Clinical patterns and trends of outcome of elderly patients with bronchogenic carcinoma

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Abstract

Objective: To investigate the clinical characteristics and determinants of operative mortality and long-term survival of elderly patients submitted to pulmonary resection for intended cure of lung cancer. Methods: Retrospective analysis of 500 consecutive pulmonary resections performed in patients aged over 70 years from 1975 to 1996. Predictors of in-hospital mortality were identified by univariate and multivariate analyses. Determinants of long-term outcome were investigated in all survivors, with no patient being lost to follow-up. Results: Mean age was 74 ± 3 years (maximum: 90), and 36 patients were octogenarians. The sex-ratio M:F was 5:3. History of combined cardiovascular or previous neoplastic disease was noted in 193 and 63 patients, respectively. The predominant histology was squamous cell carcinoma (n = 243), with a significantly higher incidence in male than in female. Most patients received standard procedures, while 103 patients underwent extended resections for tumors involving the mediastinum (n = 44), the chest wall (n = 33), the carina (n = 2) or had a sleeve resection of the main bronchus (n = 24). Procedures were considered to be complete and curative in 459 patients, among whom 294 had a stage I disease. There were 37 (7.4%) in-hospital deaths. Mortality rates following pneumonectomy, bilobectomy, lobectomy and lesser resection were 11/136, 4/34, 22/291, and 0/39, respectively. Age, male gender, hypertension, low FEV1 and extended procedure were identified as independent predictors of early mortality. Overall survival rates were 33.7 and 12% at 5 and 10 years, respectively. Multivariate analysis demonstrated that the disease stage was the main prognosticator. During the follow-up period, cancer recurrence (n = 183; 39.5%) or second primary lung cancer (n = 20; 4.3%) occurred in 203 patients, among whom 18 (9%) had a second lung resection. Carcinoma in other systems occurred in 25 patients (5.3%), and major cardiovascular event in 51 (11%). Conclusions: Male and squamous cell carcinoma are characteristic of elderly patients with resected lung cancer. Operative mortality is acceptable for standard resection, and survival figures are concordant with those reported in other series which include younger patients. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Lung neoplasms; Aged; Surgery

1. Introduction

Developed countries have already decided that everyone, irrespective of age, has the same right to health resources. Currently, lung cancer accounts for increasing deaths and costs in the elderly [1], and although surgery offers the best chance for cure in patients with localised disease, radiotherapy is the most commonly used treatment option in non-small-cell lung cancer [2,3]. Age thus appears to be a major factor influencing
treatment choices, although non-optimal therapeutic strategy in the elderly patient seems to affect dramatically the long-term survival [4]. Naturally shortened life expectancy, higher operative risks and possible sequelae leading to an impaired quality of life are some of the reasons why surgery is often denied in those elder individuals. There is however little information in which these outcomes are analysed in large series of elderly patients submitted to pulmonary resection for intended cure of lung cancer. This study was therefore designed to investigate the clinical characteristics of elderly patients undergoing resection for lung cancer, as well as determinants of early mortality and long-term survival in this population.

2. Methods

Data on all patients with bronchogenic carcinoma admitted to the Division of Thoracic Surgery at Laval University Hospital were reviewed for the period from January 1975 to June 1996. Among 2780 consecutive pulmonary resections, 500 (18%) were performed in patients aged 70 years or older.

Functional assessment of elderly patients was similar to that of younger patients and was dictated by the medical history, physical examination, basic blood tests, electrocardiogram, and standard pulmonary function data. Pulmonary function was assessed by spirometry and blood gas determinations. For the majority of patients, minimal requirements for performing lobectomy or pneumonectomy were both normoxemia at rest and postoperative FEV1 expected to be more than 15 ml/kg when estimated from preoperative spirometric data and predicted number of removed lung segments. All patients with previous history of cardiovascular disease, suspicious symptoms, or with ECG abnormalities such as Q waves, significant ST depression, left ventricular hypertrophy, complete right bundle branch block, or ventricular premature contraction, consulted a cardiologist, and additional investigations often included echocardiography, exercise stress testing or coronary angiography.

