury caused by damage to the other recurrent laryngeal nerve caused by endotracheal intubation was less likely.

3. Glottic Edema:

In our case, the patient had a history of recurrent laryngeal nerve injury before operation and underwent secondary operation in a short time. Moreover, the patient was operated in prone position. The endotracheal tube inserted was a reinforced endotracheal tube with a diameter larger than that of an ordinary endotracheal tube. It was considered that glottic stenosis caused by recurrent laryngeal nerve injury before operation combined with glottic edema might lead to wheezing after extubation.

Literature Review

We systematically searched PubMed, EMBASE, Medline, CNKI, Wanfang and VIP for articles related to vocal cord paralysis after general anesthesia intubation up to August 2021. The search strategy was a comprehensive search method of subject word search and free word search. The language was limited to Chinese and English.

Finally, 204 articles were retrieved. 29 articles were finally retrieved by reading titles and abstracts to screen relevant medical reports (**Table-1**, related to recurrent laryngeal nerve injury).

Table-1: Review of Case Reports on Causes of Postoperative Vocal Cord Paralysis (Recurrent Laryngeal Nerve Related)

Study	Year	Patients	Type of Surgery	Duration of Surgery	Cause of Vocal Cord Paralysis	Difficult Intubation	Symptom
YOUNG N et al	1953	3	Hysterectomy	none	Intubation injury	unclear	Hoarseness
		2	Appendicectomy	none	Unknown	unclear	Hoarseness
		1	Rectal cancer	none	Limited cricoarytenoid joint mobility	unclear	Dyspnea
		1	Gastrointestinal	none	Unknown	unclear	Hoarseness
		3	Thyroidectomy	none	Unknown	unclear	Hoarseness
		1	Left fenestration	none	Unknown	unclear	Hoarseness
Yamashita T et al	1965	19	Thyroidectomy	different	Surgical injury	unclear	Wheeze, hoarseness
		2	Trauma	none	Damage	unclear	Wheeze, hoarseness
		2	Arthritis	none	Inflammatory injury	no	Wheeze, hoarseness
		1	Syphilis	none	Unknown	no	Wheeze, hoarseness
		1	Unknown cause	none	Unknown	no	Wheeze, hoarseness
Spinadel L	1968	1	Gastrostomy	35 min	Tumor infiltration	no	Dyspnea, cyanosis
Frederick W et al	1970	5	Gastrointestinal	205 min	Unknown	no	Hoarseness
			Gastrointestinal	165 min	Unknown	no	Hoarseness
			Total cystectomy	370 min	Unknown	no	Hoarseness
			Craniocerebral	155 min	Unknown	no	Voice hoarse
			Mastoid operation	230 min	Unknown	no	Hoarseness, cough

Steele Holley	1971	4	Femoral aortic bypass	405 min	Unknown	no	Airway obstruction
			Left thyroid	120 min	Unknown	no	Obstruction, wheezing
			Craniotomy	360 min	Unknown	no	Wheeze
			Craniocerebral	55 min	Unknown	no	Airway obstruction
Komorn R M et al	1973	6	Colon cancer	210 min	Nerve injury	no	Hoarseness
			Liver surgery	120 min	Nerve injury	no	Hoarseness
Minuck M	1976	1	Hysterectomy	90 min	Endotracheal tube compression	no	Hoarseness
Charlotte et al	1980	1	Electrocystectomy	none	Myasthenia gravis	no	Wheezing, dyspnea
Juhani et al	1981	1	Appendicectomy	none	Unknown aetiology	no	Hoarseness
Cox R.H. et al	1981	3	Non-neck surgery	none	Head position change	unclear	Hoarseness
GIBBIN et al	1981	1	Caesarean section	none	Endotracheal tube compression	no	Wheeze
Michael et al	1989	1	Left shoulder	none	Transesophageal ultrasound compression	no	Hoarseness
Inomata et al	1995	1	Hysterectomy	97 min	Laryngeal mask airway compression	no	Sore throat
Laurse et al	1998	1	Ovarian cyst	95 min	Tracheal cuff compression	no	Hoarseness
Kanski et al	1999	1	Diaphragmatic hernia repair	170 min	Gastric intubation	no	Dysphonia
Mark et al	2000	1	Release of lower limbs	90 min	Laryngeal mask airway compression	no	Inspiratory wheezing
Yang Yicheng	2001	1	Head trauma	none	Head position change	no	Aphony
Kenneth et al	2002	2	Colon	180 min	Axonal injury	no	Wheeze
			Gastrointestinal	360 min	Denervated	no	Wheeze
WASON R et al	2004	1	Burn and plastic	120 min	Tracheal balloon compression	no	Hoarseness
Yue Qi	2007	1	Cholecystectomy	none	Unknown aetiology	no	Water aspiration
Kazuhira et al	2007	1	Shoulder procedure	425 min	Compression of laryngeal mask	no	Dyspnea
Dae Myoung Jeong	2010	1	Pulmonary lobectomy	60 min	Double lumen tube cannula	no	Gasp
Mee Young et al	2012	1	Colon cancer	360 min	Unknown aetiology	no	Hoarseness
Tekin et al	2012	1	Lip surgery	300 min	Unknown aetiology	no	Dyspnea
Yeun Hee et al	2013	1	Nephrectomy	150 min	Cuff compression	no	Hoarseness
Rajnish K et al	2015	1	Urological procedures	480 min	Intraoperative hypotension	no	Hoarseness
Hamdi et al	2017	1	Middle ear	300 min	Postural change	no	Hoarseness
Claudia et al	2017	1	Laparoscopic	330 min	Unknown aetiology	no	Hoarseness
Sun Xiaodi et al	2020	1	Prostate	30 min	Surgical drug withdrawal	no	Wheeze

