Similar Long-term Survival of Elderly Patients With Non-small Cell Lung Cancer Treated With Lobectomy or Wedge Resection Within the Surveillance, Epidemiology, and End Results Database*

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Study objectives: To determine the effect of age and type of surgery on long-term survival in patients with early-stage non-small cell lung cancer (NSCLC).

Design and patients: A total of 14,555 patients who were ≥20 years of age with stage I or II primary NSCLC and had been registered in the Surveillance, Epidemiology, and End Results Database from 1992 to 1997 were analyzed. Age was grouped into the following three categories: <65 years (n=5,057; 35%); 65 to 74 years (n=6,073; 42%); and ≥75 years (n=3,425; 23%). Log-rank tests and Cox regression models were used for crude and adjusted survival analyses.

Measurements and results: A total of 8,080 men (55%) and 6,475 women (mean [± SD] age, 67.3 ± 9.8 years) with stage I NSCLC (83%) or stage II NSCLC were analyzed. Curative surgery was performed in 4,669 patients (92%) who were <65 years of age (youngest), 5,219 patients (86%) who were 65 to 74 years of age (intermediate age), and 2,382 patients (70%) who were ≥75 years of age (elderly) (p < 0.0001). Thirty percent of the elderly patients were denied surgery or were offered only palliative surgery, in contrast with 8% among the youngest patients (p < 0.0001). Limited resections increased from 8% in young patients to 17% in the elderly (p < 0.0001). Survival decreased with age. The median survival times were 71, 47, and 28 months, respectively, for patients <65, 65 to 74, and ≥75 years of age (p < 0.0001). The results were unchanged after adjusting for sex, type of surgery, histology, and stage of disease. For the young patients, lobectomies conferred better survival times than limited resections after 2 years. However, there was no difference in survival between lobectomies and limited resections in terms of survival time for the elderly patients. The statistical difference in long-term survival between those patients undergoing lobectomies and those undergoing limited resections disappeared at 71 years.

Conclusions: Age is an independent predictor of postsurgical survival in NSCLC patients, even after adjustment for significant covariates. Curative surgery is performed less frequently in elderly patients. Among younger patients undergoing curative surgery, lobectomies are more commonly performed and confer a significant survival benefit over limited resections. This benefit, however, is not evident for patients >71 years of age. (CHEST 2005; 128:237–245)

Key words: elderly; limited resection; lobectomy; lung cancer; non-small cell lung cancer; surgery; Surveillance, Epidemiology, and End Results; survival

Abbreviations: CI = confidence interval; HR = hazard ratio; ICD-O = International Classification of Diseases for Oncology; NSCLC = non-small cell lung cancer; SEER = Surveillance, Epidemiology, and End Results

Lung cancer is a disease of the elderly. National Cancer Institute statistics show that the peak incidence of lung cancer is between the ages of 75 and 79 years. However, since more elderly patients die of the disease, the peak mortality rate is between ages 75 and 84 years, depending on gender. Almost 74,000 Americans >60 years of age die of lung cancer every year.

The best treatment for early-stage lung cancer is surgery. Lobectomy, the removal of one of the five lobes of the lung (excision of all lung parenchyma and associated lymph nodes within a single pleural membrane), is currently considered the standard of care. Unfortunately, age is a risk factor for death after thoracotomy. This has been substantiated in multiple single institution studies and a multi-
institutional analysis by the Lung Cancer Study Group. In the latter study, death following lung resection increased from 1.3% for patients less than age 59 years, to 7% for patients over the age of 70.

Recent attempts have been made to further reduce the risk of surgery by limiting the amount of lung removed. Limited resections include wedge resections (the removal of the lung tumor and a rim of “healthy” lung tissue around the tumor) and segmentectomies (the removal of one of the 18 bronchopulmonary segments that are divisions of each lobe with separate arterial, venous, and bronchial supplies). Complete excision of all regional draining lymphatics is not possible with these limited resections. The adequacy and risk-benefit impact of limited resections in lung cancer are still unclear.

