

## Outcomes after lobectomy and pneumonectomy in lung cancer patients aged 70 years or older

İlknur AYTEKİN<sup>1\*</sup>, Maruf ŞANLI<sup>1</sup>, Ahmet Ferudun IŞIK<sup>1</sup>, Bülent TUNÇÖZGÜR<sup>2</sup>,  
Ahmet ULUŞAN<sup>3</sup>, Kemal BAKIR<sup>4</sup>, Seval KUL<sup>5</sup>, Levent ELBEYLİ<sup>1</sup>

<sup>1</sup>Department of Thoracic Surgery, Faculty of Medicine, Gaziantep University, Gaziantep, Turkey

<sup>2</sup>Department of Thoracic Surgery, Special Güven Hospital, Ankara, Turkey

<sup>3</sup>Department of Thoracic Surgery, Çorum Hospital, Çorum, Turkey

<sup>4</sup>Department of Pathology, Faculty of Medicine, Gaziantep University, Gaziantep, Turkey

<sup>5</sup>Department of Biostatistics, Faculty of Medicine, Gaziantep University, Gaziantep, Turkey

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**Background/aim:** For the early stage of nonsmall-cell lung cancer, surgical resection provides the best survival, but the surgical risk generally increases with age because of the increased prevalence of comorbidities, especially cardiovascular disorders. The aim of this study was to compare survival and mortality rates of two groups with different ages, younger and older than 70 years, who went curative resection for nonsmall-cell lung cancer.

**Materials and methods:** We analyzed the patients who underwent curative lung cancer surgery in the Department of Thoracic Surgery of Gaziantep University Research Hospital between January 1997 and November 2014. Patients were divided into 2 groups according to their ages.

**Results:** A total of 497 patients were included in data analysis (381 were under 70 years old and 116 of them were  $\geq 70$  years old). The older group showed a 1.4-fold increased risk of mortality hazard ratio when the probability of survival was analyzed by histological type, lymph node involvement, disease stage, and age.

**Conclusion:** There was no distinct increase in 30-day mortality rates of patients with nonsmall-cell lung cancer who were  $\geq 70$  years old, but the hazard rate for long-term survival was higher in the older group. Curative pulmonary resections due to lung cancer should be carefully performed in septuagenarians.

**Key words:** Nonsmall-cell lung cancer, survival rate, elderly

### 1. Introduction

Currently lung cancer is the leading cause of cancer-related deaths among both men and women (1). Despite advances in radiotherapy and chemotherapy treatments, surgery remains the treatment of choice for nonsmall-cell lung cancer (NSCLC) that provides the best survival and cure rates (2). More than half of the patients diagnosed with NSCLC are older than 65 years and approximately 30% are over 70 years of age (3).

Although improvements in anesthesia and postoperative care encourage physicians to perform surgery, the cardiovascular and pulmonary comorbidities frequently encountered in the elderly population as well as their reduced performance increase the risk of postoperative complications (4).

In the present retrospective study, we aimed to evaluate the impact of advanced age on mortality, morbidity, and survival among patients undergoing curative surgery for NSCLC at a single center.

### 2. Materials and methods

This study was conducted in accordance with the principles set forth in the Helsinki Declaration and the Patient Rights Regulations and was approved by the Gaziantep University Medical Faculty Ethics Committee. Cases of NSCLC among patients who underwent curative surgery at our clinic between January 1997 and November 2014 were reviewed retrospectively. Patients with nonstandard resection such as wedge resection were excluded. While patients undergoing bilobectomy were considered as

\* Correspondence: [ilknurgs@gmail.com](mailto:ilknurgs@gmail.com)

lobectomy cases, patients with extended pneumonectomy represented pneumonectomy cases.

All patients were analyzed with respect to age, sex, stage and histological type of cancer, type of surgical operation performed, complications, and postoperative mortality (30 days) and survival rates. Patients were divided into two groups based on age: Group 1 consisted of patients younger than 70 years of age (n = 381) and Group 2 included patients ≥70 years of age (n = 116).

