Extended resections for lung cancer. How far is too far?[☆]

Peter C. Pairolero[1]

Mayo Medical School, Rochester, MN 55906, USA

Abstract

Pulmonary resection is the preferred treatment for patients with lung cancer. Half of all patients, however, have signs of unresectability at the time of diagnosis. Contraindication to pulmonary resection is based on cell type, the extent of the disease, and the patient's overall general medical condition. Invasion of the chest wall by bronchogenic carcinoma is not rare. The diagnostic importance of this findings, however, has been controversial. Early reports had regarded thoracic wall invasion as a uniformly ominous sign, while recent reports have been more optimistic, especially when lymph nodes were not metastatically involved. Chest wall resection should be preceeded by mediastinoscopy. If lymph nodes are negative, excision is generally performed en bloc with pulmonary resection. After the thorax is entered and the cancer is found to be invading the chest wall, wide resection of the chest wall with attached lung is performed. Generally, the line of resection should encompass the area of invasion by several centimeters. The lung with attached chest wall is then allowed to fall back into the pleural cavity, where the appropriate pulmonary resection is performed. If the chest wall defect is less than 5 cm in diameter, no reconstruction of the defect is required. If, however the defect is larger and structural stability is required. The defect should be reconstructed with a prosthetic material, such as the various meshes, metals, or soft tissue patches, and reinforced with a muscle flap. If the wound is contaminated from an intrathoracic source, prosthetic material should be avoided and reconstruction with a muscle flap alone is preferred. Muscles commonly used include serratus anterior, pectoralis major, latissimus dorsi, and occasionaly, rectus abdominus. Because the omentum lacks structural stability, it should be considered a back-up alternative procedure. Operative mortality is usually related to the extent of pulmonary resection rather than the extent of chest wall resection. Five-year survival approaches 50% for patients with T3N0M0 lesions. For patients with either N1 or N2 neoplasms, 5-year survial is less than 10%. Postoperative radiation therapy appears to have no effect on survial © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Pulmonary resection remains the cornerstone of treatment for lung cancer. Overall 5-year survival for patients with non-small cell postsurgical stage I lung cancer is approximately 70%. Five-year survival, however, varies from 80% for patients with T1N0M0 tumors to less than 10% for patients with bulky N2-3 disease. Invasions of the chest wall, vertebral body, mediastinum, or diaphragm (T3-4 disease) is not rare. The prognostic importance of this finding, however, has been controversial. Although invasion of the chest wall cancer has, in general, never been considered evidence of unresectability, early reports were pessimistic about long-term survival. Similarly, early reports regarding mediastinal intrathoracic invasion were even more ominous, with most considering this a relative contraindication to pulmonary resection. More recently, however, reports have been more optimistic [1,2], and the term 'extended

resection' has come into use, indicating an increased effort to completely excise the tumor when it has spread beyond the lung itself [3,4]. In nearly every instance, the patient who is a candidate for an extended resection has cancer extending into the chest wall, vertebral body, pericardium, atrium, pulmonary vessels, or diaphragm.

2. Staging

Ideally, lymph node metastasis should be absent. Staging procedures such as mediastinoscopy and mediastinotomy do, offer important prognostic information [5–7]. The decision to proceed with en bloc resection in patients with documented lymph node metastases, however, should be individualized, since operative mortality is high and the possibility of cure is remote.

