The Laryngoscope

Recovery of Vocal Fold Paralysis After Cardiovascular Surgery

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Objectives/Hypothesis: To review the incidence and time course of recovery of vocal fold paralysis (VFP) in adult patients after cardiovascular surgery.

Study Design: Retrospective cohort study of adults after cardiovascular surgery at a tertiary care academic medical center.

Methods: Patients with VFP after cardiovascular surgery were identified from a database of hospitalized patients undergoing voice and swallow evaluation. VFP was confirmed using transnasal fiberoptic laryngoscopy within 1 week of surgery. Follow-up laryngoscopy was performed in those with VFP in the outpatient clinic. Those with persistent paralysis were followed and the time course of recovery was noted.

Results: Eighty-six adult postoperative cardiovascular surgery patients (ages 34 to 83 years, mean 68) were identified from the inpatient voice and swallowing evaluation database. There were 20 patients (23%) with unilateral VFP. Thirteen patients followed-up for outpatient laryngoscopy. Ten of the thirteen patients (77%) ultimately had complete resolution of VFP. Three patients had persistent paralysis at a mean follow-up of 18 months. There was no obvious correlation between type of cardiovascular surgery and VFP. Signs of recovery were generally evident prior to 6 months and no recovery was seen beyond 12 months.

Conclusions: Most patients with VFP after cardiovascular surgery recover fully. In accordance with previous laryngeal electromyography findings, neuropraxia during cardiovascular surgery will usually recover within 6 months.

Key Words: Vocal fold paralysis, recovery.

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INTRODUCTION

Iatrogenic injury to the recurrent laryngeal nerve (RLN), especially during thyroidectomy, has become the most common etiology of vocal fold paralysis (VFP).[1] Other surgeries that place the RLN at risk and can lead to VFP include carotid endarterectomy, esophagectomy, and anterior approaches to the cervical spine. The majority of patients with VFP after these surgeries will eventually experience full recovery of vocal fold motion.[1–5] However, some patients develop permanent vocal fold paralysis (Table I). An infrequent but well-documented cause of vocal fold paralysis is cardiovascular surgery, such as coronary artery bypass grafting (CABG), orthotopic heart transplantation, heart valve replacement surgery, and aortic arch surgery. The main symptom of unilateral VFP is hoarseness and sometimes dysphagia; in some cases the symptoms are severe enough to cause a significant communication handicap due to breathy dysphonia. In addition, there is a risk of aspiration pneumonia due to laryngeal incompetence during swallowing. Bilateral VFP is very rare after cardiovascular surgery but is potentially fatal due to airway complications,[6,7]

A recent literature review on the incidence of VFP after cardiovascular surgery found that it ranged between 0.67% and 1.9%.[8] The true incidence is difficult to establish as routine postoperative laryngeal examination is usually not performed in patients after cardiovascular surgery. The mechanism of injury to the RLN during cardiovascular surgery is unclear, although several theories have been proposed.[9–11] These proposed mechanisms for VFP during cardiovascular surgery include RLN injury from direct trauma during central venous catheterization or secondarily from thrombosis or hematoma formation afterwards,[12] vocal fold damage from traumatic endotracheal intubation,[13,14] and several anatomical and surgical considerations related to the cardiovascular surgeries themselves. These considerations include median sternotomy with extensive sternal retraction causing stretch injury to the RLN, pressure injury in the postcricoid area from the use of transesophageal echocardiography (TEE), thermal trauma from topical cardioprotective ice slush for myocardial protection during surgery,[15] direct injury during harvesting of the internal thoracic artery, and aortic manipulation.[16–18]

The acute complications after cardiovascular surgery can be quite severe and include hemodynamic

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TABLE I.
Reported Incidences of Persistent VFP.