Categorical variables were analyzed using the chi-square test to compare two different groups. The probability of survival was estimated by the Kaplan–Meier method and the effects of other variables were assessed using hazard regression models. All statistical analyses were conducted using SPSS 22.0 for Windows and P < 0.05 was considered significant.

**3. Results**

The study included a total of 497 patients, including 463 males and 34 females. Of these, 116 were included in the older group and 381 in the younger group. The mean age of patients was 60.88 years (range: 23–84). In the younger group, 130 patients had pneumonectomy and 251 had

lobectomy, with right-sided pneumonectomy representing 34% of all pneumonectomies. In the older group, 15 patients had pneumonectomy and 46 had lobectomy, with a 24% frequency of right-sided pneumonectomy (Table 1).

The overall survival of all patients was analyzed using a log-rank test, which showed significantly longer survival for patients undergoing lobectomy compared to survival in patients with pneumonectomy (P = 0.001).

When survival following lobectomy was compared between the two age groups, no significant difference was observed (P = 0.325). The 5-year survival rate after lobectomy was 49.9% in the younger group and 46.5% in the older group.

For pneumonectomy, the younger group was found to have significantly lower survival than the older group (P = 0.024). There was no statistically significant difference between the survival times of patients undergoing right-sided or left-sided pneumonectomy (P = 0.104). Five-year survival rates after right-sided pneumonectomy were 30.5% in the younger group and 31.1% in the older group; the difference was statistically nonsignificant (P = 0.235).

Postoperative mortality rates were 7.1% in the older group and 9.5% in the younger group. The relevant

**Table 1.** Patients’ characteristics.

	Group 1, younger (n = 381)		Group 2, older (n = 116)	
	n	%	n	%
Average age	57.23	-	72.84	-
Sex				
Female	23	6%	11	9.5%
Male	358	94%	105	90.5%
Side of the tumor				
Right side	213	55.9%	61	52.6%
Left side	168	44.1%	55	47.4%
Surgical procedure				
Lobectomy	251	65.9%	80	69%
Pneumonectomy	130	34.1%	36	31%
Histology				
Squamous cell carcinoma	212	55.9%	75	64.7%
Adenocarcinoma	105	27.7%	28	24.1%
Others	62	16.4%	13	11.2%
Stage				
1–2	246	75.9%	78	24.1%
3–4	135	78.0%	38	22.0%

P-value was 0.395, indicating a statistically nonsignificant difference. The overall morbidity rate for both groups was 23.1% (17.7% for the younger group and 5.4% for the older group). The most common complication was prolonged air leak, which occurred at a rate of 5% (younger group, n = 18; older group, n = 7). Bronchopleural fistula occurred in 22 patients in the younger group and 2 patients in the older group. Expansion fault occurred in 5 patients in the younger group and 4 patients in the older group. Atrial fibrillation was seen in 6 patients in Group 1 and 3 in Group 2. Pulmonary edema occurred in 6 patients in the younger group and 1 in the older group. Empyema occurred in 7 patients in the younger group and none in the older group. Other surgical complications were chylothorax, atelectasis, hematoma, myocardial infarction, pneumonia, acute renal failure, hemothorax, pneumothorax, aspergilloma, anxiety, nephrotic syndrome, paresis of the recurrent nerve, and tumor embolism.

Based on postoperative histopathological examination, cases were classified as squamous cell carcinoma, adenocarcinoma, and others. Squamous cell carcinoma was the most common pathological type detected in both groups. Distribution of histological types was well balanced

with no statistically significant difference between the two groups (P = 0.208)

Pathological staging performed according to the 2009 TNM staging system showed that 10.2% of cases were Stage 1a and 13.3% were Stage 1b; corresponding values were 14.6% and 20.6% respectively (Figures 1 and 2).

When the survival of patients in both age groups was analyzed with respect to stages, no difference was found between the survival times of stage 3 and stage 4 patients (P = 0.245). A shorter survival was found for the older group when survival times of stage 1 and stage 2 patients were compared between the two groups (statistically significant difference, P = 0.031), as shown in Table 2.

