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Original Article

Efficiency of vocal cord medialization for recurrent laryngeal nerve dysfunction following pulmonary resections

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ABSTRACT

Background: Evaluating the incidence of postoperative vocal cord dysfunction after pulmonary resections and the impact of timing for vocal cord medialization on preventing postoperative pulmonary complications for these patients.

Materials and Methods: Patients developing vocal cord dysfunction (VCD)/unilateral vocal cord paralysis (UVCP) after pulmonary resection were examined retrospectively, in terms of postoperative pulmonary complication (PPC) rates and hospital length of stay. Total of 2740 patients underwent anatomical pulmonary resection for malignancy. Eleven patients were referred to otolaryngology team with pre-diagnosis of VCD following the operation. UVCP diagnosis was confirmed with indirect laryngoscopic examination.

Results: UVCP diagnosis was confirmed in 8 (0.3%) with indirect laryngoscopic examination. Performed resections were left upper lobectomy in 3 and left pneumonectomy in 5 patients. Atelectasis necessitating bronchoscopy and pneumonia were the PPC, seen in 3 (37.5%) patients. Calcium hydroxyapatite injection for 6 patients and polytetrafluoroethylene graft implantation for 2 patients was performed. Mean duration between pulmonary resection and medialization was 5.3 days in patients developing PPC and 3.6 days in patients with no PPC ($p = 0.011$). All patients were discharged within an average of 8.1 (6-13) days, uneventfully. One patient required re-injection of calcium hydroxyapatite on 5th month. Throughout a mean follow-up duration of 14.8 months, all patients had stable vocal cord position.

Conclusions: Vocal cord medialization can be performed safely for postthoracotomy UVCP. In order to minimize phonetic and respiratory complications, this procedure must be applied on early postoperative period.

Keywords: acquired vocal cord palsy, complications, medialization laryngoplasty, thoracotomy

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Introduction

Postoperative pulmonary complications (PPC) are the major source of morbidity in patients undergoing pulmonary resections due to malignancy. Atelectasis, bronchospasm and pneumonia incidence rate vary between 5% and 80% in literature, with 20% leading to respiratory failure and mortality among those patients [1-3]. Many risk factors associated are listed: Postoperative pain, immobilization, insufficient respiratory exercise, concomitant pulmonary diseases (e.g. chronic obstructive pulmonary disease or asthma), compromised tracheal ciliary activity, impaired glottis function due to endotracheal intubation, and orogastric aspiration [2-6].

Recurrent laryngeal nerve (RLN), which is a branch of Vagus nerve, is responsible for innervations of the larynx and vocal cords. Damage to this nerve during a thoracic operation, especially on the left hemithorax due to its anatomy, can cause phonetic problems, aspiration and respiratory distress. Repositioning of the paralytic cord is recommended to prevent these serious complications [7-10].

Aim of our study was to evaluate our rate of recurrent laryngeal dysfunction after pulmonary resections, and clinical outcomes of these patients following vocal cord medialization.

Materials and Methods

After the approval of Institutional Review Board (14.01.21/179) the clinical files of all non-small cell lung carcinoma (NSCLC) patients undergoing elective surgery via thoracotomy between January 2011 and January 2020 were examined retrospectively. Data of patients developing postoperative unilateral vocal cord paralysis (UVCP), confirmed by indirect laryngoscopic examination and have undergone vocal cord medialization procedure was evaluated. Examined variables were pulmonary complication incidence, timing and effectiveness of procedure, and hospital length of stay (LOS). Patients with prior tracheostomy or known preoperative phonetic/vocal cord dysfunction are excluded from the study. Written informed consent is waived from all patients prior to surgery.

Statistical Analysis

All analyses were performed using the MedCalc version 12.7 (MedCalc Software bvba, Belgium).Categorical data were examined using Pearson's Chi-square test. For continuous variables, Student's-t and Kolmogorov-Smirnov tests were preferred for comparison. P values <0.05 were considered as statistically significant.

