

# Lobectomy and pneumonectomy in patients over 70 years of age for the treatment of lung cancer: evaluation of surgical outcomes

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## ABSTRACT

**Aims:** The primary aim of this study is to evaluate the surgical outcomes of lobectomy and pneumonectomy operations performed due to lung cancer in individuals aged 70 and above, and to analyze the factors influencing these outcomes.

**Methods:** This retrospective study covers lobectomy and pneumonectomy operations performed on 103 lung cancer patients over the age of 70, from January 2018 to December 2021. A dataset was created including patients' demographic information, smoking status, comorbidities, results of pulmonary function tests and echocardiography, preoperative complete blood count, and serum albumin levels, and these data were analyzed.

**Results:** The average age of the patients was 73.3; 83.5% were male, and 16.5% were female. The complication rate was 47.6%, and the 30-day surgical mortality rate was 8.7%. Patients with a high American Society of Anesthesiologists (ASA) score had higher rates of complications and mortality ( $p=0.015$ ). Low preoperative serum albumin ( $p=0.017$ ) and hemoglobin ( $p=0.026$ ) levels were associated with an increased risk of complications. Postoperative outcomes between Video Assisted Thoracoscopic Surgery (VATS) and thoracotomy were found to be similar.

**Conclusion:** The study demonstrates that in elderly lung cancer surgery, comorbidities and preoperative nutritional status are decisive factors affecting surgical outcomes. Preoperative albumin and hemoglobin levels emerge as significant indicators in assessing the risk of postoperative complications. VATS and thoracotomy are surgical techniques with similar safety and efficacy profiles.

**Keywords:** Lung cancer, elderly, lobectomy, pneumonectomy

## INTRODUCTION

In recent years, it is known that the increase in life expectancy worldwide, parallel to the increase in the frequency of cancer-related diseases, has led to a significant rise in lung cancer cases. This increase is particularly more pronounced among the elderly population. The latest reports from the World Health Organization predict that cancer cases could increase by 60% over the next decade, underscoring the importance of developing new strategies in the fight against cancer.<sup>1</sup>

Factors such as advancing age, increased comorbidities, and decreased functional reserve can significantly affect surgical success.<sup>2</sup> Particularly, chronic diseases and general health conditions observed in elderly patients can significantly alter the risks and outcomes

of surgical interventions, necessitating special attention and approach in planning and implementing surgical procedures.

Lung cancer remains the most common cause of death among men worldwide, and an increase in this rate is also observed in the female population. It has been known that surgical treatment in early-stage lung cancer patients increases survival rates; however, this becomes more complex in the older age group. The effectiveness and success of surgical treatment in advanced-stage lung cancer patients, especially those over eighty years old, remains a controversial topic in light of current research and clinical practices.<sup>3-5</sup>

This study aims to comprehensively evaluate the factors affecting surgical success in elderly lung cancer patients.

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## METHODS

The study was conducted with authorization from the Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (Date: 27.04.2023, Decision No: 2023/514/248/16). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This retrospective analysis, undertaken between January 2018 and December 2021, involves lobectomy and pneumonectomy surgeries performed on patients aged 70 or older. Patients who underwent lobectomy or pneumonectomy and were aged 70 or older were included in the study. Patients who underwent segmentectomy or had incomplete data prior to the operation were excluded. Data were retrospectively collected from the hospital information system.

The demographic information, smoking history, comorbidities, pulmonary function test results, echocardiography outcomes, preoperative complete blood count, and albumin levels of the selected patients were recorded. Recognizing the impact of nutritional status on surgical outcomes, patients identified with significant albumin deficiencies (e.g., albumin levels below 3.5 g/dl) underwent a tailored preoperative nutritional support protocol. This included albumin replacement therapy and nutritional supplementation, aiming to optimize their condition ahead of surgery.

Patients with a hemoglobin level of 10 g/dl or lower received a preoperative erythrocyte suspension transfusion. All operations were overseen by an experienced anesthesia team. Postoperative needs for erythrocyte suspension transfusion, the number of drains and drainage volume, definitive pathological diagnosis and stage, length of hospital stay, complications, and mortality rates were recorded.

