Acute and Subacute Awake Injection Laryngoplasty for Thoracic Surgery Patients

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Summary: The rehabilitation of glottic incompetence by injection laryngoplasty is important in the management of thoracic surgery patients with vocal cord paralysis. This group of patients presents special considerations that favor injection under local anesthesia. The objective of this study is to characterize our experience with this minimally invasive approach in both the acute and subacute settings. The study was conducted using a retrospective chart review. From a database of 108 patients who received awake percutaneous injection laryngoplasty over a 3-year period, 15 cases were identified that underwent augmentation shortly following thoracic surgery. These records were reviewed for patient demographics, clinical characteristics, complications, and short-term outcomes. Fifteen patients were identified (12 male, 3 female); the age range for the group was 18–91 years (median = 55 years). All the patients reported vocal improvement following injection; all 15 also were improved by perceptual assessment. Five of six dysphagic patients improved following injection. One patient’s injection was aborted due to vocal fold edema; no significant bleeding or airway embarrassment was observed. No procedures were terminated because of patient discomfort. Awake percutaneous injection laryngoplasty for vocal paralysis can be performed safely in the postoperative thoracic surgery patient. Swallowing and voice complaints were almost universally improved following treatment. For patients who cannot tolerate or choose not to have open thyroplasty or vocal fold injection under general anesthesia, this procedure may offer a safe and effective alternative.

Key Words: Larynx—Voice—Vocal cord paralysis—Thoracic surgery.

INTRODUCTION

Intact dynamic function of the larynx is critical for voice, swallowing, and airway regulation in the normal state. Unilateral vocal fold paralysis may occur following aortic aneurysm repair, pneumonectomy, lobectomy, esophagectomy, open-heart surgery, heart-lung transplantation, procedures for intrathoracic malignancy, as well as other thoracic operations.1–5 The recurrent laryngeal nerve may be incidentally injured or intentionally sacrificed...
if required by the patient’s pathologic condition. Understandably, the left vocal fold is more commonly affected than the right, due to the longer intrathoracic segment of the left recurrent laryngeal nerve. Regardless of the mechanism, patients suffering from vocal cord paralysis following thoracic procedures characteristically present with vocal changes, dysphagia, and even stridor or respiratory difficulties. When superimposed on the physiological changes related to thoracic surgery, the impact may be significant. A prototypical example is the pneumonectomy patient with a left vocal paralysis who is aspirating saliva and food into the one remaining lung, perhaps resulting in pneumonitis.

The clinical manifestations of vocal paralysis may persist beyond the immediate postoperative period. Vocal fatigue, loss of range, quality, and vocal strength are commonly reported. These patients may have ineffective cough and airway clearing mechanisms as well, increasing their risk for ongoing aspiration and pneumonia. In the acute and subacute periods, vocal fold medialization may be required for improvement of their voice and swallowing disturbances.

Intervention directed at vocal fold medialization, whether thyroplasty under sedation and local anesthesia or traditional vocal fold injection under general anesthesia, is effective in this population. Additionally, the importance of vocal cord medialization in the early or acute postoperative period for the prevention of aspiration and pneumonia has been well documented.

Given their underlying pathology, thoracic surgery patients require special consideration for a return to general anesthesia. They may have significantly compromised cardiopulmonary function that increases their risk for complications. Atrial fibrillation has been described as a frequently encountered cardiac complication of noncardiac thoracic surgery in the postoperative period. Other arrhythmias, myocardial ischemia, pulmonary edema, embolism, and shunt have also been described as possible postoperative complications of noncardiac thoracic surgery. The risk of developing such conditions following thoracic procedures may surpass the potential benefit of surgical procedures under anesthesia. Therefore, procedures that can be performed under local anesthesia lessen interventional risk to postoperative thoracic surgery patients.

Whereas thyroplasty under local anesthesia and sedation is relatively benign, postoperative thoracic surgery patients may have some difficulty laying supine due to dyspnea or incisional discomfort. Though difficult to quantify, the psychological impact of a return to the operating room (OR) may also be a setback for a patient in an already compromised state. With all of these considerations in mind, it has been our practice to include awake percutaneous injection laryngoplasty as an option for patients with vocal paralysis following thoracic surgery.