Clinical staging was based on routine chest X rays, bronchoscopy, and liberal extrathoracic imaging. Since 1980, patients were investigated by routine computed tomography from thoracic inlet to umbilicus. Mediastinoscopy was performed in the vast majority of cases (83.6%). In 82 patients, however, it was not carried out because of emergent operation required for massive hemoptysis (n = 3), previously treated head and neck or lung cancer (n = 9), or isolated lung nodule without preoperative diagnosis of neoplastic disease (n = 70). Only 4 patients in this age group underwent surgery despite a positive mediastinoscopy. All patients were evaluated by a senior staff surgeon for resectability.

Our surgical policy favoured lobectomies over limited resections, and whenever possible we tried to avoid pneumonectomy. Most patients (n = 448) had standard intraoperative lymph node sampling, whereas patients with suspected or demonstrated suspicion of N2 disease underwent radical lymphadenectomy (n = 30). Early in the series, 22 patients had no intraoperative nodal staging. Patients were staged according to the postsurgical TNM classification from the AJCC [5], but because routine multilevel pathologic mediastinal nodal assessment was only begun in 1986, staging for earlier cases (n = 154) was based on a synthesis of pathology reports, operative notes, and preoperative imaging.

Clinical variables were collected and stored using a computerised database, and surgical morbidity was determined according to the terminology used by the Lung Cancer Study Group protocol 884 [6]. Operative mortality included the true 30-day mortality as well as other death occurring during the initial postoperative hospital stay. Postoperative complications were classified as minor or major. Minor complications included all events thought to have no significant impact on the patient’s postoperative course, such as sputum retention and atelectasis requiring less than two bronchoscopies, pleural effusion, pneumothorax, arrhythmia responsive to drugs, transient bronchospasm, and infection at the chest tube site. All other complications were considered major.

All patients were followed at our outpatient clinic and follow-up information was computed through June 1996 on all survivors.

Survival was estimated using the product limit method of Kaplan-Meier from the date of the operation and included the operative mortality as well as any cancer-related and unrelated death. Frequencies were compared with the \( \chi^2 \) test when appropriate. Means are given as ± S.D. Survival rates are presented with their 95% confidence intervals within brackets. Differences between survival curves have been assessed by the log-rank test. A univariate logistic regression was performed and a likelihood ratio test was used to identify the significant risk factors for postoperative complications and disease recurrence. Proportional hazards regression was used to incorporate in the same model any explanatory variables with a P value of less than 0.1. Forward stepwise procedure and likelihood ratio tests were used to select the variables with the greatest prognostic value (\( P < 0.05 \)). This statistical analysis was performed by using the Statistical Analysis System software package (SAS Institute, Cary, NC).
having stage IIIA disease, and 10 (2%) having stage IIIB disease. There were only 2 patients with a stage IV disease, whereas 22 patients were not given a stage by reason of multicentricity (n = 15) or presence of peritumoral satellite lung nodules (n = 7). Pathology disclosed a squamous cell carcinoma in 243 patients (48.6%), an adenocarcinoma in 128 (25.6%) including 24 of the bronchioalveolar type, a large cell carcinoma in 98 (19.6%), and another cell type in 15 (3%). Mixed tumors were present in 16 patients (3.2%).

3. Results

3.1. Clinical characteristics

The mean age of the cohort was 74 ± 3 years (maximum: 90), and 36 patients were 80 years old or older. The sex-ratio was 5:3 M:F, and the number of resections per year increased significantly during the study period (r² = 0.9, P = 0.02). Most patients (n = 285, 57%) were symptomatic from their disease, and 88 (17.6%) complained from recent body weight loss (mean ± S.D.: 6.5 ± 4 kg). There were 209 current smokers, 269 former smokers and 22 non-smokers. As a result, 193 patients (38.6%) had coexisting, often multifocated, cardiovascular disease involving the coronary arteries (n = 125), the peripheral arteries (n = 68), and the carotids (n = 48). ECG abnormalities were noted in 180 patients. There were 100 patients (20%) who had arterial hypertension, and 37 (7.4%) who were diabetic. Mean creatinine level was 95 ± 24 μM/l. Spirometric values are shown in Table 1, and 215 patients (42%) were diagnosed as having chronic obstructive pulmonary disease. A previous history of neoplastic disease was known in 63 patients (12.6%), and all were disease free of these neoplasms at the time of operation for lung cancer.