### Statistical Analysis

This study delineates the application of descriptive statistics, including mean, standard deviation, median, and range (minimum-maximum values), alongside frequencies and proportions for data characterization. The suitability of data for normal distribution was initially evaluated via the Kolmogorov-Smirnov test. However, acknowledging the complexity of normality assessment, it is proposed that future analyses incorporate additional measures such as skewness, kurtosis, and visual inspection methods (histograms, detrended Q-Q plots). Quantitative independent variables were analyzed using the Mann-Whitney U test due to its non-parametric nature, whereas qualitative independent variables were examined through the Chi-square test, with Fisher's exact test applied under specific conditions. Statistical procedures were executed using SPSS software (Version 29, Chicago, IL, USA). The American Society of Anesthesiologists (ASA) Physical Status Classification

System is utilized to assess the preoperative physical fitness of patients undergoing surgery. It categorizes patients into six groups based on their physical health, ranging from ASA I, indicating a healthy patient, to ASA VI, denoting a brain-dead patient. This system helps in predicting perioperative risks and tailoring anesthesia management. In this study, the ASA score was used to evaluate the baseline health status of patients undergoing surgical treatment.

## RESULTS

The ages of the operated patients ranged from 70 to 86, with an average age of 73.3. Of the 103 patients included in the study, 86 were male (83.5%) and 17 were female (16.5%). 85 of the operations (82.5%) were thoracotomies, while 18 (17.5%) were VATS (Video Assisted Thoracoscopic Surgery). 6 patients (5.8%) underwent pneumonectomy, and 97 patients (94.2%) underwent lobectomy. 82 patients (79.6%) had comorbidities. The demographic data of the patients, preoperative FEV1 value, EF value, comorbidities, and ASA (American Society of Anesthesiologists) scores are summarized in **Table 1**.

	Min-Max	Median	Mean±SD/n-%
Age	70.0 - 86.0	73.0	73.4 ± 3.4
Gender	Female		17 16.5%
	Male		86 83.5%
ASA Score	I		17 16.5%
	II		53 51.5%
	III		33 32.0%
Smoking	20.0 - 150.0	40.0	38.7 ± 16.9
Smoking	(-)		27 26.2%
	(+)		76 73.8%
Ejection fraction	50.0 - 67.0	60.0	61.1 ± 3.8
FEV1 %	60.0 - 126.0	84.0	83.7 ± 13.8
Drainage	0.0 - 2800.0	700.0	771.8 ± 495.9
Hemogram-preop	7.9 - 14.0	11.0	10.8 ± 1.5
Albumin	10.0 - 43.0	34.0	33.8 ± 5.4
Diagnosis			
Squamous			46 44.7%
Adenocarcinoma			42 40.8%
Adenosquamous			4 3.9%
Large cell neuroendocrine carcinoma			4 3.9%
Pleomorphic carcinoma			4 3.9%
Carcinosarcoma			1 1.0%
Combined small cell			1 1.0%
Neuroendocrine tumor			1 1.0%

Min: Minimum, Max: Maximum, SD: Standard deviation, FEV1: Forced expiratory volume 1

Preoperatively, 51.2% of the patients were classified as ASA 2, and 32.0% as ASA 3. The smoking rate was 73.8%. The most common pathological diagnosis was squamous

cell carcinoma at 44.7%, followed by adenocarcinoma at 40.8%. There were 47 patients (45.6%) in stage 1A, 26 (25.2%) in stage 1B, 11 (10.7%) in stage 2A, 10 (9.7%) in stage 2B, and 9 (8.7%) in stage 3A. 3 patients (2.9%) had chest wall resection and 11 patients (10.7%) were operated post neoadjuvant therapy. 49 patients (47.6%) experienced complications and 9 patients (8.7%) had surgical mortality within 30 days. The most common complication was prolonged air leak (42.9%), followed by pneumonia (26.5%). The average length of hospital stay was 9.1 days. The data on the type of operation and stage of patients are summarized in Table 2, and the types of complications, length of hospital stay, and mortality data are summarized in Table 3.