The Lung Cancer Study Group 6 compared the survival times of patients with clinical T1N0 lung cancer after a lobectomy with those after limited resections and concluded that lobectomy was a superior operation. However, the survival curve of their analysis suggested that there was no difference between the two procedures for the first 3 years. Furthermore, it has been suggested that elderly patients are more likely to undergo wedge resections than anatomic resections (ie, pneumonectomies, lobectomies, and segmentectomies) for the treatment of lung cancer without significant impact in short-term or long-term survival. Therefore, it is logical to suggest that elderly patients and individuals with a limited life expectancy may benefit more from a limited resection that minimizes perioperative morbidity and mortality with a small decrement, if any, in long-term survival. Based on this hypothesis, we sought to determine the effect of age and extent of surgery on the long-term survival of patients with early-stage non-small cell lung cancer (NSCLC) within a large multiinstitutional database.

For editorial comment see page 13

Materials and Methods

Patients

The base population is composed of patients with a diagnosis of lung cancer included in the Surveillance, Epidemiology, and End Results (SEER) database from 1992 to 1997. The SEER database is a multistitutional community-based cancer registry that contains data from 12 population-based cancer registries (ie, Atlanta, California, Connecticut, Detroit, Hawaii, Iowa, Kentucky, Louisiana, New Jersey, New Mexico, Seattle-Puget Sound, and Utah) and three supplemental registries (Alaska, Arizona, and rural Georgia), thus covering approximately 14% of the US population. Measures of poverty and education are comparable between the population covered by the SEER database and the general US population. However, the SEER population tends to have a higher proportion of urban and foreign-born people than is true overall in the US population.

As is shown in Figure 1, from the 137,592 entries contained in the SEER lung cancer database (mean ± SD age, 68 ± 11 years; men, 59%; male/female ratio, 1.45:1), we excluded patients with mesothelioma (n = 1,826) or small-cell lung cancer (n = 17,979), those patients with a history of lung cancer (n = 20,979), patients with carcinoma in situ (n = 61) or with stage III (n = 19,739), stage IV (n = 27,544), or unknown (n = 34,907) stage of disease, and those patients who were < 20 years of age (n = 2). Our study cohort was thus composed of the remaining 14,555 patients who were ≥ 20 years of age with stage I or II NSCLC and without a history of lung malignancy.

Variables

Information was obtained from the SEER database on gender, age, race/ethnicity, marital status, number of previous malignancies, histology and size of current tumor, stage, type of surgery (if any), reason why no surgery was performed on some patients, survival, and cause of death. The histology of the tumors, coded in the SEER database according to the second edition of the International Classification of Diseases for Oncology (ICD-O) 9 was used to classify the tumors into the following six categories: squamous cell carcinomas (ICD-O codes 8050–8123 and 8562); adenocarcinomas (ICD-O codes 8140, 8141, 8250–8323, 8480–8550, and 8572); large cell carcinomas (ICD-O codes 8012–8031); adenosquamous carcinomas (ICD-O codes 8560 and 8570); unknown histology (ICD-O codes 5000, 5010, and missing values); and other tumors, including but not restricted to, spindle cell carcinomas, mucoepidermoid malignancies, neuroendocrine, and mixed malignant tumors (ICD-O codes 8032, 8200, 8230, 8240, 8246, 8430, 8470, 8940, and 8980).

Three age groups were defined based on the age of the patient at diagnosis, as follows: < 65 years of age; 65 to 74 years of age; and ≥ 75 years of age. The type of surgery was classified into the following six categories: no surgery; limited resections (ie, wedge resections, segmentectomies, and lingulectomies); lobectomies (including bilobectomies); pneumonectomies; others (eg, biopsies, exploratory thoracotomies, and palliative surgery); and unknown type of surgery. Limited resections, lobectomies, and pneumonectomies were considered to be “curative surgery” for the purposes of this analysis.

Statistical Analysis

The relationships among different categorical variables and the three age groups was assessed with the χ² test. The size of the tumor was used as a continuous variable and was truncated at 20...
cm, with higher values considered to be missing (n = 6). The distribution of size among the different age groups was assessed with analysis of variance.

Mortality and lung cancer-related mortality were compared among the different age groups by Kaplan-Meier estimates and log-rank tests. Univariate survival analysis was also performed with other variables to assess their independent impact on survival. A Cox proportional hazards model then was constructed to adjust the effect of age on mortality for the other variables. Size was not included in the model due to the high number of missing values (almost 400) and the lack of significant change in the model parameters when added.

The relationship between type of surgery and survival was also assessed. Furthermore, to determine the effect modification that the age group had on the association between type of surgery and survival, we stratified by age, constructing different Kaplan-Meier curves for each age group.

