

Review

Vocal cord paralysis after open-heart surgery

Abdel Latif Hamdan^{a,*}, Roger V. Moukarbel^a, Firas Farhat^a, Mounir Obeid^b^aDepartment of Otolaryngology – Head and Neck Surgery, American University of Beirut, Beirut, Lebanon^bDepartment of Surgery, American University of Beirut, Beirut, Lebanon

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Summary

Vocal cord paralysis is a known entity often described as a complication of neck surgery. A less frequent site of injury to the recurrent laryngeal nerve is the chest. The left side is usually more affected than the right side in view of its long intrathoracic segment. Only few cases of right vocal cord paralysis following open-heart surgery are reported in the literature. The purpose of this article is to review the common possible mechanisms of injury to the right recurrent laryngeal nerve following open-heart surgery in order to draw the attention of the caring physician to the clinical significance of such a complication. In fact, transient hoarseness following open-heart surgery may be an ominous sign of recurrent laryngeal nerve injury. It should not be assumed to be secondary to intralaryngeal edema. Several mechanisms of injury to the recurrent laryngeal nerve have been suggested: (1) through central venous catheterization; (2) by traction on the esophagus; (3) by direct vocal cord damage or palsy from a traumatic endotracheal intubation; (4) trauma by compression of the recurrent laryngeal nerve or its anterior branch at the tracheoesophageal groove by an inappropriately sized endotracheal tube cuff; (5) by a faulty insertion of a nasogastric tube; (6) median sternotomy and/or sternal traction pulling laterally on both subclavian arteries; (7) direct manipulation and retraction of the heart during open-heart procedures; (8) hypothermic injury with ice/slush. If vocal cord paralysis was overlooked as a possible complication of open-heart surgery, the patient may suffer from dysphonia in addition to problems of paramount importance such as inefficient cough and aspiration. Although it is true that the incidence of vocal cord paralysis remains very low, yet its presence is alarming and necessitates close follow up on the patient for the possible need of surgical intervention if recovery fails. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Vocal cord paralysis is a known entity often described as a complication of neck surgery, mainly thyroidectomy. A less frequent site of injury to the recurrent laryngeal nerve is the chest. Even though it is rare, vocal cord paralysis is a well documented complication of thoracic surgery [1–3]. The left side is usually more affected than the right side in view of its long intrathoracic segment. It is the most common post-operative complication of extended radical esophagectomy for thoracic esophageal cancer, with a rate of 45% as reported by Nishimaki [4]. It has also been recognized as a late complication of mediastinal irradiation secondary to severe fibrosis after ruling out disease recurrence [5].

Recurrent laryngeal injury after cardiac surgery is often overlooked as a cause of post-operative respiratory insufficiency or hoarseness. In the evolutionary surgical treatment of patent ductus arteriosus, a review of 231 cases of PDA

undergoing surgical closure, three patients had vocal cord paralysis among other complications [6]. Phrenic nerve palsy is a more recognizable complication of open-heart surgery with only little emphasis put on recurrent laryngeal nerve palsy. Only few cases of right vocal cord paralysis following open-heart surgery are reported in the literature [7]. The very short course of the right recurrent laryngeal nerve around the subclavian artery before ascending into the neck makes it less prone to injury in thoracic surgery in general and more so in coronary artery bypass surgery. The purpose of this review is to look at the clinical presentation of vocal cord dysfunction and at the common possible mechanisms of injury to the recurrent laryngeal nerve following open-heart surgery. An illustration of the etiology and clinical significance of such a complication is presented.

2. Incidence

The true incidence of vocal cord dysfunction may be hard to draw in case of lack of a routine post-operative laryngeal examination for patients with dysphonia. The etiology most

* Corresponding author. Tel.: +961-1-350000; fax: +961-1-744464.

E-mail address: hb03@aub.edu.lb (A. Latif Hamdan).

Table 1
Clinical presentation of vocal cord paralysis following open-heart surgery

	Unilateral vocal cord paralysis	Bilateral vocal cord paralysis
Onset of symptoms	Days	Hours to days
Time of diagnosis	Days following extubation	Hours following extubation
Voice quality	Breathy, hoarse, weak	Normal or weak
Cough	Usually inefficient	Inefficient (paramedian position) Efficient (median position)
Breathing	Normal	Insufficient
Choking	Present	Present (paramedian) Absent (median)

often remains unclear with inability to point out the exact cause of the paralysis.

Vocal cord dysfunction following open-heart surgery is most often overlooked as a complication. In a study on 421 patients undergoing coronary artery bypass graft surgery, only five patients had unilateral vocal cord paralysis among other peripheral nervous system complications [8]. This is in accordance with other studies that have reported similar incidences of 1–2% [9,10]. The paralysis can be either isolated or in combination with other neuropathies such as phrenic nerve palsy [11]. Other peripheral nervous system complications include brachial radiculoplexopathy, saphenous, peroneal and ulnar mononeuropathies. Isolated Horner syndrome and facial neuropathy were also reported [8]. The dysfunction can affect one cord with hoarseness being the complaint, or both cords with resultant respiratory insufficiency [9].

3. Clinical presentation

Patients with unilateral vocal cord paralysis usually present with history of dysphonia, i.e. change in voice quality, perceived as hoarseness or breathiness. Moreover, symptoms such as vocal fatigue, loss of range and reduced intensity may impair their communication skills. In addition to these phonatory complaints, they may have inefficient cough and throat clearing, leading to major complications such as aspiration and recurrent pneumonia. This sensation of choking on food or secretions may affect their feeding pattern and quality of life, necessitating surgical intervention. In most reports of unilateral vocal cord paralysis following open-heart surgery, patients had hoarseness for one to few days after extubation [8,11]. In a review by Horn et al., four patients out of 193 had right vocal cord paralysis following open-heart surgery that subsided weeks after the onset [1].