Results

Total of 2740 NSCLC patients underwent pulmonary resection via thoracotomy in 10 years. Eleven patients developed severe phonetic (hoarseness or dysphonia) alteration, postoperatively. After laryngoscopic examination (Figure 1), UVCP diagnosis was confirmed in 8 (0.3%) patients and the vocal cords of other 3 were found edematous.

Operations performed on these 8 patients were left pneumonectomy in 5 (62.5%) and left upper lobectomy in 3 (37.5%). Gender distribution of the patients was 6 (75%) males and 2 (25%) females, with an age average of 62.4 ± 22.7. Final pathology revealed squamous cell carcinoma in 7 and adenocarcinoma in 1 patient.

One (12.5%) patient developed atelectasis necessitating bronchoscopy on postoperative day (POD) 2, and 2 (25%) patients developed pneumonia on POD 3 and 4, respectively. Overall PPC incidence was 37.5% in our UVCP cohort.

Calcium hydroxyapatite injection (Radiesse®; Bioform Medical Inc., USA) for 6 patients under general anesthesia, and polytetrafluoroethylene (PTFE) graft implantation under local anesthesia for 2 patients was performed. Choice of medialization technique was made upon the institution's actual amenities. Mean duration between pulmonary resection and medialization procedure was 5.3 ± 3.8 days in patients developing PPC and 3.6 ± 3.1 days in patients with no PPC ($p = 0.011$). No complication about medialization procedure or 30-day mortality was seen. All patients were discharged, uneventfully, with an average hospital LOS of 8.1 ± 4.9 days. Patient demographics and clinical data are summarized in table 1.

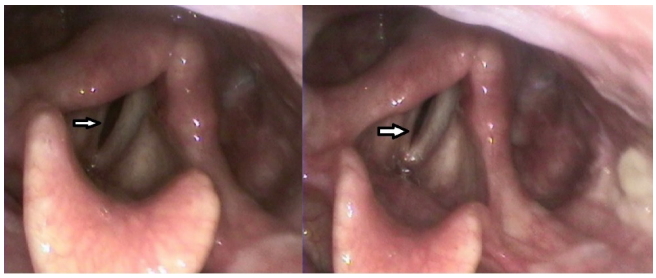

Figure 1. Paralytic left vocal cord on laryngoscopic examination.

Table 1. Patient demographics.

Patient #	Age	Gender	Resection	Pathology	Medialization technique and interval (days)	PPC	Hospital LOS (days)
1	72	Male	LUL	SCC	PTFE / 3	-	6
2	64	Male	LP	SCC	CaHA / 3	-	7
3	51	Male	LP	SCC	CaHA / 4	-	6
4	55	Female	LP	SCC	PTFE / 4	-	7
5	66	Male	LUL	SCC	CaHA / 6	Pneumonia	13
6	64	Female	LP	AC	CaHA / 5	Atelectasis	9
7	69	Male	LUL	SCC	CaHA / 4	-	7
8	58	Male	LP	SCC	CaHA / 5	Pneumonia	10

Abbrev.; AC: Adenocarcinoma, CaHA: Calcium hydroxyapatite, LOS: Length of stay, LUL: Left upper lobectomy, LP: Left pneumonectomy, PTFE: Polytetrafluoroethylene, PPC: Postoperative pulmonary complication, SCC: Squamous cell carcinoma

Only one (12.5%) patient necessitated a second injection of calcium hydroxyapatite, on postoperative month 5. Throughout our mean follow-up duration of 14.8 ± 16.2 months, the patients had stable vocal cord functions and no phonetic complains.

Discussion

Intra-thoracic malignancies, especially bronchogenic and esophageal carcinomas are associated with a range of local complications caused by the primary tumor, lymph nodes, or the surgical resection itself [2,5,7]. One of the neighboring structures which is under risk of direct tumor invasion is the recurrent laryngeal branch of the Vagus nerve, particularly in malignancies of the left hemithorax, attributable to its anatomical location. During surgery, mechanical or thermal injury, or sacrification of an invaded RLN may cause UVCP and alterations in laryngeal functions since it is the major motor nerve of the larynx [8-10].

