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Symptomatic unilateral vocal fold paralysis following cardiothoracic surgery☆

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ABSTRACT

Purpose: Unilateral vocal fold paralysis (UVFP) is a complication associated with cardiothoracic procedures that presents clinically as dysphonia and/or dysphagia with or without aspiration. The literature lacks both data on recovery of mobility and consensus on best management. Herein, our goals are to 1) Identify cardiothoracic procedures associated with symptomatic UVFP at our institution; 2) Review timing and nature of laryngology diagnosis and management; 3) Report spontaneous recovery rate of vocal fold mobility.
Materials and methods: Retrospective case series at single tertiary referral center between 2002 and 2015. 141 patients were included who underwent laryngology interventions (micronized acellular dermis injection laryngoplasty and/or type 1 thyroplasty) to treat symptomatic UVFP diagnosed subsequent to cardiothoracic surgery.
Results: Pulmonary procedures were most often associated with UVFP (n = 50/141; 35.5%). 87.2% had left-sided paralysis (n = 123/141). Median time to diagnosis was 42 days ($\bar{x} = 114 \pm 348$). Over time, UVFP was diagnosed progressively earlier after cardiothoracic surgery. 63.4% of patients (n = 95/141) underwent injection laryngoplasty as their initial intervention with median time from diagnosis to injection of 11 days ($\bar{x} = 29.6 \pm 54$). 41.1% (n = 58/141) ultimately underwent type 1 thyroplasty at a median of 232.5 days ($\bar{x} = 367 \pm 510.2$) after cardiothoracic surgery. 10.2% (n = 9/88) of those with adequate follow-up recovered full vocal fold mobility.
Conclusions: Many cardiothoracic procedures are associated with symptomatic UVFP, predominantly left-sided. Our data showed poor recovery of vocal fold mobility relative to other studies. Early diagnosis and potential surgical medialization is important in the care of these patients.

1. Introduction

Recurrent laryngeal nerve (RLN) injury is a known complication of a number of cardiothoracic procedures resulting in unilateral vocal fold paralysis (UVFP) [1]. The literature suggests that in recent years, non-thyroid surgeries, including cardiothoracic surgeries, have surpassed thyroid surgeries as the most common iatrogenic causes of UVFP [1,2]. Some authors suggest that up to 26% of patients undergoing total arch and descending aortic surgery suffer UVFP as a complication [3]. Others suggest post-operative paralysis of the RLN in 10.8% (n = 13/120) of thoracic surgery patients studied, and in 31.5% of patients whose surgery was determined to place the RLN at "high-risk." [4].

For patients with new onset UVFP, presenting symptoms usually include dysphonia and dysphagia, due to the inability of the contralateral cord to compensate and achieve glottic closure. In a patient group that already tends to have a compromised pulmonary status, UVFP increases the risk of aspiration and subsequent pulmonary complications, in addition to the negative quality-of-life impact of UVFP related dysphonia [5,6].

There are numerous mechanisms postulated to contribute to or cause RLN damage during cardiothoracic procedures and the status of the RLN is often unknown after such surgeries [1,2,7]. Further, very limited data exists to establish rate of recovery of vocal fold mobility in this population, leaving the clinician to speculate as to the ideal management strategy in this patient cohort. Variability in treatment strategies centers around two issues: timing (early laryngology intervention versus observation with potential later intervention), and temporary (i.e. vocal fold injection laryngoplasty awake or under general anesthesia by microdirect laryngoscopy) versus permanent or more durable intervention (i.e. Type I medialization thyroplasty and laryngeal reinnervation procedures) [6,7,8,9,10].

Therefore, our study sought to identify cardiothoracic procedures and surgical approaches associated with symptomatic UVFP, review timing and nature of laryngology diagnosis and management of this cohort at our institution, and calculate the rate of recovery of vocal fold mobility.

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2. Methods

Following approval by the Mayo Clinic Institutional Review Board (#IRB15-006835), a retrospective chart review was performed at a tertiary referral center. All adult patients (>18 years old) who underwent micronized acellular dermis injection laryngoplasty, type 1 thyroplasty with or without arytenoid adduction, and/or ansa cervicalis to recurrent laryngeal nerve reinnervation at the Mayo Clinic in Rochester, MN between 2002 and 2015 were retrieved from the electronic medical record by searching operative reports for these procedures.

All patients treated with some combination of the aforementioned procedures for UVFP diagnosed subsequent to cardiothoracic surgery were included. In all patients, UVFP was diagnosed via flexible laryngoscopy with or without video stroboscopy. Patients who underwent thyroidectomy including substernal thyroidectomy even if performed by a thoracic surgeon were excluded.

Multiple data points were collected and entered into a database. Demographic data collected included sex, date of birth, date of death (if available). Medical histories were reviewed for clinical presentation, laterality of vocal fold paralysis, cardiothoracic surgery and approach, laryngology interventions performed and temporality of both cardiothoracic and laryngology treatments, documentation of return of vocal fold mobility, and duration of laryngology follow-up. Available cardiothoracic surgery operative reports were also reviewed for documentation of status of recurrent laryngeal nerve (known transection versus known preservation versus unknown). Continuous features were summarized using medians, means, and ranges while categorical features were presented using frequency counts and percentages. Comparative statistical analyses were conducted using version 9.4 of the SAS software system (SAS Institute; Cary, NC). All tests were two-sided and p-values <0.05 were considered statistically significant.