Table-2: Review of Case Reports on the Cause of Postoperative Vocal Cord Paralysis (Cricoarytenoid Dislocation)

Study	Year	Patients	Type of Surgery	Duration of Surgery	Cause of Vocal Cord Paralysis	Difficult Intubation	Symptom
Yupadi et al	1974	1	Open heart surgery	450 min	Posterior dislocation of cricoarytenoid joint	no	Hoarseness
Nicholls et al	1986	1	Laparotomy	none	Unknown aetiology	no	Hoarseness
Eward et al	1988	1	Mastectomy	480 min	Posterior dislocation of endotracheal tube	no	Sore throat
Castella et al	1991	1	Gastrointestinal surgery	180 min	Dislocation of endotracheal tube	no	Respiratory failure
Gauss et al	1993	1	Urological procedures	none	Dislocation of endotracheal tube	yes	Foreign body in pharynx
Christina et al	1994	1	Intestinal polypectomy	240 min	Dislocation due to light rod intubation	no	Hoarseness
Y.T.Hiong et al	1996	1	Heart surgery	none	Anterior detachment due to catheter or laryngeal lens	no	Hoarseness
Rosenberg et al	1996	1	Total knee arthroplasty	50 min	Anterior dislocation of laryngeal mask	no	Hoarseness
Michael et al	1996	1	Thyroid surgery	none	Unknown aetiology	no	Dyspnea

		1	Coronary artery surgery	none	Unknown aetiology	no	Hoarseness
		1	Unknown	none	Unknown aetiology	no	Dyspnea
		1	CPR	none	Posterior dislocation due to endotracheal intubation	no	Hoarseness
		1	Throat surgery	none	Unknown aetiology	no	Hoarseness
		1	CPR	none	Unknown aetiology	no	Hoarseness
Tadashi et al	2001	1	Neurosurgery	360 min	Anterior dislocation due to laryngoscope	yes	Hoarseness
Wang et al	2003	1	Heart surgery	none	Unknown aetiology	no	Dysphonia
Y. NITA et al	2007	1	Heart surgery	355 min	Anterior dislocation caused by esophageal ultrasound	no	Hoarseness
Ninet et al	2008	1	Septoplasty	none	Anteromedial dislocation of cricoarytenoid joint	no	Hoarseness
A. Afonso et al	2011	1	Gastrointestinal endoscopy	none	Endoscopic dislocation	no	Dysphagia
Vadim Goz et al	2012	1	Cervical vertebra surgery	90 min	Unknown aetiology	no	Hoarseness
Nobuyasu et al	2013	1	Pulmonary lobectomy	none	Posterior dislocation caused by double-lumen tube	no	Hoarseness
Xing et al	2014	1	Colonic tumor resection	270 min	Unknown	no	Hoarseness
Tak Kyu et al	2015	1	Uterine surgery	240 min	Transesophageal dislocation by stethoscope	no	Hoarseness
Oppenheimer	2015	1	Electrical cardioversion	none	Anterior dislocation of endotracheal tube	no	Hoarseness
Yeo Hae et al	2015	1	Shoulder procedures	150 min	Posterior dislocation due to postural changes	no	Hoarseness
Jie et al	2016	1	Laparotomy	360 min	Reason is unknown	no	Hoarseness
Kuo-Chuan et al	2016	1	Cholecystectomy	300 min	Dislocation due to gastric tube insertion	no	Water aspiration
Zhuolin et al	2016	1	Cervical vertebra surgery	130 min	Unknown aetiology	no	Hoarseness
Eun H et al	2017	1	Urological procedures	25 min	Arytenoid dislocation	no	Inspiratory wheezing
Tang et al	2018	1	Laparotomy	210 min	Arytenoid dislocation	no	Hoarseness
Geng Zhi Yu et al	2019	1	Urological procedures	360 min	Laryngeal mask dislocation	no	Hoarseness
Yang Lin et al	2021	1	Pancreaticoduodenectomy	435 min	Anterior dislocation of laryngeal mask	no	Hoarseness