UVCP is a known sequel of intra-thoracic malignancies in literature. In a group of eight pooled series of UVCPs consisting of 1019 patients, 36% of cases were caused by neoplasms, with more than half of these resulting from lung cancer [8]. Reversible vocal cord dysfunction incidence is reported as high as 31% in patients undergoing left-sided pulmonary resection for malignancy, but the true incidence is difficult to determine as few centers perform routine laryngeal examination on patients with postoperative dysphonia [9]. Consequently, patients with RLN damage suffer from postoperative phonetic (hoarseness and dyspnea during speaking) problems as well as swallowing, or respiratory (difficulty in coughing, atelectasis, pneumonia or acute respiratory distress syndrome) complications [6,11]. Eleven patients in our cohort had new onset postoperative phonetic problems, of which 8 (0.3%) of them were diagnosed with UVCP, confirmed with indirect laryngoscopic examination, all have undergone pulmonary resection on the left side.

The thoracic surgery patients, in general, are at exceptionally elevated risk for postoperative respiratory complications, which are the major source of morbidity, due to the high prevalence of COPD, invasiveness of thoracotomy incision, postoperative pain, immobilization, insufficient respiratory exercise, impaired glottis function due to endotracheal intubation, and the nature of the primary surgical procedure directly diminishing pulmonary function and toilet. It's been shown that patients with UVCP injury demonstrate a 5-fold risk of contracting pneumonia (and a 20% death rate for those who contract pneumonia), a 5-fold risk of re-intubation or tracheostomy. Also, they have 40-60% longer hospital stays than patients without RLN injury because, vocal cord closure is considered to be the most important protective mechanism against aspiration [8-11]. In a study of patients with postoperative UVCP, rates of aspiration with swallowing and aspiration pneumonia were found to be 53% and 45%, respectively; and tracheostomy was necessary in 25% for the management of persistent aspiration [12]. In our series, postoperative pulmonary complication rate was 37.5% where one patient developed atelectasis necessitating bronchoscopy for bronchial toilet, and two patients had pneumonia.

Vocal cord medialization is the recommended

treatment of choice for unilateral vocal cord paralysis, in order to avoid repetitive aspiration which can lead to pulmonary complications with potentially life-threatening consequences [7,8,10]. Numerous different techniques have been described in current literature to close the glottic opening or to reposition the lateralized vocal cord. They may be performed under general or local anesthesia, using synthetic materials or allografts [11,13-16]. Intracordal injection of materials or buttressing the lateral side of the cord are the main techniques for medialization; all being used and recommended in achieving adequate closure of the glottic gap [8-11,13-15]. In our cohort, 6 patients underwent calcium hydroxyapatite injection under general anesthesia and 2 patients underwent PTFE graft implantation under local anesthesia, at the referred otolaryngology clinic, according to the surgeon's decision. No procedure-related complication occurred.

Timing of medialization is another essential issue. Early detection and surgical repositioning of vocal cords has been shown to significantly decrease the pneumonia rate, the requirement for postoperative bronchoscopy and the hospitalization time for patients developing UVCP after thoracic surgery, by preventing a possible aspiration [10,17-19]. Lack of a stable otolaryngology team at our institution and the need for scheduling external-consultation at another hospital may have caused some delay for diagnosis in our patients. Our median interval between the thoracotomy and the medialization was 4.3 days. There was a significant difference between the timing of medialization in patients with or without PPC in our group (5.3 days vs 3.6 days; $p = 0.011$).

As a conclusion, rapid intervention (≤4 days) for iatrogenic unilateral vocal cord paralysis by injection laryngoplasty appears to be a practical, safe, and effective method for minimizing pulmonary complications after pulmonary resection, possibly by reducing aspiration, improving cough and bronchial toilet; regardless of the surgical technique.

Declaration of conflicting interests

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Ethics approval

The study was approved by the institutional review board of Health Sciences University, Sureyyapasa Chest Diseases and Thoracic Surgery Training and Research Hospital (No: 14.01.21/179)

Authors' contributions

MED; Co-wrote the paper, conceived and designed analysis, collected data, ÇT; contributed data, VB; Conceived and designed the analysis. SE; Conceived and designed the analysis, co-wrote the paper

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