	n	%	
<b>Operation</b>			
Right lower bilobectomy	1	1.0%	
Right lower lobectomy	23	22.3%	
Right middle lobectomy	3	2.9%	
Right pneumonectomy	2	1.9%	
Right upper bilobectomy	3	2.9%	
Right upper lobectomy	34	33.0%	
Left lower lobectomy	7	6.8%	
Left pneumonectomy	4	3.9%	
Left upper lobectomy	24	23.3%	
Video-assisted thoracoscopic surgery	(+)	18	17.5%
	(-)	85	82.5%
Thoracotomy	(+)	85	82.5%
	(-)	18	17.5%
Neoadjuvant	(-)	92	89.3%
	(+)	11	10.7%
Chemotherapy	6	54.5%	
Chemotherapy+radiotherapy	5	45.5%	
Number of drains	I	60	58.3%
	II	43	41.7%
Erythrocyte replacement	(-)	89	86.4%
	(+)	14	13.6%
Complication	(-)	54	52.4%
	(+)	49	47.6%
Prolonged air leak	20	40.8%	
Atelectasis	3	6.1%	
Pneumonia	14	28.6%	
Hematoma	2	4.1%	
Atrial fibrillation	4	8.2%	
Bronchopleural fistula	1	2.0%	
Embolism	1	2.0%	
Other	11	22.4%	

Complication	n	%
Acute kidney failure	1	2.0%
Atrial fibrillation	2	4.1%
Arrhythmia	1	2.0%
Atelectasis	3	6.1%
Bronchopleural fistula	1	2.0%
Bradycardia	1	2.0%
Subcutaneous emphysema	2	4.1%
Couldn't extubate	2	4.1%
Hematoma	3	6.1%
Hemoptysis	1	2.0%
Liver enzyme elevation	2	4.1%
Pleurisy	1	2.0%
Pneumonia	13	26.5%
Pulmonary embolism	1	2.0%
Cerebrovascular accident	1	2.0%
Prolonged air leak	21	42.9%
Vocal cord paralysis	2	4.1%

No significant relationship was found between patients' demographic data and complications. Patients with a high American Society of Anesthesiologists (ASA) score had a higher frequency of complications (p=0.015).

Smoking was not found to significantly lead to complications. When evaluating the percentage and liters of FEV1 separately, no significant difference was found in the group with complications. Preoperative low complete blood count and albumin levels had a significant impact on the development of complications (p=0.026 and p=0.017, respectively). The presence of comorbidities, especially diabetes mellitus (DM) and chronic obstructive pulmonary disease (COPD), significantly increased the complication rate compared to other comorbidities (p=0.006 and p=0.025, respectively). The presence of secondary malignancies was not found to increase the complication rate.

No significant difference was observed in the distribution of definitive pathological diagnosis and stage between groups with and without complications. No significant difference was found in complication development among VATS lobectomy, thoracotomy, chest wall operations, and operations after neoadjuvant therapy. The need for postoperative erythrocyte suspension (ES) transfusion did not differ between the groups with and without complications. It was found that the group with complications had a longer hospital stay (p<0.001) and a higher mortality rate (p=0.001). The data on complications and their significance ratios are summarized in Tables 4 and 5.