3. Results

3.1. Patient demographics

A total of 141 patients were included, 59.6 of which were male (n = 84/141). The median age at time of surgical intervention was 61 years (range 20–87 years). Overall survival rates at 1, 2, and 3 years after laryngology intervention are 80%, 62% and 49% respectively. No patients died secondary to UVFP or laryngology intervention for UVFP.

3.2. Cardiothoracic procedures and surgical approaches associated with UVFP.

Patients underwent a wide variety of cardiothoracic procedures prior to diagnosis of UVFP as summarized in Table 1. Pulmonary procedures most commonly preceded UVFP diagnosis in our cohort (n = 50/141; 35.5%). Cardiothoracic procedures were performed through a variety of surgical approaches including combinations of more than one approach detailed in Table 2.

Table 1
Cardiothoracic procedures performed before UVFP diagnosis (total n = 141).

	Number of patients	Percent in cohort
Pulmonary[a]	50	35.46%
Cardiac[b]	32	22.70%
Other mediastinal[c] procedure	31	21.99%
Esophagectomy	21	14.89%
Transplant[d]	7	4.96%

[a] Pulmonary procedures included pneumonectomy, pulmonary lobectomy, pulmonary wedge resection, thoracic lymphadenectomy, and parietal pleurectomy.
[b] Cardiac procedures included aortic aneurysm and aortic dissection repairs; aortic hemi-arch replacement, coronary artery bypass graft, and tricuspid valve repair.
[c] Other mediastinal procedures included mediastinal lymphadenectomy alone, resection of mediastinal masses including thymectomy but excluding thyroid pathology; tracheoesophageal fistula repair, tracheal tear repair and resection of pericardial cyst.
[d] Transplant procedures include heart transplant alone, lung transplant alone, and combined heart and lung transplant.

3.3. Diagnosis of UVFP

123 patients (87.2%) had left-sided paralysis; 18 patients (12.8%) had right-sided paralysis. Median time to diagnosis after cardiothoracic procedure for all patients was 42 days ($\bar{x} = 114 \pm 348$). In more recent years, UVFP was diagnosed earlier relative to timing of cardiothoracic procedure as demonstrated in Fig. 1. Spearman Rank Correlation Coefficient demonstrates a statistically significant decrease in median times to diagnosis by quartile ($p < 0.001$) reported in Fig. 1.

3.4. Laryngology interventions for UVFP

Dysphonia was the most common symptom prompting laryngology intervention (n = 137/141; 97.2%) followed by dysphagia (n = 32/141; 22.7%). These symptoms are not exclusive of one another, some patients complained of both dysphagia and dysphonia.

All patients in our cohort (n = 141) underwent either injection laryngoplasty, type 1 thyroplasty, ansa cervicalis to recurrent laryngeal nerve reinnervation procedure, or some combination of these interventions. Details of these interventions, well described elsewhere in the literature, will not be reviewed here.

57.4% (n = 81/141) underwent injection laryngoplasty without subsequent thyroplasty or ansa cervicalis reinnervation procedure. 8.5% (12/141) underwent injection laryngoplasty prior to thyroplasty; one of these 12 had 2 injection laryngoplasties prior thyroplasty. 1.4% (2/141) underwent injection laryngoplasty followed by ansa cervicalis to RLN reinnervation procedure with simultaneous second injection laryngoplasty. Therefore, 63.4% (n = 95/141) patients had injection laryngoplasty as their initial laryngology intervention. For these 95 patients, median time to first injection from cardiothoracic surgery was 50 days ($\bar{x} = 69.6 \pm 87.3$) and median time to first injection from diagnosis of UVFP was 11 days ($\bar{x} = 29.6 \pm 54$). 9.9% (n = 14/141) had a second injection laryngoplasty in their treatment course: 11 without subsequent thyroplasty or ansa reinnervation, one who ultimately had a thyroplasty, and two who later had ansa reinnervations procedures.

41.1% (n = 58/141) ultimately underwent thyroplasty during their laryngology treatment course. Arytenoid adduction (AA) combined with thyroplasty was performed in 36 of the 58 patients (62.1%). Thyroplasty with or without AA was performed a median of 232.50 days ($\bar{x} = 367 \pm 510.2$) after cardiothoracic surgery and a median of 97.5 days ($\bar{x} = 149.3 \pm 176$) from the time of diagnosis of UVFP. Of those who ultimately underwent thyroplasty, 77.6% (n = 45/58) underwent thyroplasty with or without AA as their first surgical intervention. In those who underwent injection laryngoplasty prior to thyroplasty (n = 12/58), a median of 164.5 days ($\bar{x} = 204.2 \pm 114.1$) passed between the first injection laryngoplasty and later permanent procedure.

Table 2
Surgical approach used in cardiothoracic surgeries prior to UVFP diagnosis (total n = 141).

	Number of patients	Percent in cohort
Thoracotomy (+/− cervical)	61	43.26%
Sternotomy (+/− cervical)	36	25.53%
VATS[a] (+/− cervical)	17	12.06%
Cervical only	14	9.93%
Clamshell (+/− cervical)	8	5.67%
Some combination of VATS, Thoracotomy, clamshell, +/− sternotomy without cervical	5	3.55%

[a] Video-assisted thoracoscopic surgery.

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