The objective of this study was to review our experience with this technique in order to estimate the safety and efficacy of the procedure in the postoperative setting.

**MATERIALS AND METHODS**

Over a 3-year study period, 108 patients who had undergone awake percutaneous injection laryngoplasty were identified. All subjects had been seen as inpatient consultations at Froedtert Memorial Lutheran Hospital or as outpatients at the contiguous Medical College of Wisconsin Laryngology Clinic. Vocal paralysis was identified by history and physical examination with either rigid indirect laryngoscopy or flexible fiberoptic laryngoscopy. Of the 108, 15 were treated within 3 months of undergoing thoracic surgery. The materials injected included micronized acellular dermis (Cymetra; LifeCell Corporation, Branchburg, NJ), bovine collagen (Zyplast; Inamed Corporation, Santa Barbara, CA), and calcium hydroxylapatite (Radiesse; Bioform Corporation, San Mateo, CA). All patients injected with bovine collagen underwent preinjection skin testing with subsequent injection following a 1-week observation period. The acute setting was defined as injection during the initial hospitalization in which the patient underwent a thoracic surgical procedure. The subacute setting was defined as injection on an outpatient basis but within 90 days of the thoracic surgery procedure. The records were reviewed for age, sex, indication for thoracic surgery, presence of dysphonia and dysphagia, time elapsed since thoracic surgery,
injection materials used, complications, and short-term outcomes related to voice and swallowing.

Technique for awake injection laryngoplasty

Inpatient injections are performed at the patient’s bedside, either in the intensive care unit or on the surgical ward using a portable videolaryngoscopy unit. Outpatient procedures are performed in the laryngology clinic examination room. Informed consent is first obtained and documented. The prelaryngeal skin is cleaned with an alcohol pad. One nasal passage is anesthetized and decongested using a 1:1 solution of 4% lidocaine, and oxymetazoline is administered topically by spray. The skin over the area of laryngeal injection was anesthetized using 1% lidocaine with epinephrine (1:100,000) solution. Flexible fiberoptic laryngoscopy is performed by otolaryngology housestaff or a speech language pathologist. External laryngeal landmarks are palpated and a 25-gauge needle is used to inject the immobile vocal fold under laryngoscopic guidance. The endoscopist maximizes visualization of the vocal fold for augmentation by keeping the tip of the laryngoscope just above the contralateral arytenoid, directing the view down and toward the contralateral vocal fold. The needle enters the larynx directly through the thyroid ala or just at the inferior border of the ala at the midportion of the vocal fold and directed superiorly. The vocal fold is augmented just to the point of mild bulging. Very little overinjection is performed. Approximately 0.5 to 1 cc of injectable material is used for each injection.

RESULTS

The clinical data are presented in Table 1. Of the 15 (12 male, 3 female) subjects who received awake percutaneous injection laryngoplasty following a thoracic procedure, 8 (53%) were treated in the acute setting and 7 (47%) in the subacute setting as defined above. The acutely managed patients were more likely to complain of dysphagia (5/8, 62.5%) than those injected following hospital discharge (1/7, 14%). No patient in the acute (0/8) group suffered pneumonia during the initial hospitalization or through the initial follow-up visit. Though modified barium swallow was not performed on all patients, five of six dysphagic patients demonstrated clinical improvement in swallow function by self-report and a return to full oral intake. Two patients had pre- and postinjection studies, and both demonstrated improvement following augmentation. One improved from mild laryngeal penetration and aspiration preinjection, to no penetration or aspiration after injection. The other patient’s preinjection swallow study demonstrated frank aspiration with puree consistency barium. However, the second patient tolerated challenges with all barium consistencies following injection, with only mild laryngeal penetration with thin liquid consistencies.

Vocal improvement was reported by patients in 15 of 15 cases. The degree of improvement following injection was noted by physicians to be “marked” (6/15, 40%), “moderate” (7/15, 47%), “mild” (2/15, 13%), or “none” (0/15, 0%). The materials for augmentation included Cymetra in 8 of 15 (53%) patients, Zyplast in 6 of 15 (40%), and Radiesse in 1 of 15 (7%). The choice of injection material reflected the overall clinical scenario and the urgency of the need for glottic augmentation, as bovine collagen requires some pretesting. As previously mentioned, all patients injected with Zyplast were evaluated with preinjection skin testing.

