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UNILATERAL VOCAL CORD PARALYSIS SECONDARY TO RECURRENT LARYNGEAL NERVE STRETCHING FROM MEDIASTINAL SHIFT AFTER PNEUMONECTOMY.

Ameen SAIFUL AZHAR[1], Marina MAT BAKI[1], Thean Yean KEW[2].
[1]Department of Otorhinolaryngology and Department of Radiology[2], University Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia.

ABSTRACT

Unilateral vocal cord paralysis (UVCP) is not uncommon and can be due to various causes such as iatrogenic injuries, neoplasm or idiopathic. Damage to vagus nerve and its recurrent laryngeal nerve branch may paralyse the laryngeal muscles causing dysphonia, breathiness, vocal fatigue and aspiration. We reported a rare case of left UVCP where the paralysis was caused by the stretching of left recurrent laryngeal nerve after the patient had undergone right pneumonectomy several years earlier due to lung fungal infection. Patient underwent injection laryngoplasty at our centre and her dysphonia improved temporarily.

Keywords: Laryngoplasty, Medialisation, Pneumonectomy, Recurrent laryngeal nerve injuries, Vocal cord paralysis, unilateral.

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ABSTRACT

Unilateral vocal cord paralysis (UVCP) is not uncommon and can be due to various causes such as iatrogenic injuries, neoplasm or idiopathic. Damage to vagus nerve and its recurrent laryngeal nerve branch may paralyse the laryngeal muscles causing dysphonia, breathiness, vocal fatigue and aspiration. We reported a rare case of left UVCP where the paralysis was caused by the stretching of left recurrent laryngeal nerve after the patient had undergone right pneumonectomy several years earlier due to lung fungal infection. Patient underwent injection laryngoplasty at our centre and her dysphonia improved temporarily.

Keywords: Laryngoplasty, medialisation, Pneumonectomy, Recurrent laryngeal nerve injuries, Vocal cord paralysis, unilateral.

INTRODUCTION

The three functions of human larynx are airway provision, airway protection and phonation. Unilateral vocal cord paralysis (UVCP) is a disorder that may disrupt these vital functions. UVCP patients present with dysphonia, breathiness, inability to project their voice and vocal fatigue. However typically it does not lead to airway compromise and significant aspiration is invariably present and often relates to coexisting morbidities. [1,2]

Various studies have been done in the past to evaluate the aetiology of UVCP. Cantarella et al. reported that the common cause of UVCP was post thyroidectomy surgery followed by idiopathic and thoracic surgery.[3] Other author suggests that idiopathic is the most common aetiology.[4]

Management of UVCP should be tailored individually, taking into account the cause and duration of paralysis; functional, physical and emotional disability; and the patient's voice demand. The treatment of UVCP continues to evolve, although the primary goal is to optimize the glottal closure during phonation and decrease aspiration if present, have remained the same for many years.[1] We report a rare case of a left UVCP secondary to the stretching of left recurrent laryngeal nerve (RLN), in a woman 18 years after undergoing a right pneumonectomy for aspergilloma. To our knowledge, this is the third case reported

Corresponding author: Professor Dr Marina Mat Baki, Otorhinolaryngology Department, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaakob Latif, Cheras, 56000 Kuala Lumpur, Malaysia.
Tel: +60196534308, Fax: +60391456675
Email: marinamatbaki@ppukm.ukm.edu.my

after Soll in 2009 and Gullung in 2012.[5,6]

CASE REPORT

A 44-year-old lady, who worked as a teacher, was referred to our clinic with complaints of hoarseness, voice fatigue and occasional aspiration symptoms on drinking for 3 weeks prior to the clinic visit. She has no dysphagia, chronic throat discomfort or reflux symptoms. In the past, she had pulmonary tuberculosis when she was 16 years of age that was fully treated with anti-tuberculosis drug therapy. She subsequently developed complications from aspergilloma in her right lung and underwent a right pneumonectomy in 2000.

Her voice parameters were: 1) voice handicap index-10 (VHI-10), 36/40; 2) Overall dysphonia on GRBAS scale, 3, with main component of breathiness; and maximum phonation time (MPT), 3.6 seconds. On examination, her trachea was deviated to the right. Flexible endoscopy showed left vocal fold palsy in paramedian position with significant phonatory gap. There was no pooling of saliva or suspicious mass seen. Chest x-ray (Figure 1) and CT scan of her neck and thorax (Figure 2) showed absence of the right lung with mediastinal shift and hyperexpansion of the left lung into the right thoracic cavity.

She underwent laryngeal electromyography (LEMG) test that showed reduced recruitment without any spontaneous activities of the left thyroarytenoid muscle. The LEMG results indicated a possibility of neuropraxia with absence of ongoing denervation. The severe mediastinal shift may have resulted in traction injury to the left RLN, resulting in the left UVCP. Injection laryngoplasty (IL) trans-thyrohyoid under local anaesthesia using hyaluorinic acid (Juvederm XC Allergan USA) was carried out to medialise the paralysed vocal fold.