Each analysis was performed only with those patients that had complete data on all variables involved. Therefore, the analyzed cohort may vary slightly between analyses. Analyses were performed with the aid of statistical software packages (StatView for Windows, version 4.57; Abacus Concepts; Berkeley, CA; and SAS for Windows, version 8.1; SAS Institute; Cary, NC).

RESULTS

The cohort was composed of 14,555 patients, including 8,080 men (55%) and 6,475 women (mean age, 67.3 ± 9.8 years; age range, 20 to 101 years; median age, 68 years). Most patients had clinical stage I disease at the time of diagnosis (n = 12,016; 83%). Histology reflected modern pathologic trends, with 7,540 patients (55%) having adenocarcinomas, 4,614 patients (34%) having squamous cell carcinomas, 1,059 patients (8%) having large cell malignancies, 450 patients (3%) having adenosquamous cancers, and 50 patients (0.4%) having tumors with other histologic types.

Patients were grouped into the following three categories, based on age: < 65 years (n = 5,057; 35%); 65 to 74 years (n = 6,073; 42%); and ≥ 75 years (n = 3,425; 23%). Table 1 shows the characteristics of patients from the overall cohort and from each of the age groups.

Despite a higher number of men seen in the group of patients 65 to 74 years of age (p = 0.0062), there was no clinically significant difference in the gender split within each age group. The relative incidence of white people increased with age, while the incidence of black people decreased (p < 0.0001). Marital status was also significantly different, with younger groups having a higher incidence of married and single people, and elder groups having a higher incidence of divorced/widowed patients (p < 0.0001).
Table 1—Characteristics of Patients From the Overall Cohort and Each Age Group*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overall Cohort (n = 14,555)</th>
<th>&lt;65 yr (n = 6,057)</th>
<th>65–74 yr (n = 6,073)</th>
<th>≥75 yr (n = 3,425)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (n = 14,491)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>8,080 (55.5)</td>
<td>2,773 (54.8)</td>
<td>3,462 (57.0)</td>
<td>1,845 (53.9)</td>
<td>0.0062</td>
</tr>
<tr>
<td>Black</td>
<td>11,622 (80.2)</td>
<td>3,815 (75.9)</td>
<td>4,939 (81.6)</td>
<td>2,865 (84.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1,374 (9.5)</td>
<td>674 (13.4)</td>
<td>506 (8.4)</td>
<td>194 (5.7)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>535 (3.7)</td>
<td>198 (3.9)</td>
<td>212 (3.5)</td>
<td>125 (3.7)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>577 (4.0)</td>
<td>166 (3.3)</td>
<td>257 (4.2)</td>
<td>154 (4.5)</td>
<td></td>
</tr>
<tr>
<td>Marital status (n = 14,270)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>383 (2.6)</td>
<td>173 (3.4)</td>
<td>140 (2.3)</td>
<td>70 (2.0)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>12,016 (82.6)</td>
<td>4,005 (79.2)</td>
<td>5,037 (82.9)</td>
<td>2,974 (84.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Divorced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage I disease, n (%)</td>
<td>12,270)</td>
<td>4,669 (92.3)</td>
<td>5,219 (85.9)</td>
<td>2,382 (69.6)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Histology (n = 13,668)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>7,540 (55.0)</td>
<td>2,952 (60.8)</td>
<td>3,023 (52.6)</td>
<td>1,565 (50.4)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Squamous cell</td>
<td>4,614 (33.7)</td>
<td>1,316 (27.1)</td>
<td>2,114 (36.8)</td>
<td>1,184 (38.1)</td>
<td></td>
</tr>
<tr>
<td>Large cell</td>
<td>1,059 (7.7)</td>
<td>385 (8.1)</td>
<td>414 (7.2)</td>
<td>250 (8.1)</td>
<td></td>
</tr>
<tr>
<td>Adenosquamous</td>
<td>450 (3.3)</td>
<td>164 (3.4)</td>
<td>190 (3.3)</td>
<td>96 (3.1)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>50 (0.4)</td>
<td>31 (0.6)</td>
<td>10 (0.2)</td>
<td>9 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Size, cm (n = 14,159)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curative surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited</td>
<td>1,403 (11.4)</td>
<td>380 (8.1)</td>
<td>626 (12.0)</td>
<td>397 (16.7)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>9,875 (80.5)</td>
<td>3,784 (81.0)</td>
<td>4,223 (80.9)</td>
<td>1,868 (78.4)</td>
<td></td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>992 (8.1)</td>
<td>505 (10.8)</td>
<td>370 (7.1)</td>
<td>117 (4.9)</td>
<td></td>
</tr>
</tbody>
</table>

*Values given as the absolute No. of patients (% of the group being analyzed) or mean ± SD, unless otherwise indicated. Some analyses may not reflect the total number of patients in the cohort due to missing data; in that case, the total number of patients being analyzed is specified.