There was a single complication noted. One injection was aborted due to moderate acute vocal fold swelling at the time of injection. There was no respiratory distress. It was felt that the benefit of the therapeutic injection would be limited by the edema; the injection was successfully performed 1 week later. No patient had hemorrhage, airway embarrassment, or inability to tolerate the procedure due to discomfort.

Follow-up of greater than 3 months was available for only 7 of 15 patients, as many returned to their local physician for ongoing care or were otherwise lost to follow-up. Of the seven with clinical information beyond 3 months, the average duration of the clinical voice improvement was 4 months. All patients maintained safe oral intake without subsequent pneumonia.

DISCUSSION

Vocal fold augmentation by type I thyroplasty has been well documented as a safe intervention...
Injection laryngoplasty has also been described as an alternative to thyroplasty for the restoration of glottic competence.\textsuperscript{7,13} This report suggests that awake percutaneous injection laryngoplasty can be performed safely with very good immediate results in these challenging clinical cases, representing another option for practitioners and patients. Though this retrospective study did not detail voice or swallowing function beyond patient report and clinical assessment, the success rate was notable, with 100\% of the patients reporting improved voice and 83\% of the dysphagic patients improving. None of the acutely injected patients developed pneumonia, a difficult setback following thoracic surgery.\textsuperscript{9}

There was only a single complication noted with no adverse sequelae. As this investigation moves forward, prospectively acquired data are being collected to investigate the efficacy of this procedure on objective voice and swallowing parameters, as well as the duration of injection benefit. Most of the patients returned to care of the referring practitioners or were lost to follow-up, resulting in a lack of long-term outcomes information.

There are advantages and disadvantages to the injection of temporary materials for glottic incompetence. VOCAL fold injection under local anesthesia, or “awake” laryngoplasty, has been previously described as a viable medialization technique for unilateral vocal cord paralysis.\textsuperscript{14} Furthermore, awake laryngoplasty with Gelfoam (Upjohn, Kalamazoo, MI) has been described as a temporary treatment for acute vocal cord paralysis with evidence of aspiration.\textsuperscript{13} Many patients in this study population,

\begin{table}[h]
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\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
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\# & Sex & Age (y) & Thoracic Procedure & Days to Injection & Ip/Op & Injected Material & Voice Improvement & Dysphagia (pre injection) & Dysphagia (post injection) & Complications \\
\hline
1 & M & 39 & CABG, 4 vessel & 10 & IP & Cymetra & Moderate & Present & Improved & None \\
2 & M & 45 & Pleurodesis & 7 & IP & HA & Moderate & Absent & n/a & None \\
3 & M & 58 & Esophageo-gastrectomy & 41 & IP & Cymetra & Marked & Present & Improved & None \\
4 & M & 71 & LUL lobectomy & 16 & IP & Zyplast & Mild & Absent & n/a & None \\
5 & M & 91 & TAA & 6 & IP & Cymetra & Moderate & Present & Improved & None \\
6 & M & 64 & Prevertebral mass excision & 5 & IP & Cymetra & Moderate & Present & Persistent & None \\
7 & M & 52 & Left pneumonectomy & 1 & IP & Cymetra & Mild & Present & Improved & None \\
8 & M & 55 & Transhiatal esophagectomy & 65 & OP & Zyplast & Marked & Absent & n/a & None \\
9 & F & 18 & Mediastinal mass excision & 57 & OP & Zyplast & Moderate & Absent & n/a & None \\
10 & M & 41 & Thoracotomy & 54 & OP & Zyplast & Marked & Present & Improved & None \\
11 & M & 50 & Transbronchial biopsy of lung mass & 21 & OP & Cymetra & Marked & Absent & n/a & None \\
12 & M & 61 & Right upper lobectomy & 73 & OP & Zyplast & Marked & Absent & n/a & None \\
13 & M & 77 & CABG, CEA & 90 & OP & Zyplast & Moderate & Absent & n/a & Acute VF edema \\
14 & F & 71 & Squamous cell carcinoma of lung & 42 & OP & Cymetra & Moderate & Absent & n/a & None \\
15 & F & 36 & Ascending aortic aneurysm repair & 6 & IP & Cymetra & Marked & Absent & n/a & None \\
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\end{tabular}
\caption{Patient Characteristics and Results for Awake Injection Laryngoplasty in 15 Postoperative Thoracic Surgery Patients}
\end{table}