**Table 4.** Analysis of factors influencing postoperative complications

		Complication (+)							
		Average±SD/n-%			Average±SD/n-%				
<b>Age</b>		73.3	±	3.2	73.5	±	3.6	0.754	m
<b>Gender</b>	<b>Female</b>	11		20.4%	6		12.2%	0.267	X <sup>2</sup>
	<b>Male</b>	43		79.6%	43		87.8%		
<b>ASA score</b>	<b>I</b>	14		25.9%	3		6.1%	0.015	X <sup>2</sup>
	<b>II</b>	27		50.0%	26		53.1%		
	<b>III</b>	13		24.1%	20		40.8%		
<b>Smoking</b>		40.0	±	20.5	37.4	±	12.8	0.737	m
	(-)	17		31.5%	10		20.4%	0.202	X <sup>2</sup>
	(+)	37		68.5%	39		79.6%		
<b>Ejection fraction</b>		61.4	±	3.9	60.7	±	3.8	0.335	m
<b>FEV1 %</b>		84.3	±	13.9	83.1	±	13.8	0.744	m
<b>Drainage</b>		596.3	±	375.2	965.3	±	542.6	0.000	m
<b>Hemoglobin</b>		11.1	±	1.5	10.5	±	1.4	0.026	m
<b>Albumin</b>		34.6	±	6.1	32.9	±	4.6	0.017	m
<b>Comorbidity</b>	(-)	17		31.5%	4		8.2%	0.003	X <sup>2</sup>
	(+)	37		68.5%	45		91.8%		
<b>Diabetes mellitus</b>		5		9.3%	15		30.6%	0.006	X <sup>2</sup>
<b>Hypertension</b>		19		35.2%	23		46.9%	0.225	X <sup>2</sup>
<b>Coronary artery disease</b>		11		20.4%	14		28.6%	0.332	X <sup>2</sup>
<b>Congestive heart failure</b>		1		1.9%	1		2.0%	1.000	X <sup>2</sup>
<b>Kidney failure</b>		4		7.4%	4		8.2%	0.886	X <sup>2</sup>
<b>Chronic obstructive pulmonary disease</b>		6		11.1%	14		28.6%	0.025	X <sup>2</sup>
<b>Second malignancy</b>		8		14.8%	6		12.2%	0.704	X <sup>2</sup>
<b>Diagnosis</b>									
<b>Adenocarcinoma</b>		20		37.0%	22		44.9%	0.417	X <sup>2</sup>
<b>Adenosquamous</b>		4		7.4%	0		0.0%	0.119	X <sup>2</sup>
<b>Large cell neuroendocrine carcinoma</b>		2		3.7%	2		4.1%	1.000	X <sup>2</sup>
<b>Carcinosarcoma</b>		1		1.9%	0		0.0%	1.000	X <sup>2</sup>
<b>Combined small cell</b>		0		0.0%	1		2.0%	0.476	X <sup>2</sup>
<b>Neuroendocrine tumor</b>		1		1.9%	0		0.0%	1.000	X <sup>2</sup>
<b>Pleomorphic carcinoma</b>		2		3.7%	2		4.1%	1.000	X <sup>2</sup>
<b>Squamous</b>		24		44.4%	22		44.9%	1.347	X <sup>2</sup>
2									
<b>Stage</b>	<b>1A</b>	30		55.6%	17		34.7%	0.105	X <sup>2</sup>
	<b>1B</b>	11		20.4%	15		30.6%		
	<b>2A</b>	3		5.6%	8		16.3%		
	<b>2B</b>	4		7.4%	6		12.2%		
	<b>3A</b>	6		11.1%	3		6.1%		

SD: Standard deviation, ASA: The American Society of Anesthesiologists, m: Mann-Whitney U test, X<sup>2</sup>: Chi-square test, FEV1: Forced expiratory volume 1

**Table 5.** Impact of comorbidities on surgical outcomes

		Complication (-)		Complication (+)		P			
		Average ±SD/n-%	Median	Average±SD/n-%	Median				
Video-assisted thoracoscopic surgery	(+)	9	16.7%	9	18.4%	0.820	X <sup>2</sup>		
	(-)	45	83.3%	40	81.6%				
Thoracotomy	(+)	45	83.3%	40	81.6%	0.820	X <sup>2</sup>		
	(-)	9	16.7%	9	18.4%				
Chest wall	(+)	1	1.9%	2	4.1%	0.604	X <sup>2</sup>		
	(-)	53	98.1%	47	95.9%				
Neoadjuvant	(-)	46	85.2%	46	93.9%	0.154	X <sup>2</sup>		
	(+)	8	14.8%	3	6.1%				
Chemotherapy		4	50.0%	2	66.7%				
Chemotherapy+radiotherapy		4	50.0%	1	33.3%				
Number of drains	I	35	64.8%	25	51.0%	0.156	X <sup>2</sup>		
	II	19	35.2%	24	49.0%				
Erythrocyte replacement	(-)	49	90.7%	40	81.6%	0.178	X <sup>2</sup>		
	(+)	5	9.3%	9	18.4%				
Length of the hospital stay		6.6	1.5	7.0	11.8	5.5	10.0	0.001	m
Mortality	(-)	54	100.0%	40	81.6%	0.001	X <sup>2</sup>		
	(+)	0	0.0%	9	18.4%				

SD: Standard deviation, m: Mann-Whitney U test, X<sup>2</sup>: Chi-square test

## DISCUSSION

It is known that the frequency of cancer increases with advancing age and cancer surgery in older ages becomes more challenging due to increased comorbidities and decreased physical condition.<sup>1</sup> In this study, surgical outcomes for patients aged 70 and above were evaluated, and parameters affecting the development of complications were examined.