The frequency of clinical stage I disease increased with age, from 79% in the group with patients < 65 years of age, to 87% in the most elderly group (p < 0.0001). Histology was also different among age groups, with adenocarcinomas being more common among the youngest patients (patients < 65 years of age, 61%; patients ≥ 75 years of age, 50%), and squamous cell carcinomas being more frequent among the oldest patients (patients < 65 years of age, 27%; patients ≥ 75 years of age, 38%; p < 0.0001). The difference in tumor size among groups was statistically significant, but not clinically significant (p = 0.004).

The frequency of limited resections increased with age, and the number of pneumonectomies and lobectomies decreased with age (p < 0.0001). Curative surgery was more commonly performed among the youngest patients (p < 0.0001). Approximately 30% of the most elderly group of patients were denied surgery or were offered only palliative surgery, in contrast with only 8% among the youngest patients. Among patients undergoing curative surgery, the proportion of limited resections vs lobectomies and pneumonectomies increased with age (patients < 65 years of age, 8%; elderly patients, 17%; p < 0.0001).

Figure 2 depicts the crude survival time for each age group. Overall survival, with or without curative surgery, decreased as a function of age (p < 0.0001). The median survival times for patients < 65 years, 65 to 74 years, and ≥ 75 years of age were 71, 47, and 28 months, respectively. Considering age as a continuous linear variable, the risk of death increased 10% for every 5 years of age. The death of patients from lung cancer (excluding other natural competing causes of death) was also significantly different among the groups (p < 0.0001), with elderly patients having the lowest survival rates.

Age continued to be a significant predictor of both overall and lung cancer-related mortality, after adjusting for gender, histology, clinical stage of disease, and type of surgery (Table 2). The overall hazard ratio (HR) of dying was almost twice as high for the elderly population than for those < 65 years of age. Men and patients with stage II disease also had a higher risk of mortality. In this selected group of
patients with stage I and II NSCLC, clinical stage II disease was the most important predictor of decreased long-term survival.

When comparing adjusted mortality among types of surgery, limited wedge resections appeared to provide an increased HR for death compared to lobectomies, either as a function of suboptimal resection or as an association with underlying comorbidities. Pneumonectomies were even more detrimentally associated with survival, perhaps due to increased perioperative mortality, association with more central tumors, or loss of pulmonary reserve. However, type of surgery did not completely explain the differences in survival observed among age groups. Figure 3 depicts the overall and lung cancer-related survival difference by age group for only those patients who underwent lobectomies as treatment for their cancer.

As shown in Figure 4, patients not undergoing curative surgery had a poor prognosis, with the median overall survival times being 15, 13, and 12 months, respectively, for patients < 65, 65 to 74, and ≥ 75 years of age (p = 0.0025). Lung-cancer related survival for these patients was not statistically significant among age groups (p = 0.0533).

The overall survival benefit conferred by lobectomies over limited resections proved to be a function of age (Fig 5). For patients < 65 years of age, there was a significant difference in survival between patients undergoing the two operations, with the curves deviating at approximately 2 years (p = 0.03; HR, 1.24; 95% confidence interval [CI], 1.02 to 1.50). Similar differences were noted in the group of patients between 65 and 74 years of age (p = 0.0009; HR, 1.26; 95% CI, 1.10 to 1.44). However, there was no difference in the overall survival time between patients undergoing lobectomies and those undergoing limited resections among patients ≥ 75 years of age (p = 0.47; HR, 0.94; 95% CI, 0.79 to 1.11). In particular, among the most elderly patients, the median survival time was 44 months for patients who had undergone limited resections and 42 months for those who had undergone lobectomies.