Mediastinoscopy resulted in adequate mediastinal nodal staging in 91% of cases. Overall, pathological staging resulted in 294 patients (58.8%) having stage I disease, 80 (16%) having stage II disease, 92 (18.4%) having stage IIIA disease, and 10 (2%) having stage IIIB disease. There were only 2 patients with a stage IV disease, whereas 22 patients were not given a stage by reason of multicentricity (n = 15) or presence of peritumoral satellite lung nodules (n = 7). Pathology disclosed a squamous cell carcinoma in 243 patients (48.6%), an adenocarcinoma in 128 (25.6%) including 24 of the bronchioalveolar type, a large cell carcinoma in 98 (19.6%), and another cell type in 15 (3%). Mixed tumors were present in 16 patients (3.2%). The distribution of histology by sex showed significant differences (P = 0.001) with a higher incidence of squamous cell carcinoma (52 vs. 31.6%), and a lower incidence of adenocarcinoma (22.3 vs. 42.3%) in male than in female. The last difference was explained in part by the significantly higher incidence of bronchioloalveolar carcinoma in female (16.5 vs. 2.6%).

3.2. Types of operation

Types of resections performed are shown in Table 2. Most patients had a standard procedure, while 103 patients (20.6%) underwent extended operations for tumors involving the mediastinum (intrapericardial pulmonary artery or veins, n = 40; superior vena cava, n = 2; oesophagus, n = 1; aorta, n = 1), the chest wall (n = 33), the carina (n = 2) or had a sleeve resection of the main bronchus (n = 24). Octogenarians underwent significantly less pneumonectomies (P = 0.01) and less extended resections (P = 0.001) than septuagenarians (Table 3). On the basis of removal of all gross carcinoma, disease-free resection margins, and highest mediastinal node free of tumor, 91.8% (n = 459) of procedures were considered to be complete and curative (R0). Resection was considered incomplete when the final pathology report identified microscopic residual cancer at the bronchial margin or in the highest mediastinal node (R1, n = 35, 7%), or when gross cancer was left in place (R2, n = 6, 1.2%).

Table 1

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>S.D.</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV₁ (l/s)</td>
<td>1.9</td>
<td>0.56</td>
<td>0.44</td>
<td>3.49</td>
</tr>
<tr>
<td>FVC (l)</td>
<td>2.96</td>
<td>0.77</td>
<td>0.77</td>
<td>7.21</td>
</tr>
</tbody>
</table>

Numbers in parenthesis are percentage from predicted values.

3. Results

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Table 2

<table>
<thead>
<tr>
<th>Variables</th>
<th>Nb</th>
<th>Operative mortality (%)</th>
<th>Recurrence rate (%)</th>
<th>5-year survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonectomy</td>
<td>136</td>
<td>11 (8.1)</td>
<td>60 (44.1)</td>
<td>25.2</td>
</tr>
<tr>
<td>Bilobectomy</td>
<td>34</td>
<td>4 (11.8)</td>
<td>15 (44.1)</td>
<td>18.2</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>291</td>
<td>22 (7.6)</td>
<td>91 (31.3)</td>
<td>37.6</td>
</tr>
<tr>
<td>Lesser resection</td>
<td>39</td>
<td>0</td>
<td>14 (35.9)</td>
<td>45.5</td>
</tr>
<tr>
<td>Standard procedure</td>
<td>397</td>
<td>24 (6)</td>
<td>126 (31.7)</td>
<td>35.5</td>
</tr>
<tr>
<td>Extended procedure</td>
<td>103</td>
<td>13 (12.6)</td>
<td>45 (43.7)</td>
<td>26</td>
</tr>
<tr>
<td>R0</td>
<td>459</td>
<td>33 (7.2)</td>
<td>156 (34)</td>
<td>35</td>
</tr>
<tr>
<td>R1</td>
<td>35</td>
<td>3 (8.6)</td>
<td>21 (60)</td>
<td>17.4</td>
</tr>
<tr>
<td>R2</td>
<td>6</td>
<td>1 (16.7)</td>
<td>4 (66.7)</td>
<td>0 (at 22 months)</td>
</tr>
<tr>
<td>No lymph node resection</td>
<td>22</td>
<td>1 (4.5)</td>
<td>7 (31.8)</td>
<td>41.6</td>
</tr>
<tr>
<td>Sampling</td>
<td>448</td>
<td>32 (7.1)</td>
<td>155 (34.6)</td>
<td>34.3</td>
</tr>
<tr>
<td>Curage</td>
<td>30</td>
<td>4 (13.3)</td>
<td>19 (63.3)</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Nb: number of patients.
The leading causes of mortality/morbidity were related to pulmonary complications. To allow ventilatory assistance and/or repeated bronchial suctions 26 patients required a tracheotomy postoperatively. One or more non-fatal major pulmonary complications occurred in 72 patients (14.4%), and included sputum retention (n = 53), pneumonia (n = 19), temporary mechanical ventilation (n = 5), laryngeal oedema (n = 1), and adult respiratory distress syndrome (n = 1). Minor respiratory complications also occurred in 18 additional patients. Overall, multivariate analysis identified extended procedure (P = 0.0007), low FEV₁ (P = 0.0001), and low FVC (P = 0.005) as independent predictors of fatal or non-fatal major pulmonary complications.

