



Original Research

The incidence of vocal fold motion impairment after primary thyroid and parathyroid surgery for a single high-volume academic surgeon determined by pre- and immediate post-operative fiberoptic laryngoscopy



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ABSTRACT

Background: Vocal fold motion impairment (VFMI) is a well-recognized complication of thyroid and parathyroid surgery. Preoperative counseling requires a thorough understanding of the incidence, risk factors, and value of early diagnosis of postoperative VFMI. Our objective is to describe the incidence of and risk factors for VFMI for a single high-volume academic surgeon, and to assess the utility of immediate postoperative fiberoptic laryngoscopy (FOL) in early diagnosis of VFMI.

Methods: Retrospective cohort study of patients undergoing primary thyroid and parathyroid procedures by a single high-volume surgeon at an academic tertiary care center. All patients underwent preoperative and immediate postoperative FOL. The primary outcome was incidence of VFMI, either temporary (< 1 year) or permanent (1 year or more). The unit of analysis was number of recurrent laryngeal nerves (RLN) at risk. Risk factors for VFMI were analyzed using logistic regression, reporting unadjusted and adjusted odds ratios (OR and aOR) and 95% confidence intervals (CI).

Results: The study population comprised 1547 patients undergoing 1580 procedures for a total of 2527 nerves at risk, excluding the 27 nerves found to have motion impairment on preoperative FOL. Sixty-seven new incidents of VFMI were identified on postoperative FOL, with an additional six new incidents detected after voice complaints prompted FOL upon follow-up. Thus, the incidence of postoperative VFMI was 2.9% of RLNs at risk (73 of 2527). The sensitivity and negative predictive value of immediate postoperative FOL were 92% and 99.8% respectively. Permanent VFMI occurred in 9 cases (0.4%), 3 of which were from intentional RLN transection for malignancy. Odds of VFMI were significantly lower after parathyroidectomy (aOR = 0.1, 95%CI = 0.01–0.8 compared with hemithyroidectomy) and higher with central neck dissection (aOR = 2.4, 95CI = 1.0–5.9). Among cases of malignancy, odds of VFMI increased significantly with increasing T-stage (adjusted $P_{trend} < 0.001$).

Conclusion: VFMI is rare and usually temporary after primary thyroid and parathyroid procedures, with increased risk associated with larger primary malignancies and the inclusion of central neck dissection. Immediate postoperative FOL is useful for early detection of VFMI that may allow for clear definition of temporary and permanent immobility rehabilitation especially if there is evidence to support early intervention.

1. Introduction

Vocal fold motion impairment (VFMI) is a well-recognized complication of thyroid and parathyroid surgery. Permanent VFMI is rare and

is reported to occur in 0.3–3.5% of thyroid surgeries [1–3], while temporary VFMI is seen in 3.0–8.9% [1,4–6]. The rate of permanent VFMI after parathyroidectomy approaches 0% due to the very limited traction on the recurrent laryngeal nerve (RLN) during dissection [7].

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The reported incidence of VFMI varies significantly, which may be due to variation in the methodologies used to diagnose RLN injury (e.g., voice alone, indirect laryngoscopy, videostroboscopy, fiberoptic laryngoscopy [FOL], and more recently transcutaneous ultrasound), with each method having significantly different sensitivities and specificities [1]. Laryngoscopy for evaluation of vocal fold motion is the gold standard for assessment of VFMI [13], however few studies have incorporated visualization of the vocal folds as part of routine postoperative assessment [8,10]. Notably, using voice quality alone has been shown to underestimate the true incidence of VFMI after thyroid and parathyroid surgery, as unilateral VFMI can occur without voice changes [11] (see Table 4).

The purposes of this study were to describe the incidence of VFMI for a high volume surgeon in an academic teaching hospital after primary thyroidectomy and parathyroidectomy incorporating pre-operative and immediate postoperative FOL, and to assess patient- and disease-related risk factors for VFMI.

2. Methods

2.1. Data source and patient population

We collected data from medical records of all consecutive patients who underwent primary thyroid procedures (with or without central neck dissection) or primary parathyroid procedures between March 2004 and December 2015. All procedures were performed by a single surgeon (R.P.T.) who had been performing high volume [16] thyroid and parathyroid surgery independently, at a university-based tertiary care center, for more than 3 years prior to the data collection starting point. We identified all patients who underwent primary parathyroidectomy, hemithyroidectomy, total thyroidectomy, completion thyroidectomy, substernal thyroidectomy with or without sternal split, and total or completion thyroidectomy with central neck dissection, in which one or both RLNs were surgery-naïve and at risk of injury. Completion thyroidectomy was considered a primary procedure and included in this analysis if no prior dissection had been performed on the side in question, as the RLN would therefore be anatomically intact and undisturbed. Patients with confounding laryngotracheal invasion of thyroid cancer and those undergoing reoperative thyroid surgery with a previously dissected RLN were excluded from the study. This retrospective study was approved by the Institutional Review Board of XXX Medicine, and informed consent was waived in accordance with the Health Insurance Portability and Accountability Act.