For all age groups, lobectomies and limited resections offered similar overall survival time for the first 25 months. The threshold of age at which lobectomies stopped providing a survival benefit over limited resections was sought in the group of patients between 65 and 74 years of age. The statistical difference between survival curves disappeared at 71 years of age in post hoc analysis. The survival curves differed after 25 months in patients who were ≤ 71 years of age, but no statistically significant difference in long-term survival between lobectomies and limited resections was noted in patients > 71 years of age (Fig 6).

Table 2—Overall Mortality and Lung Cancer-Related Mortality Adjusted By Age, Gender, Stage, and Type of Surgery

<table>
<thead>
<tr>
<th>Variables</th>
<th>Overall Mortality</th>
<th>Lung-Cancer Related Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>HR (95% CI)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 65 yr</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>65–74 yr</td>
<td>1.38 (1.29–1.47)</td>
<td>1.23 (1.14–1.33)</td>
</tr>
<tr>
<td>≥ 75 yr</td>
<td>1.82 (1.69–1.96)</td>
<td>1.56 (1.43–1.71)</td>
</tr>
<tr>
<td>Men</td>
<td>1.29 (1.22–1.36)</td>
<td>1.23 (1.10–1.26)</td>
</tr>
<tr>
<td>Stage II disease</td>
<td>1.88 (1.76–2.00)</td>
<td>2.17 (2.01–2.34)</td>
</tr>
<tr>
<td>Type of surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lobectomy</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Wedge resection</td>
<td>1.28 (1.17–1.41)</td>
<td>1.17 (1.04–1.32)</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>1.58 (1.43–1.75)</td>
<td>1.60 (1.42–1.80)</td>
</tr>
<tr>
<td>Palliative surgery</td>
<td>3.88 (3.59–4.19)</td>
<td>4.56 (4.17–4.99)</td>
</tr>
<tr>
<td>No surgery</td>
<td>3.88 (3.52–4.27)</td>
<td>4.07 (3.62–4.58)</td>
</tr>
</tbody>
</table>
**DISCUSSION**

The relationship between age and survival in lung cancer patients has been a matter of debate for the last several decades. In our study, age proved to be an independent predictor of survival in lung cancer patients, even after adjustment for significant covariates. This trend, also observed in other studies, can partly be explained by the higher probability of dying from nonrelated competing causes among the elderly. However, the increased risk in our study was also observed when analyzing only lung cancer-related deaths among the different groups. The explanation for these findings is unclear, especially since the elderly patients appeared to have a higher incidence of stage I disease on diagnosis, an observation that has also been documented in previous reports. Part of this phenomenon may be secondary to the understaging of lung cancer in the elderly population due to less use of more invasive and specific studies (eg, CT scans and positron emission tomography scans) in the workup of pulmonary nodules among elderly patients than in younger patients or to more conservative mediastinal lymph node sampling among the elderly to minimize perioperative morbidity.

Squamous cell carcinomas are more common among patients in the elderly population. In our study, the probability of a tumor being of squamous histology increased from 27% among patients < 65 years old to 38% for patients ≥ 75 years old. These tumors are associated with a higher incidence of local disease, and tend to have lower recurrence rates and portend longer survival times than nonsquamous cancers, also partly explaining the higher incidence of stage I disease among the elderly. However, central tumors are more likely to be

![Figure 3](image1.png)

**Figure 3.** Overall survival (A) and lung cancer-related survival (B) after diagnosis for patients undergoing lobectomies for the treatment of lung cancer, by age group.

![Figure 4](image2.png)

**Figure 4.** Overall survival (A) and lung cancer-related survival (B) after diagnosis for patients with no curative surgery by age group. – – – < 65 years; – – 65 to 74 years; – – – ≥ 75 years.
squamous cell carcinomas and, thus, more likely to require pneumonectomies for adequate resection. The hesitance to perform pneumonectomies in elderly patients may translate into inadequate resections for these patients and therefore may decrease their overall survival times.

The relationship between age and mortality may be partly related to the selective treatment of patients with lung cancer based on age. Older patients tend to be poorly represented in cancer treatment trials and tend to undergo fewer diagnostic and therapeutic procedures than younger patients, observations that are not unique to lung cancer patients. The impact of the preoperative selection of patients based on comorbidities is beyond the possible analysis of this database.