In patients undergoing lobectomy, age, ASA score, male gender, Zubrod score, diabetes, renal function disorders, induction therapy, FEV1 value, and smoking have been shown to be risk factors.<sup>6</sup> A study in France reported risk factors for mortality including age, gender, dyspnea score, ASA score, performance status, priority of surgery, diagnosis, comorbidities, and surgical procedure.<sup>7</sup> Hino and colleagues<sup>8</sup> have indicated that male gender and pathological diagnosis are associated with poor prognosis, and Licker and colleagues<sup>9</sup> have found that a low FEV1 value and the diagnosis of COPD increase the development of complications. In our study, no relationship was found between gender or pathological diagnosis and prognosis. However, a significant correlation was identified between a high ASA score and increased rates of complications and mortality. Similarly, smoking and diagnoses of COPD were found to increase complications and mortality.

In the study by Jingjing Shao and colleagues<sup>10</sup>, it was found that insufficient preoperative nutrition in lung resection is associated with poor prognosis.

Similarly, Sheng Wei and colleagues<sup>11</sup> demonstrated the relationship between nutrition, immunity, and survival in cancer patients using the HALP score. Our study also found a correlation between low albumin levels and complications, indicating that preoperative serum albumin could be a predictor for postoperative outcomes. Additionally, the study by Hiroyuki Ogawa and team<sup>12</sup> revealed that HgA1c levels are associated with recurrence-free and overall survival, with lower overall survival in patients with HgA1c levels above 8. Our findings also reflect the negative short-term impacts of diabetes due to its adverse effects on wound healing and the immune system. Marcus Taylor and colleagues<sup>13</sup> research on preoperative anemia found it to be independently associated with overall survival.

Our study similarly concludes that lower preoperative hemoglobin levels are linked to increased complications. Studies on early-stage lung cancer resection in the elderly generally report positive results<sup>14-16</sup>, but there's a lack of research on advanced stages. In our study, no significant difference in stages was observed, although many patients were in the early stages. Igor Saftic and colleagues<sup>17</sup> identified pneumonia and prolonged air leak as common complications. Kutluk and colleagues<sup>18</sup> reported a three-month mortality rate of 6.4%. Dominguez-Ventura and colleagues<sup>19</sup> reported a 30-day mortality rate of 6%. Pages and colleagues<sup>20</sup> found VATS lobectomy to be safer than thoracotomy in patients over 80, with 16.7% undergoing VATS and

83.2% undergoing thoracotomy. Our study found a slightly higher mortality rate, likely related to the high comorbidity of included patients.

### Limitations

This study's significant limitations include potential data inadequacies and inconsistencies due to its retrospective design. Being single-centered limits the generalizability of the results. The specific characteristics of patients aged 70 and above make the findings particularly relevant to this age group but may limit applicability to the general population. The limited number of patients may not provide sufficient data for rare conditions or detailed subgroup analyses.

### CONCLUSION

This study examines surgical outcomes in patients over 70 with lung cancer, highlighting the impact of high comorbidity indices and preoperative nutritional status. Notably, preoperative levels of albumin and hemoglobin are crucial for predicting postoperative complication risks. Comorbidities such as diabetes and COPD necessitate careful attention due to their risk enhancement. Surgical techniques like VATS and thoracotomy show similar postoperative outcomes. While these findings contribute to decision-making in this field, the study's retrospective nature and single-center approach suggest a need for more comprehensive research.

### ETHICAL DECLARATIONS

#### Ethics Committee Approval

The study was carried out with the permission of Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (Date: 27.04.2023, Decision No: 2023/514/248/16).

#### Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

#### Referee Evaluation Process

Externally peer-reviewed.

#### Conflict of Interest Statement

The authors have no conflicts of interest to declare.

#### Financial Disclosure

The authors declared that this study has received no financial support.

#### Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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