Reference	Etiology	Median Follow-Up Period, mo	% Incidence of Permanent VFP
Eisele[1]	Thyroidectomy	Variable	0–3.6
Sulica[4]	Idiopathic	Variable	17–87
Espinoza et al.[2]	Carotid endarterectomy	6	4
Morpeth et al.[3]	Anterior approach to cervical spine	12	0.4

VFP = vocal fold paralysis.

instability, respiratory insufficiency, renal failure, and cerebrovascular accident. Therefore, hoarseness after cardiovascular surgery is often overlooked as a minor complication. However, once acute postoperative complications and other medical and surgical issues are resolved, vocal fold paralysis adversely affects the quality of life and hinders further physical and emotional improvement of the patient. Once recovered from cardiovascular surgery, the patient with dysphonia and dysphagia visits the otolaryngologist. If the examination shows VFP, the patient will raise the obvious question: what are the chances the vocal fold mobility will recover to normal? To date, the rate of recovery of vocal fold motion after cardiovascular surgery is unknown as there are no reports in the literature that specifically address this topic. Thus, with the ultimate goal of helping the management of patients in this category, we have followed a group of patients with VFP and report on the long-term recovery of vocal fold motion.

MATERIALS AND METHODS

The institutional review board of the University of California, Los Angeles (UCLA), approved this retrospective cohort study. Adult patients who underwent either elective or emergent cardiovascular surgery were identified from a database of hospital inpatients undergoing voice and swallow evaluation at UCLA Medical Center between July 1, 2005 and March 31, 2008. All cardiovascular surgeries performed on patients in our study population were primary procedures (i.e., no revision cases). Patients with postoperative VFP were diagnosed at the bedside by a single otolaryngologist (D.K.C.) via transnasal flexible laryngoscopy during fiberoptic endoscopic evaluation of swallowing. In order to assess for vocal fold immobility, patients were asked to perform the standard maneuvers for vocal fold motion, specifically phonating the vowel sound "e" for adduction, and performing a short, audible breath through the nose (i.e., sniff) to assess abduction.

Patients with VFP were then examined again during a follow-up outpatient clinic visit. Transnasal flexible fiberoptic laryngoscopy was repeated to assess vocal fold motion by the same otolaryngologist. Patients with persistent VFP were followed at serial intervals until resolution of the VFP, at least 12 months, or until symptoms resolved after permanent treatment, such as medialization laryngoplasty. The medical histories of the patients were reviewed for associated factors, such as type of cardiovascular surgery performed, symptoms at presentation, symptoms at follow-up, and type of treatment performed. Specific clinical parameters studied included time to follow-up, recovery of vocal fold motion as documented by flexible fiberoptic laryngoscopy, and subjective symptom resolution.

RESULTS

There were 86 adult patients (age range 34 to 83 years, mean 68) with postoperative dysphagia and/or voice disturbance after cardiovascular surgery who underwent voice and swallowing evaluation. Twenty patients (23%) were diagnosed with unilateral VFP in the postoperative setting. All 20 patients who were identified had complete unilateral vocal fold immobility on initial examination (i.e., no patients were initially diagnosed with paresis). Although no patients had laryngoscopic evaluations preoperatively, all reported having a normal voice prior to the operation, and therefore the VFP is assumed to have been manifested after the cardiovascular surgery.

Patient characteristics are listed in Table II. All were examined by laryngoscopy within 1 week of surgery. Among those with VFP, 14 (70%) had left and six (30%) had right VFP. Women were equally likely to have left VFP compared to men; whereas more men had right VFP than women. Presenting symptoms were mainly comprised of hoarseness, weak cough, and dysphagia mainly to liquids. The types of cardiovascular surgery among patients with VFP were as follows: CABG alone (six patients), CABG with valve replacement (three patients), CABG with abdominal aortic aneurysm repair (one patient), orthotopic heart transplantation (two patients), dual heart and lung transplantation (one patient), valve replacement surgery without CABG (six patients), and thoracoabdominal aortic aneurysm repair (one patient). The latter cardiovascular surgery shares the common elements of median sternotomy and cardiac bypass with the other cardiac operations, and thus was included in this study. Among patients having isolated valve replacement surgery, four had aortic valve replacement, whereas two patients had simultaneous mitral valve and tricuspid valve replacement. All cardiovascular surgeries were primary surgeries (i.e., none were revision surgeries).