In our study, despite the higher incidence of earlier stage tumors among the elderly, this cohort was offered curative surgery less frequently. Almost 30% of patients in the elderly group were denied surgery or were offered only palliative surgery, compared to 8% among the younger group. Other studies have also shown that the surgical treatment of lung cancer decreases with age and that elderly patients are more commonly denied treatment with not only surgical modalities, but also nonsurgical modalities (e.g., chemotherapy and radiotherapy). The reasons for these observations may include the presence of comorbidities, the rejection of treatment by the family or the patient, or the subjective and sometimes unconscious perception of frailty by the physician or the family.

Similarly, despite lobectomies being the standard of care for lung cancer patients, limited resections were more commonly used as means of curative surgery among the elderly (17% of patients undergoing curative surgery) when compared to the younger population (5% of those with curative surgery). The reason why surgeons chose to perform more limited resections among the elderly population despite the unproven oncologic adequacy of these resections is unclear. However, one may assume that associated comorbidities, perceived surgical risk, and pulmonary reserve contributed to this bias. Interestingly, long-term survival was comparable between patients who underwent lobectomies and those who underwent limited resections among patients in the elderly cohort, an observation that does not apply to the younger population.

This century has seen the evolution of progressively fewer resections for the treatment of lung cancer, from pneumonectomies to lobectomies, and most recently, segmental resections. In 1933, the first pneumonectomy for the treatment of lung cancer was described. The removal of the entire lung became the only feasible option for the curative treatment of lung malignancy. However, with the advent of newer surgical techniques and the possibility of removing a single lobe of the lung with less morbidity, lobectomy soon became the standard operation for lung cancer. Lobectomies remained the preferred operation until the description of segmental resection for the curative treatment of lung cancer in 1973 by Jensik et al. Since that time, the optimal extent of resection has been a matter of debate. In 1995, the Lung Cancer Study Group...
published the results of a prospective randomized trial comparing lobectomies with limited resections (including segmentectomies). Patients who had undergone limited resections were found to have a higher incidence of local recurrence and statistically borderline worse survival times when compared to those who had undergone lobectomies. Another study including patients from several large academic centers also showed a higher local recurrence rate and lower survival times among patients who had undergone wedge resections when compared to those who had undergone lobectomies. Lobectomy is therefore still currently considered the standard of care for stage T1 lung cancer in patients with adequate cardiorespiratory reserve. Lesser resections constitute a reasonable alternative for patients with a limited pulmonary reserve, who are unable to tolerate a lobectomy.

The difference in recurrence and survival between patients who have undergone lobectomies and those who have undergone limited resections may not be as clear for the elderly as it is for younger patients. Elderly patients have a higher rate of perioperative complications, a higher probability of presenting with early-stage disease, a lower pulmonary reserve, and a lower life expectancy than their younger counterparts, making limited resections a tempting alternative for curative intent. The reduction in morbidity and mortality provided by limited resections may preferentially benefit the elderly given their reduced cardiac and pulmonary reserve, associated comorbidities, and their higher propensity for surgical complications.

Previous studies have shown that limited resections may provide a similar survival rate to that of lobectomies among elderly patients, as long as the resection includes all foci of the tumor and provides a margin microscopically free of disease. These findings were confirmed in this large multiinstitutional database in which the difference in long-term survival between both treatment modalities disappeared after 71 years of age.

The use of a large multiinstitutional database such as the SEER database allowed us to evaluate long-term survival between multiple subgroups of patients with lung cancer based on age and treatment modality. However, the heterogeneity of the data, the amount of missing information in the database, the difficulty of achieving strict quality control on data collection, and the lack of other important covariates in the database such as location of the tumor, significant comorbidities, associated symptoms, radiographic appearance of the lesions, and detailed adjuvant treatments are limitations that we cannot surpass in this study. Further studies designed to specifically study the relationships among age, type of resection, and associated covariates are warranted.

In conclusion, age is a significant predictor of survival for lung cancer patients, with elderly patients having worse survival rates. Limited resections are more common among the elderly population, but there is no significant difference in long-term survival between elderly patients undergoing limited resections and those undergoing lobectomies. Lobectomy thus remains the "gold standard" for the treatment of lung cancer for patients who are 71 years of age. However, limited resections with adequate margins may provide a reasonable alternative for curative treatment in elderly patients who are >71 years of age without a significant impact in long-term survival.

**REFERENCES**

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