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# CHOICE OF PULMONARY RESECTIONS IN INTRATHORACIC TUMORS: SHORT-TERM OUTCOMES

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## Abstract

**Relevance:** Lung cancer still leads in morbidity and mortality among other cancers. In 2018, 2.094 million new lung cancer cases and 1.8 million deaths from lung cancer were registered globally. The study aimed to evaluate the effectiveness of surgical treatment for lung cancer depending on the extent of surgery. **Material and Methods:** The article provides a retrospective analysis of 137 patients operated for lung cancer at Almaty Oncology Center in 2014-2018. The database was created in Microsoft Excel. IBM SPSS Statistics, package 19 (trial version) mathematical data processing software was used for statistical processing. The survival rate was measured from the commencement of treatment till the patient's death for any reason or to the last observation date. The cut-off date was January 1, 2019. **Results:** Most of the patients (91/137, 69.3%) had a locally advanced Stage IIb-IIIb process. Localized forms of the disease were diagnosed in 21.1% of cases. R0 resection was achieved in 83.9%, R1 – 13.1%, R2 – 2.9% of patients. The post-surgery mortality amounted to 5.8%. One-year survival amounted to 70% SE4 for lobectomy, 87% SE9 for segmental resections, 79% SE8 for bronchoplastic, lobar resections, and 67% SE10 for pneumonectomy. The difference in median survival was statistically significant:  $\chi^2 = 9.7$ ,  $p = 0.045$ . **Conclusion:** We consider the extent of surgery a risk factor. The organ ectomies should be minimized since our data and the literature report high one-year mortality and low 5-year survival after such surgeries.

## Keywords

lung cancer, lung cancer surgery, lobectomy, pneumonectomy, sleeve lobectomy, segmentectomy.

## Кеуде ішілік ісіктерді хирургиялық емдеу көлемін таңдау: жақын нәтижелерді талдау

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## Аңдатпа

**Өзектілігі:** Өкпенің қатерлі ісігі барлық онкологиялық аурулардың арасында өлім-жітім және аурушаңдық бойынша көш бастап тұр. 2018 жылы әлемде ӨҚІ-нің 2,094 млн жаңа жағдайы тіркелді, осы патологиядан көз жұмғандардың саны 1,8 млн-ға жетті. **Зерттеудің мақсаты:** хирургиялық араласу көлеміне байланысты өкпенің қатерлі ісігін хирургиялық емдеудің тиімділігін бағалау. **Материалдар және әдістер:** Мақалада 2014-2018 жылдар аралығында Алматы Онкология орталығының хирургия бөлімшесінде өкпенің қатерлі ісігі бойынша ота жасалған 137 науқасқа ретроспективтік талдау жасалғаны туралы ақпарат қамтылған. Мәліметтер базасы Microsoft Excel бағдарламасы арқылы жасалды. Материалды статистикалық өңдеу IBM SPSS Statistics 19 (trial-нұсқа) мәліметтерді математикалық өңдеу пакетінің көмегімен жүзеге асырылды. Өмір сүру деңгейі емдеу басталған күннен бастап кез келген себеп бойынша орын алған өлімге дейін немесе науқасты соңғы бақылау күніне дейін есептелді. Ақпарат жинау 2019 жылғы 1 қаңтарда аяқталды. **Нәтижелер:** Науқастардың көпшілігінде (137-нің 91, 69,3%) IIb-IIIb сатылары деп бағаланған жергілікті кең таралған процесс болды. 21,1% жағдайда аурудың локализацияланған формалары деген диагноз қойылды. R0 резекцияға науқастардың 83,9%-

ы, R1 – 13,1%, R2 – 2,9% жетті. Ота жасалған науқастар арасындағы өлім-жітім 5.8%-ды құрады. Бір жылдық өміршеңдік: лобэктомия – 70% SE4, сегментарлық резекция – 87% SE9, бронхопластикалық, лобарлық резекция – 79% SE8, пневмонэктомиядан кейін – 67% SE10. Өмір сүру медианасындағы статистикалық сенімді айырмашылық:  $\chi^2 = 9,7$ ,  $p = 0,045$ . **Қорытынды:** Осылайша, біз ота көлемі қауіп-қатер факторы деп санаймыз. Ағзаны сақтау оталары барынша азайтылуы керек, өйткені біз біз алған мәліметтер мен әдеби деректер осындай оталар кезіндегі бір жылдық өлім-жітімнің жоғары деңгейін және бес жылдық өміршеңдіктің төмен деңгейін көрсетеді.

