

Improved outcomes with early vocal fold medialization for vocal fold paralysis after thoracic surgery

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Abstract

Objective: To determine the clinical impact of early versus late surgical therapy for new onset unilateral vocal cord paralysis (UVCP) after thoracic surgery. **Study design:** Patients diagnosed with new onset UVCP after esophagectomy, pneumonectomy or pulmonary lobectomy were reviewed to determine the incidence of pneumonia, need for postoperative bronchoscopy and length of stay (LOS). Comparisons were made between patients undergoing early (≤ 4 days after thoracic procedure) versus late rehabilitation (≥ 5 days after thoracic procedure) of their UVCP with vocal cord medialization. **Results:** Some 86 patients (27 esophagectomies, 43 pneumonectomies and 16 lobectomies) with new onset UVCP were examined. A total of 32 patients (37.2%) underwent early vocal cord medialization and 54 (62.8%) underwent late repair. The pneumonia rate for patients undergoing early vocal cord medialization (6.3%) was significantly lower than the rate for vocal cord medialization (37.0%, $P = 0.001$, χ^2). Early medialization patients required fewer postoperative bronchoscopies (mean number of bronchoscopies, 0.26) than late medialization patients (mean bronchoscopies, 0.94, $P = 0.013$). The median LOS was significantly decreased for early versus late medialization patients in both pneumonectomy (reduction in LOS of 8 days) and lobectomy groups (reduction in LOS of 7 days). **Conclusions:** Early vocal cord medialization decreases the pneumonia rate, the requirement for postoperative bronchoscopies and the LOS for patients suffering from new onset UVCP after thoracic surgery. **Significance:** Consideration should be given to early medialization for new onset UVCP when medically sound.

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1. Introduction

Unilateral vocal cord paralysis (UVCP) is the most common neurologic disorder of the larynx and may be due to several different etiologies. Patients undergoing thoracic surgery constitute a special group of patients at increased risk for UVCP. Such patients may have UVCP secondary to recurrent laryngeal nerve involvement from their tumor or may suffer from UVCP from planned sacrifice or inadvertent surgical injury to the recurrent laryngeal nerve as it traverses the thoracic

cavity. The glottic incompetence associated with UVCP may render patients with a variety of problems including decreased cough strength, diminished airway protection during deglutition and, in a significant portion of cases, aspiration [1]. Patients undergoing thoracic procedures often have diminished lung capacity, which may be even further reduced by surgical resection [2,3]. Therefore, UVCP arising after thoracic surgery places these patients at significantly increased risk for serious complications should their remaining lung volume become infected, either secondary to aspiration pneumonia or postoperative pneumonia.

Several surgical options exist for the rehabilitation of patients with UVCP, including vocal cord injection augmentation techniques or laryngeal framework surgery with medialization of the paretic cord (Type 1

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thyroplasty) [4–6]. Other authors have suggested that early rehabilitation of vocal cord paralysis after skull base surgery leads to improved patient outcomes [7,8]. However, patients who have undergone thoracic surgery often have tenuous postoperative courses and otolaryngologists may be reluctant to perform vocal fold surgery early in the postoperative period for fear of procedure-related complications [9]. In contrast, these patients may benefit from earlier rehabilitation of the vocal cord paralysis in order to prevent postoperative pulmonary complications.

We undertook this study to examine the patient outcomes for surgical rehabilitation of UVCP after thoracic surgery, in order to determine if early rehabilitation of the paralyzed cord improved outcomes for patients recovering from thoracic surgery.

2. Methods

This study was approved by our institutional committee on human subjects research. A combined thoracic surgery and otolaryngologic procedural database from a large tertiary care academic medical center was examined to identify all patients who underwent thoracic surgery, suffered from a postoperative new onset UVCP and underwent rehabilitation of the paralyzed cord with either vocal cord injection augmentation techniques or external Type 1 thyroplasty. For the purposes of simplicity in this discussion, the term vocal cord medialization will encompass both Type 1 thyroplasty and vocal cord injection for UVCP. Patients were separated into three groups based on thoracic surgery procedure: (1) total esophagectomy; (2) extrapleural pneumonectomy; and (3) pulmonary lobectomy; other thoracic procedures were excluded. In addition, patients with preoperative hoarseness or known preoperative UVCP were also excluded.

Patients with newly diagnosed (related to purposeful recurrent laryngeal nerve sacrifice) or suspected UVCP after thoracic surgery underwent bedside transnasal

fiber-optic endoscopy to confirm the diagnosis of unilateral vocal cord immobility. For patients with known RLN sacrifice, either vocal cord injection augmentation or external medialization laryngoplasty was performed based on the discretion of the attending otolaryngologist. For patients with UVCP without known RLN sacrifice, vocal cord injection augmentation was the preferred technique, in anticipation of the possible return of function from neuropraxic injury. These patients were followed with serial inpatient and outpatient fiber-optic laryngoscopic examinations to determine return of vocal cord function.

