

Management of Complications After Pneumonectomy

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KEYWORDS

• Pneumonectomy • Postoperative complications • Postoperative care

KEY POINTS

- Mortalities after pneumonectomy have steadily declined over the last 80 years but morbidity remains significant.
- Following pneumonectomy, patients have limited cardiopulmonary reserve and therefore live along a narrow margin of error.
- Appropriate patient selection and a proactive approach to perioperative management are essential to optimizing outcomes after pneumonectomy.
- When complications do occur, they must be aggressively treated to curtail their potential impact on the patient.

The patient's outcome correlates directly with the surgeon's attention to a myriad of minor details. This obsession of doing a lot of little things right is the foundation for good surgical results.

—Hiram C. Polk, MD

Indeed, meticulous attention to detail is paramount for optimizing outcomes after pneumonectomy. As compared with lesser pulmonary resections, most single- and multi-institution studies over the last 80 years indicate that pneumonectomy is associated with the highest morbidity and mortality rates.^{1,2} Complication rates after pneumonectomy, however, have steadily decreased with time, likely because of improvements in patient selection, operative techniques, and perioperative care. In fact, one recent multicenter study of select patients who underwent resection for early-stage non-small

cell lung cancer found no significant difference in mortality after pneumonectomy, as compared with lobectomy.³

Although most complications of pulmonary resection are not immediately life-threatening, they are associated with increased cost, increased length of hospital stay,⁴ and lower 5-year cancer-specific survival rates.⁵ As such, it is imperative that thoracic surgeons understand the cause and management of potential complications of a standard pneumonectomy and extrapleural pneumonectomy (EPP) to proactively minimize their risk of occurrence and to curtail their impact when they do occur.

PATIENT SELECTION

Most pneumonectomies are done on an elective basis. As such, it is essential that patients who

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are potential candidates for pneumonectomy undergo an appropriate preoperative physiologic assessment to facilitate informed decision-making by both patients and surgeons. The decision regarding a patient's candidacy for a pneumonectomy can then accurately be placed in the context of operative risk. Physiologic assessment should include a thorough preoperative history and physical examination, with specific attention paid to signs and symptoms of cardiopulmonary compromise. Several standardized indices, such as metabolic equivalent tests⁶ and the Duke Activity Status Index,⁷ have been published. However, a simple review of systems provides an essential, noninvasive means of assessing a patient's functional capacity and risk of perioperative morbidity and mortality. For instance, a patient who reports an inability to walk 4 blocks or to climb 2 flights of stairs without symptomatic limitation has a significantly increased risk of developing perioperative cardiovascular complications following pneumonectomy.⁸ Ancillary studies are a critical adjunct, but should not supplant the clinician's general assessment of a patient's physiologic fitness.

Given the relatively high incidence of perioperative arrhythmias and concomitant cardiovascular disease, a preoperative electrocardiogram should be obtained for all patients being considered for pneumonectomy.⁹ The thoracic revised cardiac risk index (ThRCRI) is a useful screening tool to identify patients at an increased risk of cardiovascular complications, who may need further preoperative evaluation.^{9,10} According to the current (2014) American College of Chest Physician Guidelines, patients with a ThRCRI >1.5 , with a cardiac condition requiring medications, a newly suspected cardiac condition, or an inability to climb 2 flights of steps should be evaluated by a cardiologist for consideration of further cardiac testing.⁹ The authors routinely obtain an echocardiogram on all of their patients being considered for pneumonectomy to assess right and left heart function and to estimate the pulmonary artery pressures (PAPs), to gauge the risk of postpneumonectomy pulmonary hypertension.

In addition to evaluating cardiovascular risk, pulmonary fitness should also be assessed. A baseline assessment of arterial gas exchange is important for future comparison and provides prognostic information. Specifically, preoperative hypoxemia, defined as an arterial oxygen saturation of less than 90% at rest, is associated with an increased risk of postoperative complications.¹¹ Despite being historically quoted as an exclusion criterion for pulmonary resection, hypercapnia (carbon dioxide partial pressure >45 mm

Hg) is not an independent risk factor for perioperative complications. It does, however, indicate a need for further physiologic testing.¹²

Pulmonary function tests also provide essential information regarding the ability of a patient to tolerate a pneumonectomy. A predicted postoperative (PPO) forced expiratory volume in 1 second (FEV₁) greater than 60% and a diffusion capacity of the lung for carbon monoxide (D_{LCO}) $>60\%$ indicate a low risk for perioperative complications; further testing is not indicated.⁹ For patients with either a PPO FEV₁ or a PPO D_{LCO} less than 60%, an exercise test (eg, stair climb or shuttle walk test) should be performed.⁹ Patients with either a PPO FEV₁ or a PPO D_{LCO} less than 30% or who demonstrate poor reserve during an exercise test (eg, walk <25 shuttles on the shuttle walk test or <22 m on the stair climb) are at a high risk for perioperative morbidity and mortality. Such patients should be evaluated with formal cardiopulmonary exercise testing to assess their maximal oxygen consumption (Vo₂ max).¹² Although the threshold has been debated, a Vo₂ max of 15 mL/kg/min or greater indicates sufficient cardiopulmonary reserve. A Vo₂ max less than 10 mL/kg/min is associated with an increased risk of perioperative complications. The care of such patients should be discussed at a multidisciplinary conference and may be best limited to nonoperative treatment options.¹³

Poor cardiopulmonary function may preclude a patient from undergoing pneumonectomy, yet chronologic age alone should not. Lung cancer primarily affects people older than 50, a significant number of whom (30%–35%) are older than 70.^{9,14} As the longevity of the general population increases, an increasing number of patients older than 70 will be diagnosed with lung cancer. In fact, the age-adjusted incident rates for lung cancer among patients over the age of 65 increased by 50% from 1975 (about 220 per 100,000 person-years) to 2011 (about 330 per 100,000 person-years).¹⁵ Rather than chronologic age, factors such as tumor stage, comorbidities, performance status, and life expectancy should be taken into consideration when determining whether a patient is a candidate for a pneumonectomy.⁹ The increased risk of complications after pneumonectomy in older patients noted in some studies may be confounded by comorbidities. Associated comorbidities may have precluded some older patients from undergoing resection, and others may have refused intervention; nonetheless, a significant proportion may be denied an operation, because of the erroneous assumption that older patients' postoperative life expectancy is too short or that their quality-of-life

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