**4. Discussion**

Currently, there is an increasing number of studies that assess NSCLC surgery and its outcomes in patients of advanced age. Geriatric oncologic surgery has become even more important as a result of the increased life expectancy of the population.

In a series of 726 patients, Cerfolio and Bryant looked at 5-year survival rates and reported that these were 51% for NSCLC patients over 70 years of age and 58% for younger

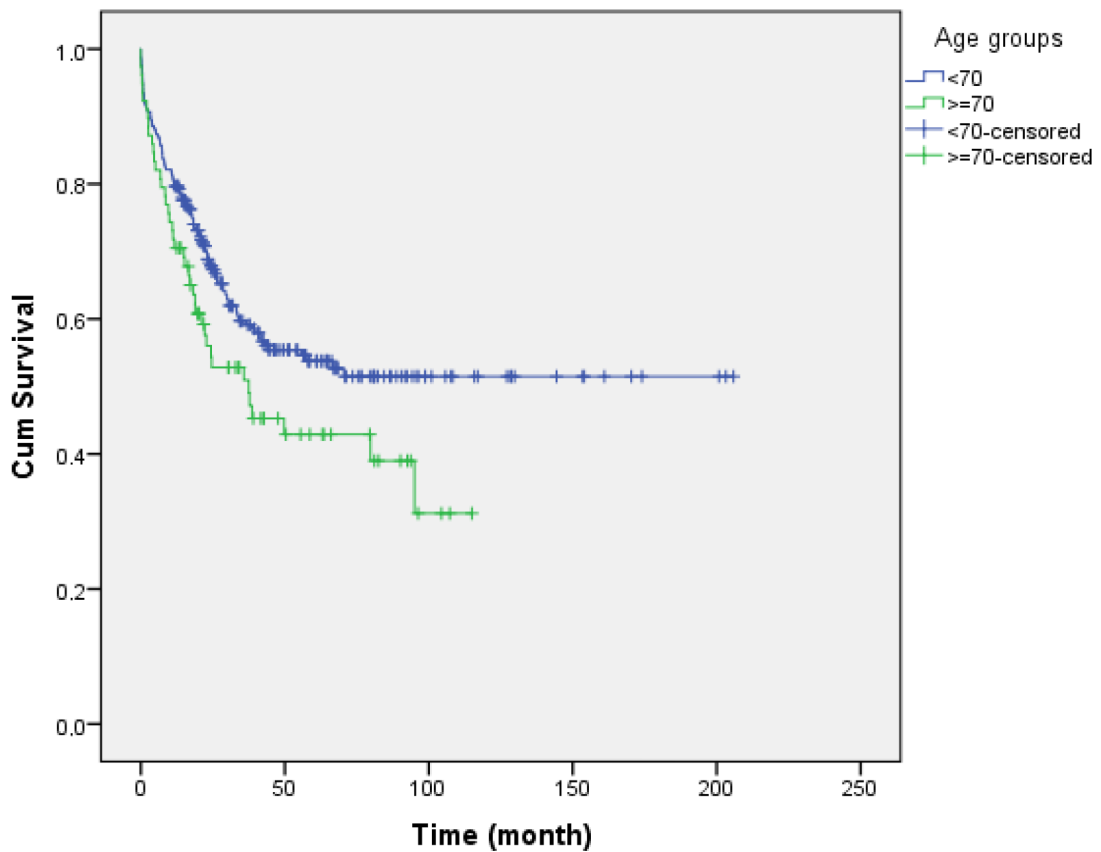


Figure 1. Survival rates of stage 1 and 2 patients.