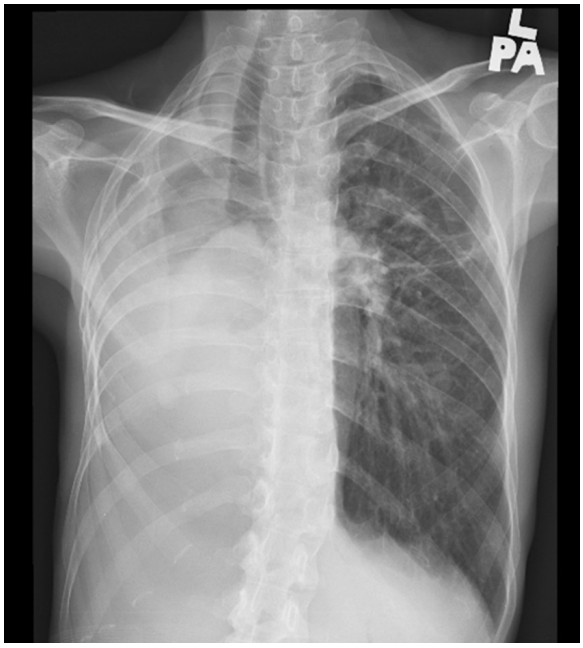

Figure 1: Post-pneumonectomy PA chest radiograph of the patient showing the marked mediastinal shift (including the tracheal) to the right thoracic caivity, with compensatory hyperinflation of the left lung.

Her voice quality improved and at one month post-IL the voice parameters were: 1) voice handicap index-10 (VHI-10), 18/40; 2) Overall dysphonia on GRBAS scale 2; and maximum phonation time (MPT), 5.7 seconds. Her voice quality slowly deteriorates again after 3 months following the IL and she was offered the 'Isshiki type 1 thyroplasty' procedure as a permanent solution to medialise the vocal fold for which she agreed. However on subsequent follow up, she decided against any surgical interventions due to the worsening of her respiratory condition, which require long-term oxygen therapy.

DISCUSSION

Although rare, vocal cord paralysis is a well-documented complication of thoracic surgeries.[7,8,9] During the process of embryogenesis, the motor innervation of the larynx from the vagal trunk accompanies the descent of the fourth branchial arch great vessels from the neck into the chest. As a result, the right RLN arches around the right subclavian artery,

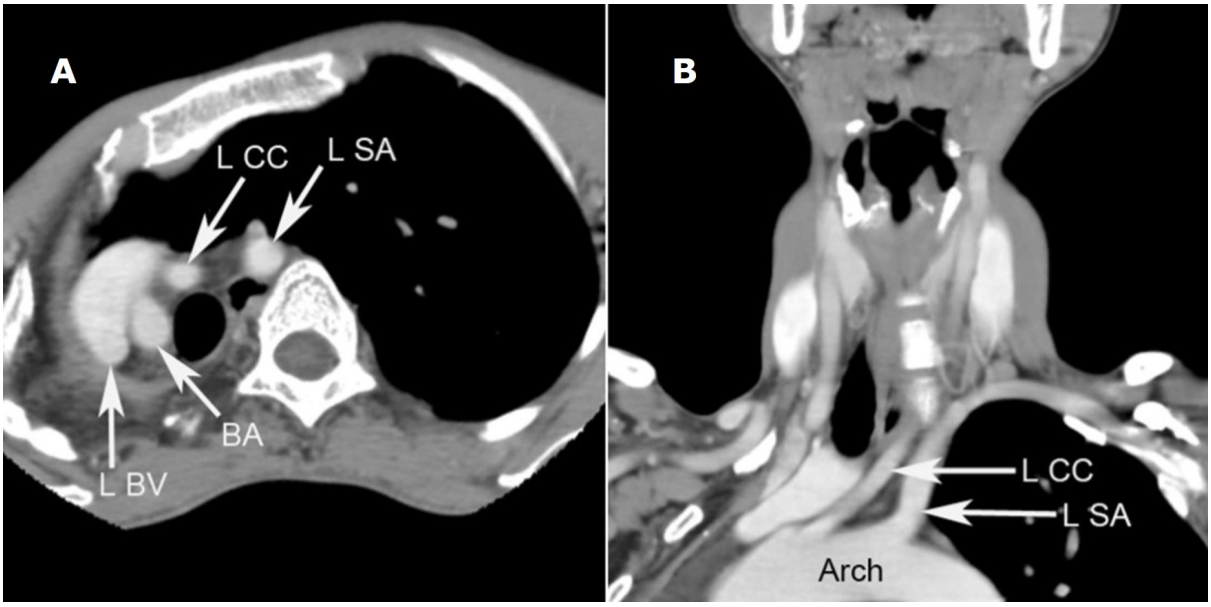

Figure 2A and 2B: CT angiography of the great vessels in axial plane (A) and reconstructed in coronal plane (B). (LSA=left subclavian artery, LCC=left common carotid artery, BA=brachiocephalic artery, LBV=left brachiocephalic vein.) Severe displacement of the great vessels is depicted, with the aortic arch and ostia of all the great vessels located right of midline. Note also the counterclockwise rotation of the great vessels and aorta (usually showing an oblique posteroanterior course; it now displays a horizontal course as seen in B). An increased distance is noted between the left subclavian and common carotid arteries, most plausibly explained by the rotation. The left vagus nerve descends the neck within the carotid sheath and crosses the left subclavian artery, entering the thorax between the left common carotid and subclavian arteries. The left RLN loops around the aortic arch (distal to the ligamentum arteriosus) and enters the aortopulmonary window (asterisk in B), indicating that left RLN nerve is now located to the right of midline which been susceptible to stretch injury.