\textit{Abbreviations:} CABG, coronary artery bypass graft; LUL, left upper lobe; TAA, thoracic aortic aneurysm; CEA, carotid endarterectomy; VF, vocal cord; n/a, not applicable; Op, outpatient; Ip, inpatient; M, male; F, female; HA, calcium hydroxylapatite.
however, likely will never recover from their vocal paralysis, as is the nature of thoracic malignancies. A more common established option is to immediately medialize the impaired vocal fold with a permanent implant as described by Kraus et al in their important paper. Some will recover, however, and the distinction between the two groups may not be clear at the time. Decision making in the postoperative thoracic surgery patient must consider the urgency of the symptomatology, the likelihood of nerve recovery, patient preference and tolerance of additional procedures, and, of course, the overall life expectancy of the patient. With these issues in mind, it is difficult to advocate one paradigm for all patients; the experience noted in this study shows that this select group of patients underwent safe and effective restoration of glottic competence without general anesthesia or a return trip to the OR.

Of course, each case must be evaluated individually. An example can be seen in patient 2 (Table 1), a generally fit 45-year-old with a poor prognosis from his malignancy. There was no chance for recurrent laryngeal nerve recovery, and he was unable to lay flat for thyroplasty due to incisional pain from his thoracotomy. He underwent successful awake injection laryngoplasty with Radiesse, a long-lasting calcium hydroxylapatite preparation. We have since injected several other patients with this “permanent” material in the awake setting.

The potential for medical cost savings may also be significant. A basic cost analysis was estimated for care at our institution. Comparing awake injection laryngoplasty under local anesthesia to the performance of direct laryngoscopy with injection under general anesthesia, the principal differences in expenses are the OR charge and the professional fees of the anesthesiologist. With an estimated 30-minute total OR time, our institution’s charges are approximately $7500 for use of the completely stocked OR (which includes personnel, equipment, and disposables) and $750 for the professional fees of the anesthesiologist. This results in an estimate of $8250 for each injection laryngoplasty performed in the OR over what the charges would be if performed on an awake patient in the clinic or by the bedside. Because the surgeon’s professional fees and implant costs are similar regardless of the technique, they are not included in this comparison. In the overall cost of managing a patient with a thoracic malignancy, this may not represent a significant savings; many patients will eventually undergo thyroplasty in the future regardless of their acute management. If a patient is able to avoid a complication by undergoing the procedure safely, and without postoperative complications from general anesthesia, this may have further benefit from a medical cost standpoint in addition to restoring voice and swallowing following vocal paralysis.

CONCLUSIONS

The results of this study suggest that awake injection laryngoplasty is a safe and effective treatment specifically for thoracic surgery patients with glottic incompetence. In this study, our experience with a series of 15 patients who underwent awake injection laryngoplasty for vocal paralysis following thoracic surgery was evaluated for safety and clinical efficacy. This is the first such study to investigate this management approach for thoracic surgery patients. There was a single complication with no adverse sequelae, and patient voice and swallowing complaints were almost universally improved. No patient in the acutely injected group developed pneumonia during the postoperative period. Many factors must be considered in the management of vocal paralysis complicating thoracic surgery. For patients who cannot tolerate or prefer not to undergo open laryngoplasty or injection under general anesthesia, percutaneous awake injection offers a safe and effective alternative.

Further studies may prospectively compare awake injection laryngoplasty against thyroplasty and traditional vocal fold injection under general anesthesia. Evaluation of the various injection materials may also provide important information from which practitioners and patients can make decisions regarding the management of vocal paralysis in the postoperative period following thoracic surgery.

REFERENCES