Non-fatal major cardiovascular complications occurred in 40 patients (8%), and these included arrhythmia necessitating cardioversion (n = 24), angina pectoris (n = 4), stroke (n = 3), deep venous thrombosis (n = 3), myocardial infarction (n = 2), pulmonary embolism (n = 2), and acute leg ischemia (n = 2). Transient and minor episodes of arrhythmia also occurred in 54 patients. The incidence of cardiovascular complications was significantly higher after pneumonectomy than after lesser resection (34.6% vs. 22.8%, P = 0.007), and multivariate analysis identified extent of lymph node removal (P = 0.0004), hypertension (P = 0.001), preoperative ECG abnormalities (P = 0.008), extent of parenchymal resection (P = 0.011), and age (P = 0.013) as independent predictors of those complications.

There were 96 patients (19.2%) who suffered fatal or non-fatal surgical complications that are listed in Table 5. Reoperation was performed in 19 patients. There were 8 bronchial fistulas after pneumonectomy, with a significantly higher incidence after right (6/49) than after left (2/87) pneumonectomies (P = 0.04). The most significant surgical complications after bilobectomy were those of prolonged air leaks and empyema (n = 6, 17.6%). Multivariate analysis demonstrated that extended procedures (P = 0.0009), male gender (P = 0.004), and right sided resections (P = 0.023) were independent predictors of these complications.

Table 3
Early and long-term results according to patients age

<table>
<thead>
<tr>
<th>Procedure</th>
<th>70–74 years (n = 320)</th>
<th>75–79 years (n = 144)</th>
<th>80 years and older (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobectomy</td>
<td>8 (4.9%)</td>
<td>13 (9%)</td>
<td>4 (11%)</td>
</tr>
<tr>
<td>Lesser resection</td>
<td>25 (7.8%)</td>
<td>112 (78%)</td>
<td>32 (22%)</td>
</tr>
<tr>
<td>Standard resection</td>
<td>250 (78%)</td>
<td>112 (78%)</td>
<td>35 (97%)</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>198 (57.2%)</td>
<td>82 (57%)</td>
<td>26 (72%)</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>22 (7%)</td>
<td>13 (9%)</td>
<td>4 (11%)</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>70 (22%)</td>
<td>32 (22%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>19 (5.9%)</td>
<td>15 (10.4%)</td>
<td>3 (8.3%)</td>
</tr>
<tr>
<td>5-year survival</td>
<td>35.4%</td>
<td>27.7%</td>
<td>36%</td>
</tr>
</tbody>
</table>

3.3. Early outcome

The postoperative course was uneventful in 215 patients (43%) who had a mean postoperative stay of 12 ± 5 days. Minor and/or major complications occurred in 128 and 191 patients, respectively, leading to a mean postoperative stay of 24 ± 24 days. There were 68 patients who experienced more than one major complication. There were 37 (7.4%) in-hospital deaths, and causes of death are listed in Table 4. Operative mortality was stable over the study period. Mortality rates were 4.8% for stage I patients, 6.2% for stage II patients, 12% for stage IIIA patients, and 20% for stage IIIB patients (P = 0.034). Operative mortality according to other variables is listed in Table 2. Overall, the operative mortality for patients who underwent an extended procedure was 12.6% as opposed to 6% for patients who had a standard operation (P = 0.02). Mortality rates that were associated with extended procedures were as follow: chest wall: 6%, main bronchus (sleeve): 8.3%, mediastinum and carina: 19.6%. Multivariate analysis showed that extended procedure (P = 0.0001), male gender (P = 0.0003), hypertension (P = 0.01), age (P = 0.02), and low FEV₁ (P = 0.04) were independent predictors of early mortality.