#### Түйін сөздер

өкпе обыры, өкпе обырын хирургиялық емдеу, лобэктомия, пневмонэктомия, sleeve лобэктомия, сегментэктомия

## Выбор объема хирургического лечения при опухолях внутригрудной локализации: анализ непосредственных результатов

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#### Аннотация

**Актуальность:** Рак легкого занимает лидирующие позиции по заболеваемости и смертности среди всех онкологических заболеваний. В 2018 году в мире было зарегистрировано 2,094 млн. новых случаев РЛ, число умерших от этой патологии достигло 1,8 млн. **Цель исследования:** оценка эффективности оперативного лечения рака легкого в зависимости от объема оперативного вмешательства. **Материалы и методы:** Статья содержит ретроспективный анализ 137 пациентов, прооперированных по поводу рака легкого в хирургическом отделении Алматинского Онкологического Центра с 2014 по 2018 годы. База данных была создана с использованием программы Microsoft Excel. Статистическая обработка материала производилась с помощью пакета математической обработки данных IBM SPSS Statistics 19 (trial-версия). Выживаемость рассчитывалась от даты начала лечения до смерти от любой причины или до даты последнего наблюдения пациента. Сбор информации был завершен 1 января 2019 года. **Результаты:** Большинство пациентов (91 из 137, 69,3%) имели местно-распространенный процесс, который оценивался IIb-IIIb стадиями. Локализованные формы заболевания были диагностированы в 21,1% случаев. R0 резекция достигнута у 83,9% больных, R1 – у 13,1%, R2 – у 2,9%. Летальность среди прооперированных пациентов составила 5.8%. Одногодичная выживаемость составила: для лобэктомии – 70% SE4, для сегментарных резекций – 87% SE9, при выполнении бронхопластических, лобарных резекций – 79% SE8, после пневмонэктомии – 67% SE10. Статистически достоверная разница в медиане выживаемости составила:  $\chi^2 = 9,7$ ,  $p = 0,045$ . **Заключение:** Таким образом, мы считаем, что объем операции является фактором риска. Выполнение органо-уносящих операций следует минимизировать, так как полученные нами и литературные данные свидетельствуют о высоком уровне одногодичной летальности и низком уровне пятилетней выживаемости при таких операциях.

#### Ключевые слова

рак легкого, хирургическое лечение рака легких, лобэктомия, пневмонэктомия, циркулярная резекция бронха, сегментэктомия

#### Relevance

Lung cancer still leads in morbidity and mortality among other cancers despite active prevention, new diagnostic methods, and advances in anesthesiology and surgical treatment. In 2018, 2.094 million new lung cancer cases (11.6% of all new cancer cases) and 1.8 million deaths from lung cancer (18.4% of all deaths from cancer) were registered globally [1]. Five-year overall survival with non-small cell lung cancer (NSCLC) has not exceeded 23% [2].

In the Republic of Kazakhstan, in 2018, lung cancer ranked second in cancer incidence (20.5 per 100,000) and first in cancer mortality (13.7 per 100,000). One-year mortality remained high: 49.4% died within a year after diagnosis. Five-year overall

survival varied by regions from 2.5% to 11.5%[3].

Surgery is a generally accepted standard of resectable lung cancer treatment providing real healing prospects [4]. Surgical techniques are constantly improved thanks to high-tech dissection instruments, atraumatic suture material, parenchymal and bronchial stapling devices. Anesthetic support is also improving. The use of separate pulmonary ventilation, the widespread introduction of inhalation (combined) anesthesia, and modern means of cardiac support provide a chance for surgery in a functionally difficult group of patients.

The study aimed to evaluate the effectiveness of surgical treatment for lung cancer depending on the extent of surgery.

## Material and Methods

The article provides a retrospective analysis of 225 patients operated for lung cancer at Almaty Oncology Center in 2014-2018. Thoracotomy was performed in 137 of 225 (53.7%) operations.

The patients for surgery were thoroughly selected by contrast-enhanced CT modeling with 3D imaging. According to ICH guidelines, all the patients signed informed consent for surgery and medical data processing upon approval of a multi-disciplinary team [5].