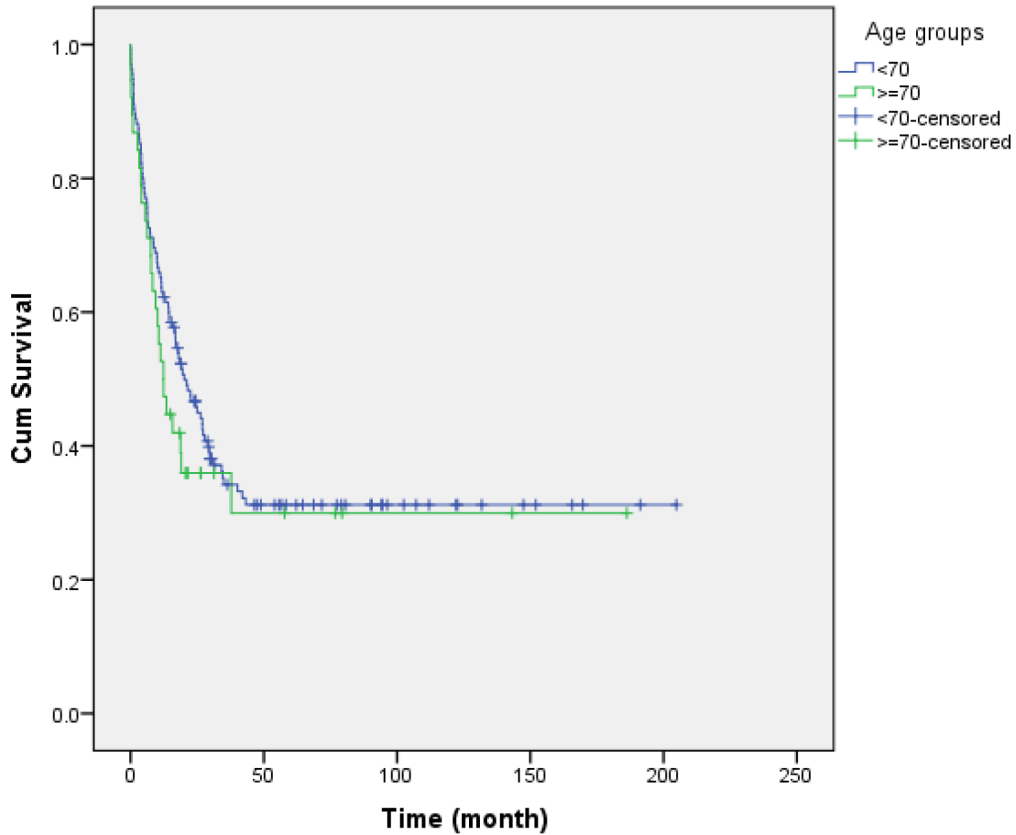


Figure 2. Survival Rates for stage 3 and 4 patients.

Table 2. Median survival in age groups according to stages.

Stage	Age groups	Median (IQR) survival	Std. error	Log-rank test
				P
1-2	<70	115.764	6.746	0.031
	≥70	55.359	5.975	
	Overall	108.142	6.094	
3-4	<70	73.425	8.073	0.245
	≥70	63.048	14.635	
	Overall	71.527	7.209	

patients (5). In another study involving 126 NSCLC patients, Birim et al. found that the 5-year survival rate was 37% and median survival was 3.8 years (6). However, in a separate series involving 762 patients who were surgically treated for NSCLC, Bryant and Cerfolio found a 5-year survival rate of 51% among patients younger than 45 years of age who were surgically treated for NSCLC and 62% in patients older than 45 years of age (7). Leo et al.

reported a survival rate of 17.5% for patients over 70 years of age and 53.6% for patients younger than 70 years of age (8). In our patient series, 3-year survival rates were 50% in the younger group and 45.8% in the older group and the corresponding figures for 5-year survival were 45.6% and 38.5%, respectively. A survival analysis by age group yielded a P-value of 0.052. Age alone was not found to be a statistically significant factor for survival.

A hospital mortality rate of 1.9% was reported by Suemitsu et al. in a study conducted with 756 patients (9). In Rostad et al.'s study, the reported postoperative mortality rate was 9% (10). In our patient series, postoperative mortality rates were 7.1% in the younger group and 9.5% in the older group. Although older patients in the present study showed a higher rate of postoperative mortality, the difference was not statistically significant ( $P = 0.395$ ).