Table 4
Causes of postoperative deaths

<table>
<thead>
<tr>
<th>Complication</th>
<th>Nb</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchial fistula</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td>Haemorrhage</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>Cardiac herniation</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>12</td>
<td>32.4</td>
</tr>
<tr>
<td>ARDS</td>
<td>3</td>
<td>8.1</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>4</td>
<td>8.1</td>
</tr>
<tr>
<td>Heart failure</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>Stroke</td>
<td>6</td>
<td>16.2</td>
</tr>
<tr>
<td>Aortic thrombosis</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td>Digestive perforation/bleeding</td>
<td>3</td>
<td>8.1</td>
</tr>
<tr>
<td>Cachexia</td>
<td>1</td>
<td>2.7</td>
</tr>
</tbody>
</table>

ARDs, adult respiratory distress syndrome; Nb, number of patients; %, percentage.
which three required a laparotomy.

Late complications or sequelae were observed in 14 patients (3% of the survivors), and were the cause of death in seven cases. There were four patients who had a late bronchopleural fistula of which two were associated with local recurrence, and one had an oesophaegopleural fistula following postoperative radiotherapy. One other patient died of the late consequences of an early post-operative bronchial fistula. Eight patients required prolonged convalescent care after discharge because of cachexia (n = 2), respiratory (n = 5) and cardiac insufficiency (n = 1). Median survival was 13 months in this subset of patients.

3.5. Long-term survival

In total, 305 patients died during follow-up. Overall survival rates were 33.7% (29–38.4), 12% (6.7–15.2), and 3.3% (0–7) at 5, 10 and 15 years, respectively, and median survival time was 31 months. To illustrate the negative influence of lung cancer on the long-term survival, we compared the survival of the 45 patients of the present series who underwent resection of their lung cancer at the age of 70 years to that of the general population in Canada at the same age (Fig. 1). Survival curves according to the disease stage are shown in Fig. 2. In stage IIA patients, 5-year survival was 7.6% (0–17.6) in cases of N2 disease, but 19.3% (8.3–30.3) in cases of T3N0-1 disease. The 5-year survival rate for patients with unstaged disease was 18.3% (0–40). According to histology, 5-year survival rates for squamous cell carcinoma, adenocarcinoma, large cell carcinoma, and other types were 36.5, 24.9, 31.2, and 36.2%, respectively, without any significant difference.

Overall survival was not influenced by age, symptoms at presentation, medical history, history of previous malignant disease, year of operation or histology. Multivariate analysis demonstrated that disease stage (P = 0.0001), low FEV\textsubscript{1} (P = 0.004), high creatinine level (P = 0.01), and hypertension (P = 0.03) were independent prognosticators.

3.6. Disease progression

During the follow-up period, cancer progression occurred in 203 patients (43.8%), leading to death in 186. Recurrences were diagnosed in 183 patients (39.5%). In these patients, the median disease-free interval was 11 months (mean: 15 ± 16 months). Stage of the disease was the sole explanatory parameter independently correlated with recurrence (P = 0.0001). For stage I patients, recurrence rate was 34.4% after limited resection, and 25.6% after standard lobectomy (NS). The 5-year survival rates were 50.6% (28.4–72.9) and 42.4% (34.6–50.1), respectively (NS).

There were 20 patients who developed a second primary lung cancer (4.3%) with a median interal time of 31 months (mean: 43 ± 37 months). Among the 203 patients who had cancer progression, 19 (9.3%) underwent a second lung operation with one postoperative death and an added median survival time of 12.5 months.

3.7. Other significant events

Carcinoma in other systems or recurrence of a previously known neoplasm occurred in 25 patients (5.3%), leading to death in 23. Major cardiovascular events occurred in 51 patients (11%): myocardial infarction (n = 27), stroke (n = 12), heart failure (n = 7), acute limb ischemia (n = 4), and pulmonary embolism (n = 1), leading to death in 43 patients. There were 17 patients who succumbed to pneumonia or chronic lung disease, and miscellaneous causes were retrieved in 10. Elderly by itself accounted for the 26 remaining late deaths.

