Minimally Invasive Repair of Post-Pneumonectomy Syndrome

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Abstract

We report on a 42-year-old female who underwent right pneumonectomy for hemoptysis from an aspergilloma cavity. Several years postoperatively she complained of increasing shortness of breath, wheezing, and dyspnea upon exertion. Chest computed tomography showed a counterclockwise rotation of the mediastinum with obstruction of the left lower lobe bronchus. Minimally invasive repair was carried out using an intrapleural tissue expander for dissection and an adjustable saline prosthesis for mediastinal centralization. Intraoperative bronchoscopy showed complete resolution of the left lower lobe bronchial obstruction, and postoperatively her symptoms resolved completely. This is the first reported case of a minimally invasive approach for the treatment of post-pneumonectomy syndrome in the United States.

Key words

Thoracic surgery · post-pneumonectomy syndrome · saline prosthesis · minimally invasive

Case Report

The patient was a 42-year-old Hispanic female who underwent a right pneumonectomy six years ago for hemoptysis from an aspergilloma cavity. Three years postoperatively, the patient began to experience shortness of breath, wheezing, dyspnea upon exertion, and dysphagia. She was treated for "adult-onset asthma" without any improvement. Her symptoms continued to worsen and cardiac evaluation showed normal overall heart function. She was then referred for surgical evaluation. Chest X-ray suggested rotation of the mediastinum into the right pleural cavity (**Fig. 1**) and CT scan confirmed a marked counterclockwise rotation of the heart, trachea, left main stem bronchus, and esophagus into the post-pneumonectomy space with near-complete obstruction of the left lower lobe bronchus between the pulmonary artery and the descending thoracic aorta (**Fig. 2a**), confirming the diagnosis of post-pneumonectomy syndrome (PPS).

Preoperative pulmonary function tests showed an obstructive defect with a forced expiratory volume in 1 second (FEV_1) of 1.52 liters (43% predicted).

Intraoperative bronchoscopy revealed enlargement of the left main stem bronchus and marked stenosis of the left lower lobe bronchus in the anteroposterior plane without other endoluminal pathology (**Fig. 2c**). A six centimeter incision was made in the midaxillary line within the previous thoracotomy incision and a segment of the seventh rib was resected. Minimal dissection was carried out within the pleural space to free the pericardium from the lateral chest wall. A tissue expander was inserted and slowly filled with saline to produce mediastinal movement toward the midline. The central venous pressure (CVP) was monitored during the inflation and was terminated when the CVP rose by 10 mmHg. Intraoperative chest X-ray confirmed centralization of the mediastinum. The tissue expander was removed and replaced by a saline prosthesis (Mentor Siltex Spectrum Style 2400, 475 cc, Mentor Corporation, Santa Barbara, CA, USA) with a subcutaneous port for postoperative volume adjustment as needed. Repeat bronchoscopy revealed patency of all branches of the left bronchial tree (**Fig. 2d**). Postoperatively, she experienced immediate relief of her symptoms and was discharged home on the third postoperative day without complications. Her postoperative forced expiratory volume in 1 second (FEV_1) increased to 2.25 liters (61% predicted). Six months after the operation, she remains asymptomatic and in excellent condition.

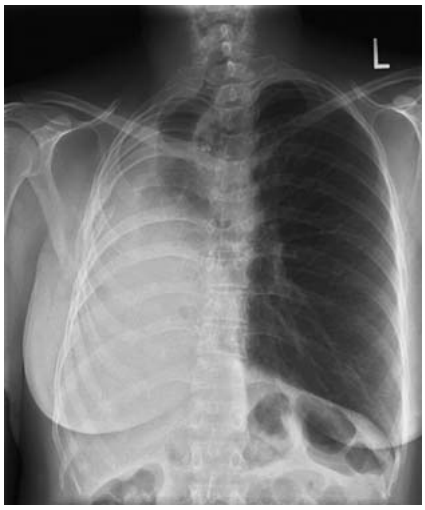

Fig. 1 Preoperative chest X-ray suggested rotation of the mediastinum into the right pleural cavity.

Discussion

Post-pneumonectomy syndrome is a rare complication following pneumonectomy. It is most common following right pneumonectomy [1]. Grillo et al. and Shamji et al. described a similar condition after left pneumonectomy in patients with a right aortic arch [2,3]. However, several cases of the syndrome after left pneumonectomy in patients with normal aortic arches have been reported. The pathophysiology of the syndrome comes from an accentuated shift of the mediastinal structures into the post-pneumonectomy space with either a counterclockwise (right) or a clockwise (left) rotation of these structures [1]. This results in compression of the trachea and contralateral bronchial structures between either the pulmonary artery and aorta (right) or the aorta and vertebral column (left) [1]. Post-pneumonectomy syndrome has been described mostly in infants and young adults, theoretically due to the more pliable and mobile mediastinum in these patients. However, multiple case reports have been published that involve adults as well [4]. The syndrome has been reported to occur anywhere from months to years following pneumonectomy with an average time interval of 5 to 7 years [3]. The classic symptoms include dry, progressive cough, stridor, and difficulty clearing secretions, with recurrent