Of the 20 patients identified with VFP, two were deceased before outpatient follow-up could be performed, and another five patients were either lost to follow-up or the long distance to travel back to our institution precluded a return visit. Therefore 13 patients were available for a follow-up laryngoscopy. The mean follow-up period for all 13 patients was 14.8 months (range, 4–36 months). Ten of the 13 patients (77%) ultimately had full recovery of vocal fold motion when examined at a mean follow-up of 13.8 months (Table III). The shortest time to recovery was 4 months in two patients. Two other patients were followed serially, and both demonstrated partial recovery at 4 months (i.e., progression

TABLE II.
Patient Characteristics.

	n	Male	Female
Total	86	58	28
VFP	20	12	8
Right VFP	6	5	1
Left VFP	14	7	7

VFP = vocal fold paralysis.

TABLE III.
Types of Cardiovascular Surgeries Performed.

Type of Surgery	No. of Patients	Side of Paralysis		Number Recovered
		R	L	
CABG alone	4	1	3	3
CABG with valve replacement	1	0	1	1
Isolated aortic valve replacement	2	0	2	1
Combined mitral & tricuspid valve replacement	2	0	2	1
Heart transplantation	3	1	2	3
Thoracoabdominal aortic aneurysm repair	1	0	1	1
Totals	13	2	11	10

CABG = coronary artery bypass grafting.

from paralysis to paresis), and then had full recovery when examined at 6 and 7 months, respectively. The last six patients all had follow-up exams beyond 8 months, and were found to have resolution of their VFP.

Three patients (23%) had persistent VFP. The follow-up interval was 17 months each for two patients and 20 months for the third. Therefore the minimum incidence of permanent VFP after cardiovascular surgery in this patient population was 3.5% (3/86). However, if the seven patients who were lost to follow-up were considered, and if the same proportion (23%) of them had permanent VFP, then there would be an additional 1.6 patients. Thus, the estimated incidence of permanent vocal fold paralysis is 5.3% (4.6/86). All three patients with permanent VFP had involvement of the left vocal fold, and all were treated with injection laryngoplasty or medialization thyroplasty.

DISCUSSION

Vocal fold paralysis is a well-known complication of cardiovascular surgery and several studies note its incidence in patients undergoing these procedures.[8] However, long-term recovery of VFP in this patient population has not been previously reported. In the present study we found that 23% of patients with symptoms of dysphagia and/or voice disturbance following cardiovascular surgery had VFP on postoperative exams. We followed these patients long-term and found that the majority had resolution of their VFP. The estimated rate of persistent vocal fold paralysis in this population is between 3.5% and 5.3%. This is somewhat higher than the incidence of vocal fold paralysis reported postoperatively by others.[8] We believe that this is because more frequent voice and swallowing evaluations are being performed at our institution because this service is integrated into the inpatient management plan. Thus more patients with vocal fold paralysis are being identified. It is also possible that the small sample size may have skewed the data.

Several etiologic mechanisms of laryngeal or RLN injury during cardiovascular surgery have been suggested. These include traumatic endotracheal intubation, use of a large size endotracheal tube and/or increased cuff pressure, median sternotomy with extensive sternal retraction, use of TEE, and thermal trauma from topical cardioprotective ice slush for myocardial protection during surgery.[19,20] Median sternotomy is thought to result in strain to both RLNs secondary to lateral retraction of the subclavian arteries. The TEE probe is thought to compress the RLN as it is placed in the postcricoid region. Core hypothermia during cardiopulmonary bypass and topical ice slush for myocardial protection has the potential to cause neuropraxia with temporary RLN paresis.[21] Of the three patients in this study with permanent VFP, one had CABG alone, the second had aortic valve replacement, and the third had simultaneous mitral and tricuspid valve replacement (Table III). We did not find any correlation between type of cardiovascular surgery and VFP. However, definite conclusions cannot be drawn, as the sample size is small.