4. Discussion

As a consequence of the ageing of population and the increased life expectancy in Western countries, patients aged over 70 years suffering from cancer are seen with increasing frequency. Although it is generally thought that cancer has less aggressive biological behaviour in this age group, thus justifying the use of more conservative treatment modalities than in younger patients, there is no evidence to support this view for lung carcinoma.
In our experience, male and squamous histology were the only strong characteristics of lung cancer in this age group [3]. In accordance with other investigators [7], more than 40% of our patients were asymptomatic, indicating that their tumor might be more localised and resectable at the time of diagnosis. Considering the risk/benefit ratio of surgery, recent studies have shown that both operative risk and long-term results entirely justify lung cancer resection in these patients providing that they are properly selected [7–13]. The age limit for surgery has even been pushed upwards to 80 years more recently [14–16]. If chronological age is no longer a firm limitation to surgery, some concerns remain about selection of candidates, and type of procedure that should be used.

The 7.4% operative mortality observed in this series is consistent with that reported in similar series over the past decade (Table 6), and is also identical to the estimation issued from a national American survey based on Medicare claims data [17]. It is however twice as high as current standards associated with lung cancer resection in the general population [6]. As identified by our multivariate analysis and other studies [17–19], the operative risk increases with age, but decreases as the operation preserves more lung tissue. Indeed, pneumonectomy has been reported to be associated with an important mortality exceeding 20% [20,21]. In this series, patients aged beyond 80 years had fewer pneumonectomies than ‘younger’ patients, and this is the likely explanation for the maintenance of an in-hospital mortality at an acceptable level.

Since the loss of pulmonary function is greater after right pneumonectomy than after left pneumonectomy, we also tend to avoid this procedure in the elderly [20]. Indeed, bronchopleural fistulae are more common after right pneumonectomy (vs. left), and our multivariate analysis identified right-sided lung resections as an independent predictor of overall surgical complications. The role of limited resections in the management of lung cancer is still very controversial even if the randomised trial conducted by the Lung Cancer Study Group has demonstrated a higher locoregional recurrence rate associated with limited resections when compared to lobectomy for the treatment of T1N0 non-small cell lung cancer [22]. Our results show however that limited resection may be an adequate compromise in older patients with early stage disease. Perioperative mortality was higher with more advanced disease, and this observation can be explained by more extended procedures being done in these situations. Indeed, extended resection was identified as an independent predictor of

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**Fig. 1.** Overall survival following lung cancer resection in 45 patients at the age of 70 years. The dotted line illustrates the expected survival in the general population at the age of 70 years (data from the Canadian National Institute of Cancer, Toronto, 1996). The bold line illustrates the Kaplan-Meier survival in the 45 patients who underwent resection of their lung cancer at the age of 70 years. Thin lines illustrate the interval of confidence.

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**Fig. 2.** Survival according to the disease stage in 500 elderly patients who underwent resection of a lung cancer. I vs. II: $P = 0.15$; II vs. IIA: $P = 0.005$; IIA vs. IIB: $P = 0.12$. 

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operative mortality, a finding previously noted in the literature [10]. As reported in other series [7–13], major cardiorespiratory complications were common. More appropriate patient selection and complication prevention can thus be assumed. Since preoperative pulmonary function was an independent predictor of pulmonary complications, additional testing such as measurement of maximal oxygen consumption (VO₂ max) might be useful to select lower risk patients [23]. Cardiac events were also seen frequently during the postoperative period. Several multivariate risk indices have been proposed to predict such morbidity, but none has been consistently accurate and applicable [24]. The efficacy and cost-effectiveness of exercise stress testing or dipyridamole thallium imaging, is controversial, and among historical predictors, only a recent myocardial infarction or actual congestive heart failure are known to be strong predictors of perioperative cardiac mortality [24]. Like the Pooling Project Research Group [25], we were able to identify in the current study hypertension and ECG abnormalities as predictors of cardiac morbidity. Interestingly, the incidence of cardiovascular complications increased as the operation involved more mediastinal lymph node removal, a morbidity which might be the result of cardiac nerve injury during extended mediastinal dissection. Similarly, injuries to recurrent nerves and/or bronchial arteries are well-known contributing factors to the high incidence of respiratory complications seen after radical mediastinal lymphadenectomy [26]. The extent of lymph node dissection in the surgery of non-small cell lung cancer is still a matter of controversy. A randomised trial has recently demonstrated that radical lymphadenectomy was not essential to determine the pathological nodal status when compared to node sampling [27]. Since the morbidity associated with radical lymphadenectomy is substantially higher in the elderly, we recommend preoperative mediastinoscopy and intraoperative standard lymph node sampling at operation.