Table-3: Review of Case Reports on Causes of Postoperative Vocal Cord Paralysis (Vocal Cord Edema)

Study	Year	Patients	Type of Surgery	Duration of Surgery	Cause of Vocal Cord Paralysis	Difficult Intubation	Symptom
Shaw WW et al	1946	1	Burn operation	153 min	Edema due to duration and position	yes	Acute airway obstruction
Robert K et al	1968	4	Heart surgery	145 min	Supraglottic edema	no	Wheeze
			Heart surgery	150 min	Glottidial edema	no	Wheeze
			Heart surgery	180 min	Glottidial edema	no	Wheeze
			Heart surgery	150 min	Glottidial edema	no	Wheeze
Bennett et al	1981	1	Craniocerebral operations	690 min	Hyperextension edema of head and neck	no	Hoarseness
Ki Jinn et al	2005	1	Reduction of radial fracture	none	Glottic edema due to laryngeal mask	no	Gasp
Vanda G et al	2008	1	Thoracoscopic lung surgery	none	Patient hypersensitivity to dual lumen tube	no	Can't move catheter
Yukari et al	2011	1	Gastrointestinal endoscopy	none	Mucosal trauma edema due to gastroscopy	unclear	Sore throat
Sara et al	2016	1	Knee surgery	none	Uvula edema due to laryngeal mask airway	no	Foreign body sensation in throat

Combining the causes of vocal cord paralysis and preventing the omission of retrieved articles, the same method was used to retrieve articles on cricoarytenoid joint dislocation and glottic edema after general anesthesia, including 27 articles related to cricoarytenoid joint dislocation after general anesthesia (**Table-2**) and 7 articles related to glottic edema after general anesthesia (**Table-3**).

A total of 78 patients in **Table-1** experienced vocal cord paralysis after general anesthesia, including 13 types of surgery. Only 2 case reports mentioned thyroid surgery [6,7]. Nerve injury may be related to surgical trauma. The average operation time is 209 minutes, which is consistent with Kikura's suggestion that the operation time is 3–6 hours and the probability of postoperative vocal cord paralysis increases twice [8]. There are 23 patients who do not find the specific cause of vocal cord paralysis. The most common cause was compression of the endotracheal tube cuff, which was reported in 8 patients as being related to pressure or position of the endotracheal tube cuff. The second most common cause was the effect of the underlying disease on the laryngeal structure and intraoperative head and neck position changes. Intraoperative hypotension was a rare cause. All cases had no difficulty in intubation before surgery. The most common symptom after surgery was hoarseness or wheezing, which occurred in 16%–55% [9].

A review of the literature suggests that recurrent laryngeal nerve-related vocal cord paralysis following general anesthesia intubation may be caused by mechanical injury or neurogenic injury [2].

According to Ellison and Pallister and Cavo [10], autopsy results show that the anterior branch of the recurrent laryngeal nerve extends to the thyroid cartilage plate to innervate the lateral cricoarytenoid and thyroarytenoid muscles (see **Fig-4**). When the superficial recurrent laryngeal nerve is mechanically injured or the cuff is compressed between the spoon-like cartilage and the thyroid cartilage, the recurrent laryngeal nerve is denervated, resulting in vocal cord paralysis.

