Lung Resection in the Postpneumonectomy Patient

Megumi Asai, MD, Walter J. Scott, MD, FACS*

KEYWORDS

• Pneumonectomy • Lung cancer • Surgery • Recurrence • Metachronous cancer

KEY POINTS

- Pulmonary resection after pneumonectomy is a reasonable option in selected patients.
- Wedge resection for single peripheral metachronous disease has the best outcome with 5-year survival as high as 63%.
- Current and predicted postoperative cardiopulmonary reserve should be evaluated carefully.
- Stereotactic body radiotherapy is a promising alternative for inoperable patients.

INTRODUCTION

Pneumonectomy is commonly performed for resectable lung cancer and more rarely for trauma and selected benign diseases. Seven percent of 119,146 surgical resections performed for non–small cell lung cancer (NSCLC) from 2004 to 2009 were pneumonectomies.[1] After pneumonectomy for cancer, there is always a possibility of developing lesions in the contralateral lung. The risk of having recurrent carcinoma after complete resection of bronchogenic carcinoma is 2% to 5% per year,[2,3] and 1% to 5% for second primary lung carcinoma.[4,5] Although surgical resection is preferred for those synchronous or metachronous tumors, pulmonary resection after contralateral pneumonectomy is a challenging procedure that requires a thorough understanding of postpneumonectomy pathophysiology and the risk-benefit ratio of the procedure for that specific patient. Postpneumonectomy lung resection was initially reported in the 1950s; however, the number of cases in literature is still limited because of several restrictive factors.[6] Insufficient pulmonary reserve and advanced disease are the main limitations that prevent patients from undergoing postpneumonectomy lung resection. Grodzki and colleagues[7] reported that 82% of patients who developed lung cancer after pneumonectomy were refused surgery because of dissemination of the disease, central localization of the tumor, and functional contraindications. There is also a misconception on the part of some physicians that previous pneumonectomy is an absolute contraindication to additional lung resection even though satisfactory long-term survival can be achieved with acceptable morbidity and mortality for selected patients.[7–10]

The short-term and long-term outcomes after postpneumonectomy lung resection have improved over time.[11,12] Surveillance with computed tomography (CT) and follow-up PET detect second primary lung disease and metastatic disease in the early stage that may be amenable to resection. Careful patient selection, advances in anesthetic techniques including the adoption of lung protective strategies, improved postoperative management, and newer surgical techniques have all led to improved outcomes.

Disclosures: The authors disclose no potential conflicts of interest.
Financial Support: None.
Department of Thoracic Surgery, Abington Hospital-Jefferson Health, Price Medical Office Building, 1245 Highland Avenue, Suite 401, Abington, PA 19001, USA
* Corresponding author.
E-mail address: Walter.Scott@jefferson.edu

Thorac Surg Clin 28 (2018) 19–25
https://doi.org/10.1016/j.thorsurg.2017.08.004

SELECTION OF PATIENTS FOR RESECTION

Appropriate selection of surgical candidates for subsequent lung resection after pneumonectomy is critical for a successful procedure. It requires multispecialty evaluation, especially focusing on the patients' functional status, cardiopulmonary reserve, tumor stage, and location.

Functional Status and Cardiopulmonary Evaluation

The American College of Chest Physicians recommends cardiovascular evaluation and spirometry to measure the forced expiratory volume in 1 second (FEV_1) and diffusing capacity for carbon monoxide (DLCO) before any pulmonary resection to predict postoperative morbidity and mortality.[13] It has been considered acceptable for surgical risk if predicted postoperative FEV_1 and DLCO are both more than 40%. When patients do not meet these criteria, the peak oxygen consumption greater than 10 mL/kg/min or 35% predicted may be adequate for major resection.

After pneumonectomy, FEV_1 and DLCO decrease from preoperative values by 34% to 41%, and 20%, respectively.[13] This negative impact on pulmonary reserve limits subsequent pulmonary resection significantly.

In addition, arterial blood gas analysis, echocardiography, and exercise testing are often performed to evaluate cardiopulmonary reserve. Pneumonectomy may cause elevation of total vascular resistance of the pulmonary circulation and an increase in the workload of the right ventricle.[14] Right heart dysfunction and pulmonary hypertension are considered absolute contraindications to surgical resection. Performance status is important to evaluate. Patients' comorbidities are also taken into consideration.

Assessment of Tumor Extent

Preoperative evaluation of a new lesion involves determining the stage and also the likelihood that the lesion represents a metastasis as opposed to a second primary.[7–9] Martini and Melamed[15] identified a second primary tumor when the cell type of the 2 lesions is different, the time interval between the 2 lesions exceeds 2 years, and the second tumor is in a different lobe or lung without common lymphatic metastases. When the cell type is the same in 2 lesions and the time interval to development of a second tumor is relatively short, it is less likely that a new nodule is a second primary.

Chest CT is used to assess the size, location, relation to adjunct structure, and characteristics of the lesion. Single wedge resection (wedge resection of only one nodule) has a better prognosis compared with more extensive surgery, such as multiple wedge resections, segmentectomy, or lobectomy after pneumonectomy.[9,16,17] Resections of small, single peripheral lesions are associated with the best outcomes.[7] Resections of central tumors or multiple lesions are not optimal, and alternative treatment should be considered. Judicious use of transthoracic or transbronchial biopsy may be considered in order to obtain a tissue diagnosis when resection is not planned. Grodzki and colleagues[7] used percutaneous biopsy in 83% of patients with a 13% rate of pneumothorax, which did not require intervention. This process may save patients from unnecessary surgery; however, sometimes it is nondiagnostic. Pneumothorax occurs after transbronchial lung biopsy in approximately 1% to 6% of cases,[18] while pneumothorax after percutaneous fine needle aspiration (FNA) occurs in 0% to 61% of cases with an intervention (chest drain) needed from 0% to 13% of the time.[19] Obviously pneumothorax can be life-threatening for a patient with a single lung. The clinician performing the biopsy should be prepared to place a percutaneous drain immediately should symptomatic pneumothorax occur. Bronchial lavage can retrieve a specimen for cytology with low risk of pneumothorax, but the diagnostic yield is low. Bronchoscopy is useful to identify any endobronchial invasion of the tumor.

Grodtzki and colleagues[7] noted decreased survival for patients undergoing postpneumonectomy lung resection who were found to have N2 disease compared with those who had only N0-N1 disease. Therefore, mediastinal lymphadenopathy should be evaluated by endobronchial ultrasound (EBUS)-guided FNA. Cervical mediastinoscopy can be performed, although it may be challenging given the previous surgical procedure, mediastinal shift after pneumonectomy, and any previous mediastinal radiation therapy. Postpneumonectomy patients with proven N2 lymph node metastases should generally not be offered lung resection. PET/CT should be considered for all patients to evaluate the likelihood of malignancy of a lung nodule, assess involvement of mediastinal lymph nodes, and look for distant metastasis. Mediastinal lymph nodes less than 10 mm on CT can be positive for metastasis on pathology, which correlate with poor survival rate.[7,8] The use of PET can save 1 in 5 patients with NSCLC from unnecessary surgery compared with conventional study alone.[20] The authors recommend brain MR in these patients if they have a previous history of lung cancer.

Postpneumonectomy lung resection is not limited to malignancy; however, the risk-benefit ratio should be carefully considered given the nature of the procedure.