In keeping with data from the literature [7–16,20,21], long term survival was not influenced by patients age, and similar survival figures were observed between patients aged 70–74, 75–79, and beyond 80 years (Table 3). As expected, prognosis was strongly affected by stage of the disease. There is a general tendency to deny surgery in elderly patients with higher stage tumors, and the proportion of stage I patients in series reporting older patients [7–13] is higher than in series also reporting patients from all age groups [8,9,11]. Our survival figures strongly justify surgery for patients with clinical stage I–II lung cancer. Similarly, acceptable long-term survival may be achieved in stage IIIA patients providing that they do not have N2 disease, and that a complete resection can be carried out.

A previous history of cancer did not affect overall survival, but this clinical situation may create a diagnostic and therapeutic dilemma. When a lung tumor is observed in patients with history of a previous cancer in another system, differentiation between metastasis and primary lung cancer must be made before selecting an appropriate therapy. In poorly differentiated tumors this determination may be difficult or impossible, and our attitude has always been to consider the lung tumor as a primary cancer whenever there was no evidence of locoregional recurrence of the previous tumor. It is therefore important for patients with a history of previous malignancy in complete remission not to be denied lung cancer operation.

Benefits from resectional surgery in elderly patients should not be considered only in terms of survival. Indeed, in such a segment of the population affected by tobacco abuse, and submitted to high risks of various cancers and cardiovascular and respiratory diseases, even the efficient control of one of the potential causes of death might not affect the overall survival [28]. Thus, the role of surgery in providing satisfactory comfort might be important, although quality of survival is difficult to assess on the basis of a retrospective study. In this series, the incidence of late complications and sequelae which are considered important components of patient well-being, was low (3% of the survivors). Tumor recurrence has been identified as the most important factor determining a significant and negative influence on postoperative quality of life [29]. In that respect, our findings emphasise the need for an accurate.

Table 6
Lung cancer resection in the elderly—data from the literature

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number</th>
<th>Year of publication</th>
<th>Mortality (%)</th>
<th>Long-term survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ishida [8]</td>
<td>167</td>
<td>1990</td>
<td>3.6</td>
<td>48% at 5 years</td>
</tr>
<tr>
<td>Roxburgh [9]</td>
<td>43</td>
<td>1991</td>
<td>6.9</td>
<td>66.6% at 4 years</td>
</tr>
<tr>
<td>Thomas [10]</td>
<td>47</td>
<td>1993</td>
<td>12.8</td>
<td>29.8% at 5 years</td>
</tr>
<tr>
<td>Gebitekin [11]</td>
<td>145</td>
<td>1993</td>
<td>8.9</td>
<td>30% at 5 years</td>
</tr>
<tr>
<td>Massard [7]</td>
<td>210</td>
<td>1996</td>
<td>7.6</td>
<td>32.9% at 5 years</td>
</tr>
<tr>
<td>Santambrogio [12]</td>
<td>54</td>
<td>1996</td>
<td>5.5</td>
<td>52.1% at 5 years*</td>
</tr>
<tr>
<td>Morandi [13]</td>
<td>85</td>
<td>1997</td>
<td>1.2</td>
<td>28% at 5 years</td>
</tr>
</tbody>
</table>

* Stage I disease only.
patient selection and a complete resection to offer the longest disease-free interval.

How old is too old for the surgical treatment of a lung cancer, and where the line should be drawn are still open to debate. Based on these data, the following conclusions emerged as significant new information for the management of operable lung cancer in elder patients.

1. Patients with a history of previous malignancy should not be denied lung cancer operation, provided they are in complete remission.


3. At operation, lymph node sampling should be preferred to radical mediastinal lymphadenectomy.

4. Surgery is justified for the treatment of stage I–II lung cancer. Substantial long-term survival rates may also be achieved in stage IIIA patients in the absence of a N2 disease.

5. Standard lobectomy is the procedure of choice, but lesser resections may be justified selectively in poor-risk individuals with stage I disease.