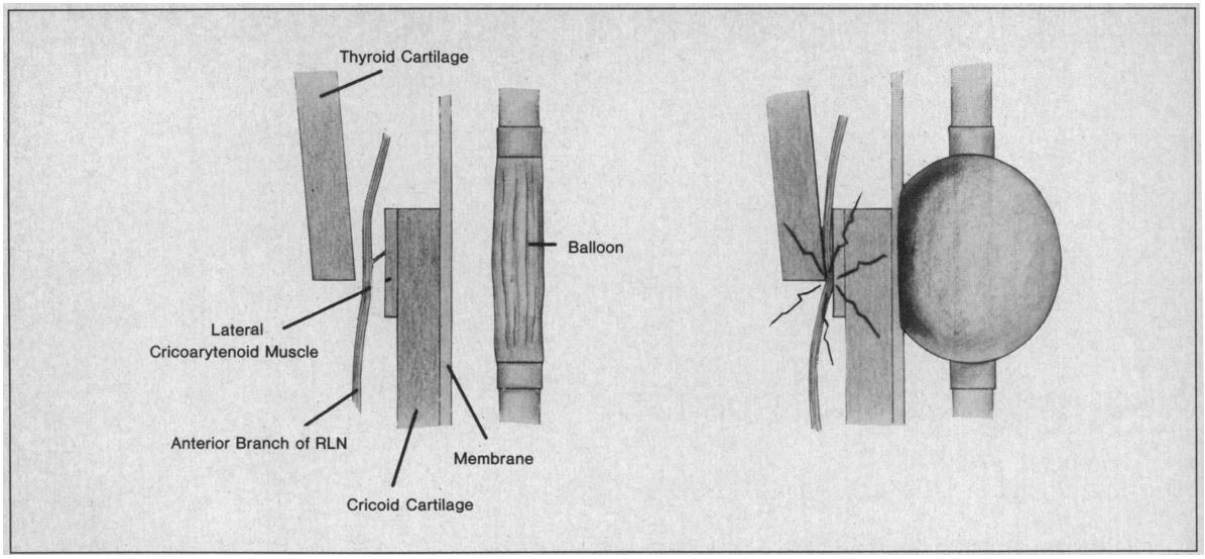

Fig-4: Schematic Diagram of Recurrent Laryngeal Nerve Damage

The sources of injury can be classified into four categories: mechanical injury from endotracheal tube tip or direct laryngoscope and videolaryngoscope, denervation injury from oversize or misplaced endotracheal tube and excessive cuff pressure, chemical injury due to endotracheal tube sterilization or paraffin oil, gastric tube or transesophageal ultrasound placement in the reflux-damaged larynx [11].

Thus, most vocal cord paralysis can be avoided by conscious change and skillful and gentle handling by anesthesiologists. However, for patients who have a history of thyroidectomy before surgery, due to unilateral or bilateral recurrent laryngeal nerve damage

before surgery, bilateral vocal cord paralysis is more likely to occur after reoperation, resulting in serious adverse consequences. Therefore, it is very important for anesthesiologists to deal with this situation through a procedural process.

According to Jhon et al., precautions for reoperation are proposed:

1. Diagnosis of vocal cord condition early after thyroid surgery by direct laryngoscopy or completion of laryngoscopy before secondary surgery.
2. Early tracheotomy after confirmation of bilateral vocal cord paralysis to avoid death due to difficult ventilation or emergency tracheotomy.
3. Expectant treatment for 6 weeks when bilateral vocal cord paralysis is suspected and only a small amount of wheezing occurs [6].

In **Table-2**, there were 34 patients with postoperative cricoarytenoid joint dislocation, including 11 types of surgery, of which 5 cases were related to tissue injury caused by the endotracheal tube, 3 cases were related to emergency intubation during cardiopulmonary resuscitation, 3 cases were related to laryngeal mask injury, and 3 cases were related to transoral esophageal insertion, such as transesophageal ultrasound, gastric tube, etc. This is consistent with Takkyu et al.'s view that cricoarytenoid joint dislocation mostly originates from iatrogenic injury [12].

Lingeer Wu et al. pointed out that prolonged operation time increases the incidence of cricoarytenoid dislocation [13], and summarized that the average operation time in the literature is 264 minutes, so it is prone to cricoarytenoid dislocation.

There were 10 patients in **Table-3** and 7 types of surgery. The most common type of surgery was cardiac surgery, which was related to the duration of cardiac surgery, with an average operation duration of 266 minutes. Glottic edema often occurred in loose connective tissue on the anterior surface of the epiglottis and on the aryepiglottic fold, which was related to mechanical damage of the endotracheal tube to the periglottic mucosa [14].

The origin of cricoarytenoid joint dislocation and vocal cord edema is similar to that of recurrent laryngeal nerve injury [15]. 87% of cricoarytenoid joint dislocation is caused by endotracheal intubation [16], but the injury occurs in different parts of the larynx and the stress applied to the wound site varies. Posterior dislocation of the cricoarytenoid joint is often associated with extubation and presents as sore throat and dysphagia; anterior dislocation is associated with intubation and presents as hoarseness [9,12]. However, posterior dislocation may also occur during intubation and may be related to the posterolateral force exerted on the spoon cartilage by the bending of the lower third of the endotracheal tube during intubation [17].