Profile of the patients enrolled in the study: the average age of lung cancer patients – 63.42 (40 to 83) years of age; SE 0.689, SD 8.063, dispersion – 65.01. Most of the patients enrolled (45.3%) belonged to the age group of 61-70 years; least of the operated patients (4.4%) were below 50 years. Men were more often affected by lung malignancies, with the men-to-women ratio of 3:1 (Table 1).

Cardiovascular comorbidity was presented in 96 (70.1%) cases, more often in men – 78.4% (80/102) vs. 45.7% (16/35) in women. Chronic obstructive pulmonary disease was registered in 86 (62.8%) patients, again more often in men – 65.7% (67/102) vs. 54.3% (19/35) in women. In 11 (8%) cases, NSCLC was diagnosed as a second metachronous cancer since those patients have been previously treated for cancer. Those patients had neither relapse nor progression of the primary malignant disease. A history of cancer was confirmed in 8/102 (7.8%) male and 3/35 (8.6%) female patients. 56 (40.9%) patients had combined cardiovascular and respiratory comorbidity, with a clear prevalence among male patients: 51.0% vs. 8.6% of females. Thus, men had a reliably higher frequency of comorbidity (Table 2).

By the prevalence of the disease and the topical localization of the primary tumor, patients taken for surgical treatment most often had an upper lobe tumor – 59 (43.1%) cases, with the same frequency

to the right and left – 31 (22.6%) and 28 (20.4%), respectively. Lower lobe lung cancer was detected in 17.5% (24) cases, more often to the left – 15 (10.9%) vs. 9 (6.6%) to the right. Bilobar involvement has been reported in 13 (9.5%) patients, with a predominant lesion of the right lung – 12 (8.8%) vs. 1 (0.7%) lesion of the left lung. Centralized tumor was found in 29 (21.2%) cases: 16 (11.7%) cases to the right and 13 (9.5%) to the left.

The choice of extent of surgery depended on the disease prevalence and the patient's cardio-pulmonary reserve. The surgical technique was selected according to the generally accepted NCCN criteria [6]. The intervention was performed under total intravenous and inhalation anesthesia. The lungs were intubated and ventilated separately, through axillary access of 8-12 cm in the 5th intercostal space, with maximum preservation of the muscle layer and separate lung roots treatment. All patients with primary lung cancer underwent a systemic ipsilateral lymph node dissection on the surgery side, regardless of the lymph nodes macroscopical lesion [7]. The bronchus stump was treated with a mechanical endostepler, with an individual selection of cassettes. A. at v. bronchialis were preserved for sleeve lobectomy.

Standard contraindications for surgery included: the patient's inability to endure anesthetic support; inconsistency of the functional lungs reserve with the planned resection; tumor (T4) with spread to the trachea, heart, spine, esophagus [4, 8, 9].

The main pulmonary trunk was discharged and fixed by a tourniquet-guidewire to prevent massive pulmonary bleeding. In case of vessel damage and/or bleeding development, the Satinsky clamp was turned down along the conductor to block the blood flow.

Early postoperative activation of patients was one of the factors to reduce postoperative compli-

**Table 1.**  
Lung cancer patients' distribution by demographic indicators (age, gender) (n=137)

Gender	Number of patients				Total
	Below 50 years	51-60 years	61-70 years	Over 71 years	
Female	3 (2.2%)	10 (7.3%)	15 (10.9%)	7 (5.1%)	35 (25.5%)
Male	3 (2.2%)	32 (23.4%)	47 (34.3%)	20 (14.6%)	102 (74.5%)
<b>Total</b>	<b>6 (4.4%)</b>	<b>42 (30.7%)</b>	<b>62 (45.3%)</b>	<b>27 (19.7%)</b>	<b>137 (100%)</b>