There is some evidence that operations placing the RLN at risk of direct manipulation lead to higher incidence of VFP. Truong et al. studied 109 pediatric patients who underwent patent ductus arteriosus ligation and subsequently developed VFP. Of the 80 patients who had a follow-up of >3 months, only 35% recovered vocal fold function within a median follow-up of 7 months.[22] Fifty-two patients (65%) had not resolved their VFP at a median follow-up of 16 months, and ultimately 29 (27%) required intervention (i.e., medialization procedures) for persistent VFP. Ohta et al. reported that of 182 patients who underwent repair of aortic aneurysm and aortic dissection, 21.9% developed VFP.[23] They found that extension of procedures into the distal aortic arch, total arch repair, and the use of a stent-graft were independent predictors for the development of VFP. Similarly, Itagaki et al. also demonstrated that aortic surgery patients had a higher incidence of VFP compared with CABG patients.[24] They noted that the duration of surgery, intubation, and cardiopulmonary bypass were significantly longer in the aortic surgery patients compared to their nonaortic counterparts, and that because the left RLN is longer than the right RLN and courses as a loop around the aortic arch, direct injury to the nerve could possibly occur more frequently in surgeries that require manipulation of the aortic arch.

We performed this study to not only assess the long term outcome of VFP in cardiovascular surgery but also to glean guidelines for treatment. Six of the 13 patients in our cohort underwent collagen injection laryngoplasty as inpatients postoperatively in order to improve voice and to improve cough and prevent aspiration of food and secretions. We did not follow a set serial protocol for follow-up, and therefore cannot fully assess the exact time course of recovery. However, we noted complete resolution within 4 months in two patients and resolution over 4 to 7 months in another two. In recent years laryngeal electromyography (EMG) has been utilized to provide clinically valuable information regarding the prognosis of patients with VFP. With respect to prognosticating return of vocal fold motion after RLN injury, highly variable rates of return of motion have been reported.[25–29] These results are difficult to apply clinically as prognostic criteria are inconsistent from study to study, and the patient populations studied are heterogeneous. However, Hirano et al. noted that in

cases less than 6 months from onset of paralysis, the recovery rate was higher when motor unit action potentials induced by voluntary activity were present than when they were not.[30] In addition, after 6 months EMG findings became irrelevant, as they observed no recovery in paralyzed vocal folds beyond this time period. Our study agrees with the EMG findings that vocal fold recovery will most likely occur within this time frame. Full recovery is expected if at less than 6 months there is some observed motion of the previously immobile vocal fold.

We recognize the limitations of this study. As a retrospective study we are limited by the characteristics of the study population and lack an established follow-up period protocol to better delineate the time course of recovery of VFP. In addition, the sample size is small, and seven of 20 patients with VFP were either deceased or lost to follow-up. However, as mentioned earlier, the incidence of VFP after cardiovascular surgery is quite low, and we feel that the 13 patients who we followed in our study represent the typical spectrum of patients with VFP after cardiovascular surgery. Finally, because all patients were diagnosed as inpatients, those potentially with asymptomatic VFP or paresis who were not recognized until after discharge have not been included in our study. Despite these limitations, we feel the information gleaned is new and relevant to this specific patient population. Our aim is to provide the otolaryngologist in clinical practice a basis for counseling these patients in regards to prognosis and treatment approaches.

CONCLUSION

In patients with postoperative VFP following cardiovascular operations the majority will generally regain full vocal fold function. The clinician and the patient should both understand that the exact etiology of VFP may be unknown and that full recovery can take time. Thus, injection laryngoplasty techniques can be used to treat the patient in the immediate and early postoperative period. Permanent medialization procedures should be considered if persistent complete VFP is seen after an adequate follow-up period of at least 6 months.

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