On the other hand, patients with unilateral vocal cord paralysis present with respiratory insufficiency, stridor and obstructive symptoms. This condition should not be overlooked and prompts immediate intervention. Following

general surgical procedures, the cause of stridor is often mistaken for laryngeal spasm. In a post-open-heart surgery condition, it is more often overlooked and mistaken for cardiac or respiratory dysfunction. If not attended to on an urgent basis, patients may decompensate and require reintubation and ventilation. In a study conducted by Shafei et al. [3], five patients out of 270 had bilateral vocal cords paralysis following open-heart surgery. All patients were diagnosed late. All patients had satisfactory weaning criteria from artificial ventilation, however in hours to days, they developed hoarseness and shortness of breath necessitating tracheotomy (Table 1).

4. Mechanisms of injury

Several mechanisms of injury to the recurrent laryngeal nerve have been suggested. The first mechanism is following central venous catheterization, either through direct trauma from the puncture site or secondary to thrombosis, fibrosis or hematoma formation [12]. The second one is traction on the esophagus due to an unnatural position of the head and neck during surgery. The third is direct vocal cord damage or palsy from a traumatic endotracheal intubation [13,14]. The fourth mechanism is trauma by compression of the recurrent laryngeal nerve or its anterior branch at the tracheoesophageal groove by an inappropriately sized endotracheal tube cuff [15]. The fifth is a faulty insertion of a nasogastric tube [12] and/or nasogastric tube syndrome whereby there is ulceration and infection of the post-cricoid area with resultant vocal cord abduction dysfunction [16]. The sixth mechanism is median sternotomy and/or sternal traction pulling laterally on both subclavian arteries. Sternotomy may cause direct trauma to the recurrent laryngeal nerve or indirect injury secondary to excessive sternal traction resulting in either neuropraxia or neurotmesis. The seventh is direct manipulation and retraction of the heart during open-heart procedures. With equal traction or pull on the recurrent laryngeal nerves transmitted from the heart to the major vessels, the shorter right nerve has more force applied to its fibers with more likelihood of being injured

Table 2
Vocal cord paralysis following open-heart surgery

Mechanisms of injury to the recurrent laryngeal nerve	Site of injury to the recurrent laryngeal nerve	Extent of injury (most likely)
Central venous catheterization	Cervical segment Thoracic segment (infraclavicular route)	Neurotmesis (direct injury) Neuropraxia (Hematoma)
Hyperextension of the neck	Cervical segment	Neuropraxia
Traumatic endotracheal intubation	Cervical segment	Neuropraxia
Endotracheal tube cuff	Cervical segment	Neuropraxia
Faulty insertion of the nasogastric tube	Cervical segment	Neuropraxia
Sternotomy	Thoracic segment	Neurotmesis (direct injury) Neuropraxia (traction)
Heart manipulation	Thoracic segment	Neuropraxia
Ice slush	Thoracic segment	Neuropraxia

[7]. The eighth mechanism is hypothermic injury with ice/slush collecting in the pleural cavity in close proximity to the left recurrent laryngeal nerve [11,17]. This problem has decreased markedly with the usage of ice/saline slush instead (Table 2).

Unlike thoracic operations for lung cancer where injury to the recurrent laryngeal nerve is anticipated and a concomitant type I thyroplasty is recommended to prevent post-operative swallowing disability and respiratory complications [18], most of the injuries reported after open-heart surgery appear to be secondary to neuropraxia with no major irreversible damage to the recurrent laryngeal nerve except in few cases [8–10].

5. Evaluation and diagnosis

In the evaluation of vocal cord dysfunction following open-heart surgery, the onset of hoarseness is very important. A key point is the premorbid condition and quality of voice, a question that is often missed and unanswered. This brings up the importance of the pre-operative evaluation of the vocal cords in patients with dysphonia. The diagnosis starts with the perceptual evaluation of the voice and is concluded with the physical examination. In patients with unilateral vocal cord paralysis, the vocal signal is mostly aperiodic and the voice is classified as rough, breathy or hoarse. This quality of voice is due to the glottal incompetence secondary to vocal cord paresis or paralysis. Poor breath support and central neurologic diseases should be ruled out.

In patients with bilateral vocal cord paralysis, the voice may be normal if the cords are in the midline, i.e. in the phonatory position, or breathy and hoarse if they are in the paramedian or lateral position.

For the laryngeal examination, two ways of visualizations are available. One is the fiber optic laryngoscope and the other a rigid telescope with 70 or 90° views. These can be

adapted to a single- or three-chip compact charge-coupled device camera to provide a video-laryngoscopic examination. The overall architecture of the larynx, mainly supra-glottic and glottis, is inspected for any variations or anomalies. Following open-heart surgery, the vocal cords are inspected for any paresis or paralysis. Laryngeal video-endostroboscopy is also being used to diagnose vocal cord impaired mobility and differentiate paralysis from paresis [19].

6. Conclusion

Transient hoarseness following open-heart surgery may be an ominous sign of recurrent laryngeal nerve injury. It should not be assumed to be secondary to intralaryngeal edema. If overlooked, in addition to the dysphonia, complications of paramount importance may occur secondary to the inadequate cough and aspiration. Although it is true that the incidence of vocal cord paralysis remains very low, yet its presence is alarming and necessitates close follow up on the patient for the possible need of surgical intervention if recovery fails. In cases of unilateral paralysis, vocal cord medialization via endoscopic injection or thyroplasty is usually done if spontaneous recovery fails. In cases of bilateral vocal cord paralysis, lateralization procedures such as laser arytenoidectomy can be done.

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