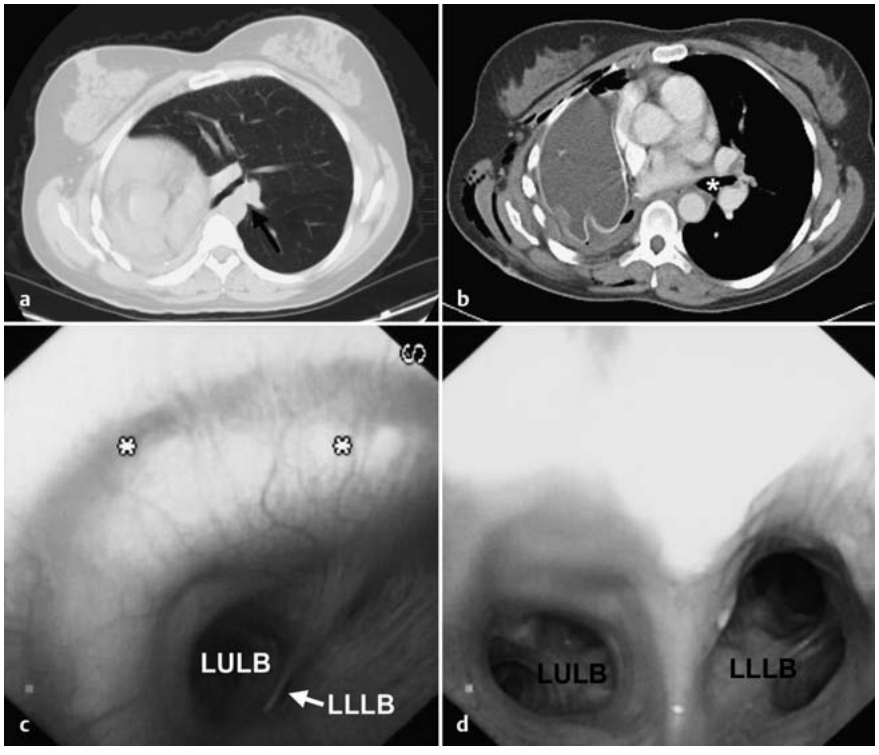

Fig. 2a to **d** Pre- (**a**) and postoperative (**b**) computed tomography of the chest, and intraoperative bronchoscopy before (**c**) and after (**d**) insertion of the saline implant.

pulmonary infections and progressive dyspnea and dysphagia as seen in our patient [5]. These symptoms can progress over time with the ultimate destruction of the remaining lung or malacia of the major airways. The diagnosis is confirmed by demonstration of a marked shift and rotation of the mediastinal structures into the post-pneumonectomy space in conjunction with bronchial narrowing or obstruction, using either chest CT or fiberoptic bonchoscopy.

A wide variety of treatment options have been described for post-pneumonectomy syndrome, including endobronchial stenting, phrenectomy, mediastinal repositioning with non-expandable implants or muscle-flap transposition, aortic division and bypass grafting, and pericardial fixation [2, 6 – 8]. Today, however, the most widely accepted treatment modality is the insertion of expandable saline implants to achieve mediastinal repositioning and fixation [8]. This has traditionally been done by performing a redo thoracotomy with wide lysis of all intrathoracic adhesions to achieve mediastinal repositioning before placing the implants for fixation. The technique reported here involves a small incision with minimal dissection within the hemithorax.

The tissue expander is inserted into the pleural space and used to dissect the tissue planes followed by placement of the saline prosthesis which produces both mediastinal centralization and fixation. This technique was first described by Macaré van Maurik et al. in the Netherlands [8]. They found that 17 of 19 patients (90%) who underwent the procedure had rapid clinical improvement with midline or near midline repositioning of the mediastinum on postoperative imaging. Six of the 19 patients (32%) experienced either herniation, luxation, leakage or inadequate positioning of the prosthesis between 4 weeks and 5 years following the procedure but, in many of their cases, the expander and prosthesis were placed in the extra-pleural space. All of those patients, however, were successfully treated by a repeat minimally invasive approach. This procedure, when compared to the traditional approach, offers the advantage of a shorter operation time, less blood loss, less postoperative pain, shorter hospital stay, and a rapid and durable functional improvement. Intrapleural expansion should be attempted initially unless precluded by extensive intrapleural scarring. These patients should be followed up with periodic chest imaging, and the volume of the prosthesis can be adjusted in the outpatient setting as needed [8]. Follow-up is also necessary in order to screen for late complications due to implantation of the prosthetic material into the pleural space.

Conclusion

We report a case of post-pneumonectomy syndrome causing near-total obstruction of the left lower lobe bronchus with progressive respiratory symptoms repaired by minimally invasive insertion of a tissue expander and a saline prosthesis within the pleural space for centralization and fixation of the mediastinum without the need for reoperative thoracotomy. The patient had immediate relief of her symptoms and remains asymptomatic six months following the procedure. When indicated, we feel that this should be the standard approach for this rare but potentially life-threatening complication of pneumonectomy. Long-term results of the technique have to be validated by both prospective and retrospective studies in order to prove its value and safety.

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