Hospital mortality was 3.2% in a series of 126 NSCLC patients in Birim et al.'s study and 58% of patients were reported to experience complications. The most common complication was arrhythmia, occurring at a rate of 31%, followed by prolonged air leak, reported for 21% of patients (6).

In a study involving 727 NSCLC patients published by Ogawa et al., a higher incidence (49%) of postoperative complications was reported among patients 75 years of age and older versus the comparative group (11).

In contrast, postoperative complications occurred at a rate of 17.7% in the younger group and 5.4% in the older group in our patient series. Due to two reasons, some of the pulmonary complications were seen in a large number of patients in the younger group. First, the number of young patients was much higher than the number of patients in the older group, and the second reason is related to the characteristics of the young patients. The young patients had many more comorbidities than older patients (e.g., previous lung diseases, diabetes mellitus, coronary bypass). The most common complication was prolonged air leak, followed by bronchopleural fistula. More rigorous preoperative preparation undertaken for elderly patients might have resulted in lower rates of complications in the older group.

The type of resection was not reported to be a determining factor for survival in Suemitsu et al.'s study and no considerable difference was found between pneumonectomy and other types of resection with

regard to survival (6). Higher mortality rates were reported by several studies particularly for right-sided pneumonectomy (10,12). Schneider et al.'s study found a mortality rate of 1.4% for lobectomy resections and 4.3% for pneumonectomy (13).

For our patient series, 5-year mortality rates after lobectomy were 49.9% in the younger group and 46.5% in the older group when survival was analyzed according to the type of resection. Five-year mortality rates were 37.3% and 21% respectively following pneumonectomy.

All pneumonectomy and lobectomy operations were compared between groups with regard to survival and patients undergoing lobectomy in both groups (younger or older than 70 years of age) were found to have a longer survival. P-values were 0.014 for the younger group and 0.004 for the older group.

Multivariable analysis was conducted and the history of smoking, chronic obstructive pulmonary disease, and pathological stage were identified as factors that affected survival but no association was found between survival and histological type, sex, or type of resection (6). In the present study, patients  $\geq 70$  years of age showed a 1.4-fold increased risk of mortality hazard when the probability of survival was analyzed by histological type, lymph node involvement, disease stage, and age. Histological types other than squamous cell carcinoma were found to be associated with a 1.5-fold increased risk of mortality.

Considering lymph node involvement, a significant difference was found between patients with N2 disease and patients with N0 disease with a hazard ratio of 1.8. In brief, N2 involvement, age greater than 70 years, and a histological type other than squamous cell carcinoma were identified as poor prognostic factors for survival as shown in Table 3.

While a number of recent studies reported no significant difference between sublobar resection and lobectomy with respect to survival of patients, lobectomy

**Table 3.** Multivariate analyses of median survival.

Risk factors	P	Hazard ratio	95.0% CI for hazard ratio	
			Lower	Upper
Age $\geq 70$ vs. $<70$	0.017*	1.408	1.062	1.866
Adenocarcinoma vs. squamous cell carcinoma	0.133	0.793	0.586	1.073
Other groups vs. squamous cell carcinoma	0.006*	1.576	1.137	2.184
Lymph node N1 vs. N0	0.065	1.321	0.983	1.776
Lymph node N2 vs. N0	0.001*	1.882	1.365	2.596
Lymph node N3 vs. N0	0.145	4.395	0.600	32.179

\*: Statistically significant.

is still considered as a minimally invasive type of oncologic resection (14). For this reason, sublobar resections were excluded from the present study.

The patients over 70 years old were selected cautiously. They had fewer comorbidities than the younger group (bronchiectasis, tuberculosis, cavitary lung diseases, diabetes mellitus, coronary bypass surgery, renal failure), and these comorbidities were not considered in statistical analyses. This was the limitation of our study.

In conclusion, in the current study, no significant difference was found in short-term morbidity and mortality between patients younger or older than 70 years of age who underwent surgical treatment for the management of NSCLC based on a comparative analysis of mortality, morbidity, and survival data. Similarly, the younger and older groups did not differ significantly with regard to long-term morbidity and mortality.

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