6. In those patients with centrally located neoplasms, sleeve lobectomy whenever technically possible should be preferred to pneumonectomy, particularly for right-sided tumors.

7. Extended resections should only be carried out in highly selected patients.

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References


Appendix A. Conference discussion

Dr J.A. Federico (New Haven, CT): We reported a similar series yesterday. We had similar findings in patients aged 70–80, showing a higher mortality in patients of male gender. One of the questions I would like to ask of you is would you consider doing a pneumonectomy in a stage III patient with marginal lung function based on your survival statistics. We could not identify any 5-year survivals in a paper that we recently reported on octogenarians who were stage II or III. I was wondering what you would recommend for the patient who is elderly, with stage IIIA disease, and requires a pneumonectomy?

Dr P. Thomas: I completely agree with you. I think that to perform an enlarged pneumonectomy in a stage IIIA elderly patient is an elective decision that can’t be advocated for all patients, particularly in poor risk individuals.

Dr J.M. Wihlm (Strasbourg, France): According to your rules, with this IIIA are you excluding the N2 because you do mediastinoscopy first?

Dr P. Thomas: Yes. Except in the case of 4 patients with right upper lobe cancer who were operated on despite the presence of a solitary positive lymph node at the station R4 since we consider this occurrence amenable to a curative resection. On the other hand in about 19% of the patients who still had a clinical stage I disease after mediastinoscopy, lymph node sampling performed at thoracotomy discovered a stage IIIA disease.

Dr K. Mognissi (Goole, UK): I have a comment and a question. The comment is that it is a very good paper and I congratulate you. It represents a lot of work. You very rightly stratified your patients between four categories. The category of COPD was 40%. What I would like to ask concerns the mortality of patients with and without COPD? Because it may be, that if you eliminated this COPD group would also have been candidates for a sleeve lobectomy.

Dr J. Thorpe (Sheffield, UK): In this age group, cardiorespiratory complications are relatively common. How extensively do you investigate patients from the cardiac point of view preoperatively, and do you use anti-arrhythmic drugs prior to operation.

Dr P. Thomas: It is also difficult to address that particular aspect of the preoperative work-up on a retrospective basis. However, the Laval Hospital is an institution specifically devoted to cardiac and pulmonary diseases. Thus, all patients with suspicious symptoms, history of cardiovascular disease or with ECG abnormalities were referred to cardiologists. Further investigations including echocardiography, exercise stress testing or coronary angiography were selectively carried out. There were no routine investigations, except clinical examination 12-leads ECG and chest X-ray.

Dr P. Thomas: And did you have a high incidence of arrhythmias?

Dr J. Thorpe: We observed a 15% incidence of these problems, with no changes along the study period. No prophylactic drug was used.

Dr J.M. Wihlm: Among all of these groups has there been neoadjuvant therapy, as usual, or did you change your regimen, and second, did this affect the mortality and morbidity rate in this group of patients?

Dr P. Thomas: In this subset of patients, none received neoadjuvant therapy, except two patients who were operated on because of massive bleeding due to radiotherapy. In Canada, elderly patients are usually not enrolled in prospective trials dealing with neoadjuvant therapies.

Dr J.M. Wihlm: Yes, but if you considered N2 disease, for example, did you do postoperative radiotherapy then?

Dr P. Thomas: N2 disease is generally excluded for the surgical treatment option.

Dr J.M. Wihlm: But can you really say in this material that the sleeve lobectomies that you performed did better than the pneumonectomies. On what are you basing that conclusion?

Dr P. Thomas: I agree that there is no definite demonstration of that on the basis of a retrospective study, since it is difficult to assess who in the pneumonectomy group would also have been candidates for a sleeve lobectomy.

Dr P.A. Kling (Umea, Sweden): One of your conclusions, sleeve lobectomy, is that based on your own material, and in that case what are your results?

Dr P.Thomas: It was the case in the material of this study. Overall, major morbidity was lower when comparing right upper sleeve lobectomy to right pneumonectomy in stage I–II patients. In most patients, the decision to proceed to a sleeve lobectomy was dictated by operative findings: evidence of disease along the resection line after standard lobectomy, extraluminal extension to the main bronchus, metastatic nodes adherent to the origin of the lobar bronchus.

Dr P.A. Kling: But can you really say in this material that the sleeve lobectomies that you performed did better than the pneumonectomies. On what are you basing that conclusion?