3. Extent of resection

Lung cancer often invades adjacent intrathoracic struc-

tures, the extent of which frequently cannot be fully appreciated until thoracotomy. If invasion of the great vessels, esophagus, or vertebral body is encountered, the lesion, in general, should be considered unresectable. Segmental resection of great vessels and esophagus should be rarely, if ever, performed; excision, however, may be justified in selected patients if only a limited portion of the structure is involved. If the vascular structure can be partially cross-clamped, excision with either direct closure or patch angioplasty is reasonable. Similarly, if only the outer layer of the esophageal wall is involved, the tumor, at times, can be excised with an extramucosal resection. Although extramucosal excisions may result in an iatrogenic esophageal diverticulm, the patient is usually asymptomatic if the muscular resection is limited. Resection of vertebral bodies should only be considered if the invasion is limited to the hemivertebra and adequate orthopedic or neurosurgical assistance is available to stabilize the back. Similarly, a centrally located cancer can spread along the great vessels into the pericardium. In the hope that an extended resection may offer a cure, an effort may be made to completely excise these tumors. In selected patients, the pericardium is opened anterior to the phrenic nerve to assess the extent. If a sufficiently long segment of pulmonary artery can be isolated, the vessel can be safely divided. However, most cancers that invade the atria or ventricles should be considered unresectable, and only those which track down the pulmonary vein into the atria should be considered for resection. At times, heart bypass is necessary to safely remove tumors extending into the left atrium. Diaphragmatic invasion when encountered is readily treated by wide resection. The diaphragmatic defect can almost always be closed by direct suture and rarely is prosthetic material needed.

When cancer is found to be invading the chest wall, resection of the chest wall with attached lung is often appropriate. Generally, the margin of resection should encompass the area of invasion by several centimeters. The lung with attached chest wall is then allowed to fall back into the pleural cavity, where the appropriate pulmonary resection is performed. If the chest wall defect is less than 5 cm in greatest length, no reconstruction of the defect is required. Reconstruction of larger defects, however, has been a constant challenge to the surgeon. The ability to close large defects has taxed the reconstructive surgeon and excision should not be undertaken if the surgeon does not have the confidence and ability to close the defect.

The critical questions of whether the reconstructed thorax will support respiration and protect the underlying organs must be answered when considering both the extent of resection and the method of reconstruction. Stabilization is best accomplished with prosthetic material such as Prolene mesh (Ethicon, Inc., Somerville, NJ) or 2-mm polytetrafluoroethylene (Gore-tex) soft tissue patch (W.L. Gore and Associates, Inc., Elkton, MD). Placing either of these materials under tension improves the rigidity of the prosthe-

sis in all directions. The soft tissue patch is superior because it prevents movement of fluid and air across the reconstructed chest wall. Marlex mesh (Daval, Inc., Providence, RI) is used less frequently because when placed under tension, it is rigid in one direction only. Others have been a strong advocate of methyl methacrylate-impregnated meshes [8].

Both muscle and omentum can be used to reconstruct soft tissue chest wall defects. Muscle, however, is the tissue of choice as it is very malleable and has more structural stability. Muscle can be transposed both as muscle alone or as a musculocutaneous flap. The omentum should be reserved as a backup procedure for muscle transposition that has failed in full-thickness defects.

4. Clinical experience

During the past 25 years, 500 patients have undergone chest wall resection and reconstruction at the Mayo Clinic. Included were 212 patients with tumors of the chest wall, 131 with infected sternotomy wounds, 47 with radiation necrosis, and 110 with a combination of these. Ages ranged from 1 day to 85 years, with a mean of 55 years. Ribs (mean, 3.9) were excised in 241 patients and a total or partial sternectomy in 259 patients. The skeletal defects were closed with prosthetic material in 283 patients. Four hundred and seven patients underwent 611 muscle transpositions, including 355 pectoralis major, 141 latissimus dorsi, 27 serratus anterior, and 18 rectus abdominis. The omentum was transposed in 51 patients.

Mean hospitalization was 14.2 days. There were five perioperative deaths. Thirteen patients required tracheostomy. Most other patients had only minor changes in pulmonary function.

Follow-up averaged 56.4 months. No late deaths related to either resection or reconstruction of the chest wall occurred. At follow-up, 83% who were alive 30 days after operation had an excellent result.

5. Summary

En bloc resection of either chest wall, mediastinal structures, or diaphragm with attached lung for primary lung cancer with local invasion, while associated with a significant operative mortality, can be performed with a reasonable expectation of long-term survival if lymph nodes are not metastatically involved. The presence of lymph node metastases alone, however, should not necessarily preclude surgical resection. Reconstruction can often be performed in one operation, with minimal respiratory insufficiency, a short hospitalization, and low operative mortality.

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