For each patient, the postoperative pneumonia rate, number of postoperative bronchoscopies required, time from thoracic surgery to UVCP rehabilitation and overall length of stay (LOS) were determined. The determination of postoperative pneumonia was based strictly on microbiologically confirmed pneumonias, since postoperative chest X-rays may be confounded by the presence of pleural effusion, parenchymal bruising and other post thoracic surgical factors [10]. Patients were divided into two groups, those undergoing early rehabilitation of UVCP (≤ 4 days post thoracic procedure) and those undergoing late rehabilitation of UVCP (≥ 5 days post thoracic surgery procedure). Data were imported into SPSS (version 10.0, Chicago, IL) for subsequent statistical analysis. Standard descriptive demographic information was derived. Statistical analysis was conducted to determine if the timing of the UVCP rehabilitation procedure affected the rate of pulmonary complications and LOS for each subgroup of thoracic surgery procedures.

3. Results

A total of 86 patients (27 three-hole esophagectomies, 43 pneumonectomies and 16 lobectomies) who had undergone thoracic procedures were also diagnosed with a postoperative, new onset vocal cord paralysis. The mean patient age was 60.9 years. The timings of the

Table 1
Timing of vocal cord procedures

Thoracic Procedure	N	Early Medialization Days 1-4	Late Medialization Days ≥ 5
Esophagectomy	27	3	24
Pneumonectomy	43	25	18
Pulmonary lobectomy	16	4	12
Total	86	32	54

Table 2
Pneumonia rate according to timing of vocal cord procedures

Thoracic Procedure	Early Medialization Pneumonia Rate	Late Medialization Pneumonia Rate	p-value*
Esophagectomy	33.3%	16.7%	1.000
Pneumonectomy	4.0%	44.4%	0.001
Pulmonary lobectomy	0.0%	66.7%	0.077
Overall	6.3%	37.0%	0.001

*Exact significance, Chi-square

medialization procedures according to thoracic surgery type are listed in Table 1. Overall, 32 patients (37.2%) underwent early vocal cord medialization and 54 (62.8%) underwent late repair. Seventy-five patients (87.2%) underwent injection techniques, whereas 11 (12.8%) underwent Type 1 thyroplasty with Silastic™ implant.

The incidences of pneumonia following esophagectomy, pneumonectomy and lobectomy were 20, 21 and 50%, respectively. Patients who underwent early repair suffered from postoperative pneumonia at the rate of 6.3%, whereas those who underwent late vocal cord medialization suffered from a pneumonia rate of 37.0% ($P = 0.001$, χ^2). The protective effect of early medialization against postoperative pneumonia was most pronounced for pneumonectomy and lobectomy patients (Table 2). Similarly, patients who underwent early vocal cord medialization required fewer postoperative bronchoscopies (mean number of bronchoscopies, 0.26) than patients who underwent late medialization (mean number of bronchoscopies, 0.94, $P = 0.013$, Mann–Whitney U -test). The median LOS for esophagectomy, pneumonectomy and lobectomy patients are depicted in Table 3. The median LOS was significantly reduced for early

versus late vocal cord medialization patients in both the pneumonectomy and lobectomy groups ($P = 0.001$ and 0.038, respectively).

4. Discussion

Unilateral vocal cord paralysis is a relatively common complication of thoracic or mediastinal surgery. In published series, vocal cord paralysis may occur in ≈ 15 –45% of pulmonary or esophageal resection procedures [11–14]. The cause for the paralysis may be secondary to inadvertent surgical injury to the recurrent laryngeal nerve or the purposeful sacrifice of the nerve in order to maintain an oncologically sound resection. After the diagnosis is confirmed by flexible fiberoptic laryngoscopy in this setting, the otolaryngologist must attempt to determine whether the paralysis is temporary or permanent after the thoracic procedure. In some instances, the extent of resection and intraoperative findings clearly indicate purposeful sacrifice, whereas in other cases, this is less clear. Therefore, in some cases, the prognosis for return of function of the paralyzed cord may be indeterminate.

Table 3
Lengths of stay for early versus medialization procedures

Thoracic Procedure	Early Medialization Median LOS (days)	Late Medialization Median LOS (days)	p*
Esophagectomy	11	14	0.546
Pneumonectomy	9	17	0.001
Pulmonary lobectomy	7	14	0.038

*Mann-Whitney U Test

At our institution, unless a clear sacrifice of the RLN is identified by the operating thoracic surgeon, we attempt to temporize the new onset vocal cord paralysis with a transoral vocal fold injection with collagen or Gelfoam™. This provides glottal sufficiency for a finite time period allowing for the potential return of function of the paralyzed cord without altering the laryngeal framework or musculature in a more permanent fashion. Other authors have shown that although the prosthesis placed in Type 1 thyroplasty may be removed, permanent fibrotic changes occur in the thyroplasty window [15]. In addition, vocal cord injection more readily accommodates postoperative EMG analysis to determine prognosis for the UVCP after the patient has recovered from the thoracic procedure.