Patients with preoperative recurrent laryngeal nerve damage are more likely to develop postoperative cricoarytenoid joint dislocation. Similarly, laryngomalacia, renal insufficiency, acromegaly, or long-term use of corticosteroids may weaken the stability of the cricoarytenoid joint and thus facilitate dislocation [9,17].

Posture changes also increase the risk of dislocation [18], but are more important in postoperative glottic edema [19,20]. During prone position surgery, the curvature of the neck can cause the tracheal tube to bend, leading to compression of surrounding tissues and potentially causing vocal cord edema [20]. Junko Ito et al. noted that patients undergoing spinal surgery in a prone position may develop glottic edema, which follows the same mechanism as previously described [21].

In our case, it was also considered that the disturbance of venous and/or lymphatic flow of the anterior neck due to extensive neck anteflexion during the surgery in prone position had induced the laryngopharyngeal edema.

In general, identifying the cause of vocal cord paralysis requires some necessary auxiliary examinations, such as direct laryngoscope to determine the situation around the glottis, including whether the vocal cord is moving and the presence of a "collision sign" indicates nerve paralysis, whether there is associated trauma edema around the glottis, and the

position of the cricoarytenoid joint.

A high-resolution CT scan identifies arytenoid dislocation, but a negative scan does not rule out dislocation—especially in young patients, where cartilage often does not ossify and is difficult to assess. Stroboscopic laryngoscopy can clearly identify flashes of muscle activity and coexisting pathology to accurately diagnose cricoarytenoid dislocation. Laryngeal electromyography can also help rule out recurrent laryngeal nerve paralysis to confirm the diagnosis.

In the treatment of vocal cord paralysis, the most important thing is to seize the opportunity of treatment after early diagnosis. Generally speaking, throat discomfort such as hoarseness, wheezing, and dysphagia after operation should alert clinicians to the occurrence of vocal cord paralysis.

Discomfort 2–3 days after operation is generally glottic edema. In our case, the patient was extubated on the second day after surgery and recovered completely on the sixth day after surgery. Discomfort 3 days to 6 weeks after operation is mostly recurrent laryngeal nerve paralysis, while discomfort over 6 weeks should raise suspicion of dislocation of the cricoarytenoid joint (see **Fig-5**).

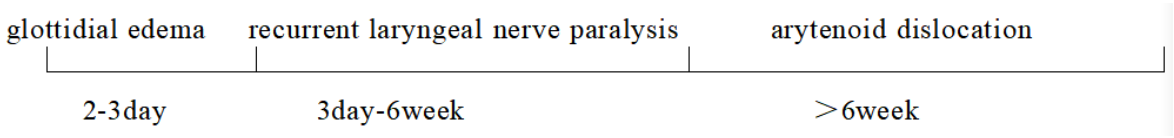

Fig-5: Causes of Postoperative Vocal Cord Paralysis Timeline

Treatment duration affects prognosis in patients with cricoarytenoid dislocation. Treatment duration within 10 weeks is associated with a good prognosis, while treatment beyond 29 weeks is associated with a poor prognosis.

It is important to note that patients with complete paralysis of the unilateral recurrent laryngeal nerve have a high possibility of postoperative dyspnea and difficulty in extubation.

In our case report, this was not done well because we did not ask the patient to undergo video laryngoscopy before the first surgery, and after the second surgery—despite the risk factors for postoperative vocal cord paralysis—we removed the endotracheal tube without performing a cuff leak test or video laryngoscopy to check airway patency. Fortunately, the patient recovered well after surgery.

Therefore, anesthesiologists should pay attention to the following: during the preoperative visit, take a thorough medical history, conduct electronic laryngoscope examination when necessary to assess vocal cord condition, and select an appropriately sized endotracheal tube. Intubation should be gentle to avoid injury; extubation should also be gentle. An air leakage test should be performed when necessary, and violent extubation should be avoided.

More importantly, for extremely high-risk patients—for example, those with a history of unilateral recurrent laryngeal nerve injury before surgery, prolonged operation time (more than 6 hours), or two operations in a short period—the possibility of dyspnea after extubation is increased. The anesthesiologist should be more vigilant: arrange for the patient to enter the ICU with the tracheal tube in place after surgery, delay extubation until airway edema subsides, and ensure that rescue equipment is ready at the bedside to manage potential post-extubation dyspnea. This is critical to ensuring the patient's life safety.

Conflict of Interest

The author has read and approved the final version of the manuscript. The author has no conflicts of interest to declare.

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