while the left RLN travels further caudally around the arch of the aorta. Because of their location, these structures are susceptible to direct involvement by mediastinal and apical intrathoracic malignancies, and are also prone to injury during upper thoracic surgical procedures. The left side is usually more affected than the right side in view of its long intrathoracic segment. According to a study by Nishimaki et al., the commonest (45%) postoperative complication of extended radical oesophagectomy for thoracic oesophageal cancer is vocal cord paralysis.[10] A study by Filairi showed that 31% of patients who underwent left lung resection and mediastinal lymph node dissection for cancer suffer vocal fold dysfunction.[11] Alloubi reported 18.5% of patients suffered left RLN injuries following pneumonectomy.[12]

There are several mechanisms of injury to the RLN during cardiothoracic or mediastinal surgery. It can be due to median sternotomy and/or sternal traction pulling laterally on both subclavian arteries. Sternotomy may cause direct trauma to the RLN or indirect injury secondary to excessive sternal traction resulting in either neuropraxia or neurotmesis.[13] Traction on the esophagus due to an unnatural position of the head and neck during surgery may also cause injury to the RLN.[14] The RLN may also be injured during direct manipulation and retraction of the heart during open-heart procedures. With equal traction on the RLN, transmitted from the heart to the major vessels, the shorter right nerve has more force applied to its fibers with more likelihood of being injured.[15] Most of the injuries reported after open-heart surgeries, appear to be secondary to neuropraxia with no major irreversible damage to the RLN.

In contrast to the direct iatrogenic cause of UVCP in cardiothoracic or mediastinal surgery, UVCP long after pneumonectomy took a different mechanism of nerve injury, as the RLN was not injured during the surgery. After pneumonectomy, the RLN of contralateral side is susceptible to stretch injury as the mediastinum and the remaining lung shift

to the side of pneumonectomy. The stretching, over a period of time, will cause demyelination of the nerve.

In this case, the patient underwent right pneumonectomy in view of pulmonary aspergillosis. She was well until after about 15 years after the procedure that she complained of hoarseness, voice fatigue and aspiration symptoms. In the absence of recent surgery, the most plausible explanation for her left vocal cord paralysis is the stretch injury induced by mediastinal shift following the previous right penumonectomy. This was confirmed on LEMG testing which reported neuropraxia. She underwent trans-thyroid injection laryngoplasty using hyaluorinic acid (Juvederm XC) under local anaesthesia and her voice improved temporarily for 3 months.

Incidence of UVCP long after pneumonectomy is extremely rare. To our knowledge, UVCP following pneumonectomy had been reported twice in the literature. In our case, the voice was assessed, pre- and post-IL, with the VHI-10 score, GRBAS scale and MPT. Laryngeal EMG was also performed to assess the neuromuscular status of the larynx. We found that these important assessments were lacking in the previous similar case reports.

Soll reported the first case in 2009 where a patient presented with hoarseness due to left RLN palsy one year after right pneumonectomy, possibly due to the shift of the mediastinum to the right causing a prolonged traction of the nerve.[5] After pneumonectomy the mediastinum shifts to the site of the removed lung and the lung in the contralateral hemithorax becomes hyperinflated. This results in a counter clockwise rotation to the right of the heart and the tracheobronchial tree after right pneumonectomy. The left main stem bronchus becomes stretched and the lower lobe bronchus is kinked over the descending aorta, which functions as a fulcrum.

Gullung reported the second case of UVCP after pneumonectomy in 2012.[6] After left pneumonectomy, the mediastinum shifts toward the side of surgery, moving posterior with rotation of the heart and great vessels in a clockwise direction as it shifts to the left. The remaining lung undergoes hyperinflation towards the side of pneumonectomy. As the right RLN branches from the vagus nerve passes under the innominate artery near the bifurcation, it is susceptible to stretch injury as these vessels shift. The cumulative effect over months could have caused delayed conduction, demyelination, or axonal degeneration of the nerve.

CONCLUSION

In conclusion, UVCP caused by stretching of the RLN is a rare occurrence and this is the third of such cases reported. Patients undergoing pneumonectomy for any reasons may need to be informed regarding this complication as it may occur months to years after the surgery. Various methods, surgical and non-surgical, are available to improve the patient's voice as well as quality of life. Eventually, patients' preference and expectations, cause and onset of paralysis, pre-operative laryngoscopic findings, duration of therapeutic effect, surgeon preference and cost are all crucial factors in defining the most ideal intervention for patient with UVCP.

DISCLOSURE

All authors have contributed to the manuscript equally. None of the authors have direct or financial conflicts of interest with this paper and material contained herein. Authors also acknowledged that consent has been obtained to publish these images.

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