Patients who have undergone thoracic surgery procedures are at elevated risk for pulmonary complications from their UVCP [2,16]. Patients undergoing thoracic surgery often have a strong history of tobacco exposure and therefore, often also suffer from chronic obstructive pulmonary disease with decreased lung function. After new onset UVCP, a significant fraction of patients will demonstrate radiographic evidence of aspiration [17,18]. In addition, the UVCP often results in decreased glottal competence, subsequently leading to decreased cough strength [1]. Decreased competence of the glottis, along with decreased lung function renders these patients at high risk for significant pulmonary embarrassment from any type of infectious pneumonia or aspiration pneumonia. Therefore, these patients warrant strong consideration for re-establishing a competent glottis.

The best timing for surgical rehabilitation of the paralyzed cord in the immediate postoperative period, however, may be difficult to determine. Thoracic surgery patients are often admitted to the intensive care unit and are medically vulnerable after their resection, and therefore they may not be optimal candidates for a secondary surgical procedure in the early postoperative period. In many cases, limited residual lung function, perioperative fluid management issues and other medical comorbidities govern the suitability and safety of a procedure in the immediate postoperative period. In contradistinction, from a lung protection standpoint, it is often desirable to perform a medialization procedure early, to avoid the above-mentioned complications. Recently, Mom et al. reported on concomitant Type 1 thyroplasty and thoracic surgery for patients with intraoperatively recognized recurrent laryngeal nerve injury or sacrifice [16]. Although this concomitant technique does not allow for the fine-tuning of the voice during the procedure, it may help avoid postoperative pulmonary complications.

We perform both Type 1 thyroplasty and vocal cord injections under local anesthesia and intravenous sedation. While this is challenging in selected patients, it limits the perioperative anesthetic risk in a high-risk

group of patients. Many of these patients, especially those with status post pneumonectomy, are not suitable candidates for a general anesthetic in the immediate postoperative period. Even though these procedures can be performed without general anesthesia, they are not without risk. Airway compromise, hematoma and aspiration may complicate these procedures and must be considered [19]. In our experience, the stress related to the vocal cord procedure itself has resulted in clinical decompensation for some of these patients.

In cases of newly diagnosed UVCP, the otolaryngologist and thoracic surgeon must jointly decide as to the need for urgent vocal cord medialization, tempered by the medical condition of the patient. Before recommending early medialization in this group of high-risk patients, it needs to be determined whether or not early versus late medialization offers advantages in terms of lung protection, postoperative complications and length of stay. Our data suggest that early medialization is preferred for patients who are diagnosed with a new onset vocal cord patients after thoracic surgery. First and foremost, early medialization patients suffer from significantly less pulmonary infections than late medialization patients. Prevention of postoperative pneumonia is critical in this group of patients [16].

In addition, early medialization of the paralyzed cord reduced the number of postoperative bronchoscopies required for bronchial toilet. We chose to analyze number of postoperative bronchoscopies because the number of bronchoscopies required often reflects the patient's ability (or inability) to mechanically maintain pulmonary toilet and also may reflect, to some degree, subclinical aspiration. Typically, patients who require multiple postoperative bronchoscopies are having difficulty maintaining efficient hygiene of the tracheobronchial tree and may be showing evidence of aspiration or micro-aspiration. Not uncommonly during these bronchoscopies, Methylene blue stained tube feedings are discovered in the tracheal bronchial tree, indicating aspiration of refluxed gastric contents. The decrease in the number of postoperative bronchoscopies afforded by early vocal cord medialization may also realize a health-care resource savings among these patients and avoid the procedure related risks of bronchoscopy in the postoperative period.

Our data clearly indicate that LOS is affected by early rather than late vocal cord medialization. With shrinking health-care resources, significant emphasis has recently been placed on length of stay for surgical procedures. Efforts directed at limiting postoperative complications may translate into significant decreases in LOS. Therefore, in patients with new onset UVCP after thoracic surgery, efforts to restore glottal competence and hopefully prevent pneumonia, may realize substantial decreases in LOS. We have previously shown that in head and neck cancer patients, postoperative pneumo-

nias contribute significantly to increased LOS [20]. The fact that esophagectomy patients did not have a significant decrease in LOS after early medialization likely reflects the fact that esophagectomy patients' discharge is primarily determined by a barium swallow on postoperative day number 10. Even if their vocal cord paralysis is addressed early, esophagectomy patients cannot be discharged until this postoperative barium swallow has been obtained, thus limiting the potential impact of vocal cord medialization on LOS. In lung surgery patients, early discharge is possible, depending on the overall status of the patient. Overall, decreasing LOS may not only realize a financial cost saving, but may reduce patient exposure to nosocomial infections and other complications.

5. Conclusions

Early vocal cord medialization for patients suffering from a new onset vocal cord paralysis after thoracic surgery reduces pulmonary complications and reduces overall LOS. Otolaryngologists should weigh the advantages of early vocal cord medialization along with other clinical factors in order to optimize the team approach to the care of these patients.

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