2.2. Surgical technique

In all thyroidectomy cases, the RLNs at risk were identified using direct visualization and dissected intraoperatively to the extent the surgeon felt it was necessary to allow for attempted preservation. Intraoperative nerve monitoring of the RLNs was performed routinely using either the NIM 2.0 or the 3.0 intermittent nerve monitoring system (Medtronic, Minneapolis, MN).

2.3. Assessment of vocal folds

Vocal fold function was assessed by the operating surgeon (R.P.T.) using FOL at the preoperative visit and immediately following extubation in the operating room at the conclusion of the surgical procedure. The primary surgeon used a flexible nasolaryngoscope with an associated halogen light source over the time period by which this study was analyzed. The postoperative laryngeal examination included at a minimum the analysis of the symmetry of arytenoid and true vocal fold motion during respiration and active abduction and adduction, with phonation or cough when possible. VFMI was defined as a new motion impairment of a vocal fold or no discernible motion after surgery, as compared to the preoperative examination. Repeat FOL was also

performed at follow-up clinic visits for any patients with new voice complaints despite normal immediate postoperative FOL. Patients with VFMI and voice changes were offered functional voice therapy with a speech pathologist to improve laryngeal function, and referred to a laryngologist as indicated. Permanent VFMI was defined as absence of complete recovery of vocal fold mobility at one year after surgery or at the last follow-up visit for patients with less than one year of follow-up time. Transient VFMI was defined as postoperative VFMI with recovery of spontaneous motion before one year or last follow-up visit for patients with less than one year of follow-up time.

2.4. Statistical analysis

Descriptive statistics were reported as N (%), mean (average) and standard deviation (SD) and/or range and median. The primary outcome was VFMI, and the unit of analysis was number of RLNs at risk; vocal folds that were found to be impaired preoperatively were considered not at risk and excluded from analysis. The sensitivity and negative predictive value (NPV) of immediate post-extubation FOL examination were calculated. Characteristics associated with VFMI were compared using unadjusted and adjusted logistic regression analysis, and unadjusted and adjusted odds ratios (OR and aOR) with 95% confidence intervals (CI) were reported. Adjusted analyses were performed separately for all RLNs at risk, and RLNs at risk in malignancy cases only. All reported p-values are two sided, and $p < 0.05$ was considered statistically significant. Data analysis was performed using Stata 14 (College Station, TX).

The work has been reported in line with the STROCSS criteria [28].

3. Results

3.1. Patient population

A total of 1547 patients underwent 1580 primary surgical procedures during the eleven-year study period, 308 (19%) of which were parathyroidectomy procedures and 1272 (81%) of which were thyroidectomy procedures. Table 1 summarizes the characteristics of the patient population, thyroid diagnoses and procedures performed. The mean patient age was 51 years (range, 6–90). The majority (81%) of patients were younger than 65 years of age and predominantly (75%) female. Most procedures were performed for either benign thyroid nodular disease (N = 581, 37%) or thyroid malignancy (N = 611, 39%), with relatively fewer cases of parathyroid adenomas (N = 310, 20%) and Graves' disease (N = 78, 5%). The most common procedure was total thyroidectomy (N = 613, 39%). The overall average follow-up duration was 7 weeks (range 0–122; median 3). Patients with VFMI were followed for a longer period of time postoperatively, with an average of 16 weeks (range 1–208; median 7.5).

3.2. Pre- and immediate post-operative vocal fold motion impairment

Preoperatively, FOL examination was performed on all but two patients. Twenty-seven (2%) vocal folds were found to be impaired on preoperative assessment in 27 patients, with 15 involving the left vocal fold and 12 involving the right. Eleven (41%) of these patients were preoperatively asymptomatic and noted no problems with their voice. These 27 nerves were considered not at risk due to pre-existing impairment, and excluded from further analysis. Of the 2527 RLNs at risk of injury, 2476 (98%) were visualized and dissected during the surgical procedures. Fifty-six RLNs were not visualized during resection of parathyroid adenomas via focused surgery, but nonetheless were at risk for injury.

Overall, at the conclusion of surgery, all but 7 (0.3%) RLNs were visually intact. Four (0.2%) RLNs were unintentionally transected (Table 2). Three of these were anterior branches injured during dissection at Berry's ligament and noted to be adherent the respective

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