**Table 2.**  
Lung cancer patients' distribution by comorbidity (n=137)

Gender	Ischaemic Heart Disease	Chronic obstructive pulmonary disease	Metachronous cancer	Total
Female	16(45.7%)	19(54.3%)	3(8.6%)	35 (100%)
Male	80(78.4%)	67(65.7%)	8(7.8%)	102 (100%)
Log-rank (Mantel-cox) P(value)	0.023	0.018	0.018	0.018
Chi-Square	5.186	5.564	5.576	5.645
<b>Total</b>	<b>96 (70.1%)</b>	<b>86(62.8%)</b>	<b>11(8.0%)</b>	<b>137 (100%)</b>

cations. 82% of operated patients were activated on Day 1-2 after surgery. The ICU patients were transferred to the wards with functional beds and central oxygen supply. Blood pressure, heart rate, respiratory rate, SpO<sub>2</sub> were monitored to get the patient out of bed for further controlled walking in the ward. The "Threeball" device maximizing the inspiratory volume was used for respiratory gymnastics. The intensity of physical activity depended on the volume of air discharged through the drainage tubes. The remaining 18% of patients were bedridden until the massive air discharge through the drainage tubes ceased and cardiopulmonary insufficiency was compensated. Despite the active drainage, those patients were sited and did exercises using the "Threeball" device. All patients used drainage box systems with adjustable aspiration within the range of 0-30 mm w.g. The drain was removed on Day 1 after pneumonectomy.

The database was created in Microsoft Excel. IBM SPSS Statistics, package 19 (trial version) mathematical data processing software was used for statistical processing. The survival rate was measured in intervals using Lifetables recommended by the International Union Against Cancer (UICC) and the World Health Organization (1979) from the

commencement of treatment till the patient's death for any reason or to the last observation date. The cut-off date was January 1, 2019.

### Results

Most of the patients (91/137, 69.3%) had a locally advanced Stage IIb-IIIb process. Localized forms of the disease were diagnosed in 21.1% of cases: Ia – 1 (0.7%), Ib – 18 (13.1%), and IIa – 10 (7.3%) cases. Only two (1.5%) patients had a primary-advanced process. Four patients with a morphologically confirmed benign process and three patients with secondary, metastatic lung disease were excluded from the analysis.

More than half of operated patients (76/137) underwent lobectomy (Table 3).

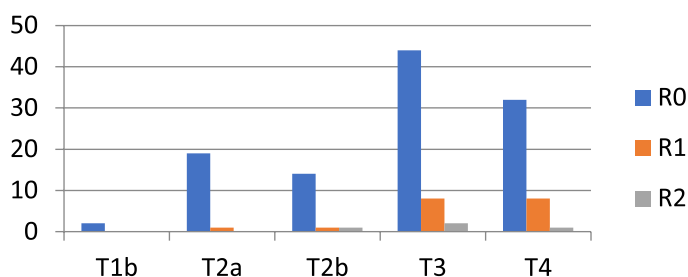
Only in one (0.7%) case of expository thoracotomy with the right-side tumor localization, the tumor involved the venous sinus, right pulmonary artery, and right heart auricle. Such involvement could not be diagnosed preoperatively (Table 3).

Postoperative histology confirmed the radicality of performed surgical interventions. R0 resection was achieved in 115 (83.9%) patients, R1 (microscopically positive edge) – in (13.1%) patients, R2 – in 4 (2.9%) patients (Figure 1).

Surgical intervention	No. of operations				Total
	Right side		Left side		
	Abs.	%	Abs.	%	
<b>Lobectomy</b>	43	31.4	33	24.1	76 (55.5%)
- upper	24	17.5	23	16.8	47 (34.3%)
- middle	3	2.2	-	-	3 (2.2%)
- lower	5	3.6	10	7.3	13 (10.9%)
Bilobectomy	11	8.0	-	-	11 (8.0%)
Pneumonectomy	11	8.0	10	7.3	21 (15.3%)
<b>Anatomical lung resection (sub-lobe):</b>	7	5.1	8	5.8	15 (10.9%)
- upper lobe	2	1.5	5	3.6	7 (5.1%)
- middle lobe	2	1.5	-	-	2 (1.5%)
- lower lobe	3	2.2	3	2.2	6 (4.4%)
<b>Reconstructive plastic (sleeve) lobectomy:</b>	16	11.7	8	5.8	24 (17.5%)
- upper	7	5.1	4	2.9	11 (8.0%)
- middle	4	2.9	-	-	4 (2.9%)
- lower	2	1.5	4	2.9	6 (4.4%)
bilobectomy	3	2.2			3 (2.2%)
Explorativethoracotomy	1	0.7	-	-	1 (0.7%)
<b>Total</b>	<b>78</b>	<b>56.9</b>	<b>59</b>	<b>43.1</b>	<b>137 (100%)</b>

**Table 3.**

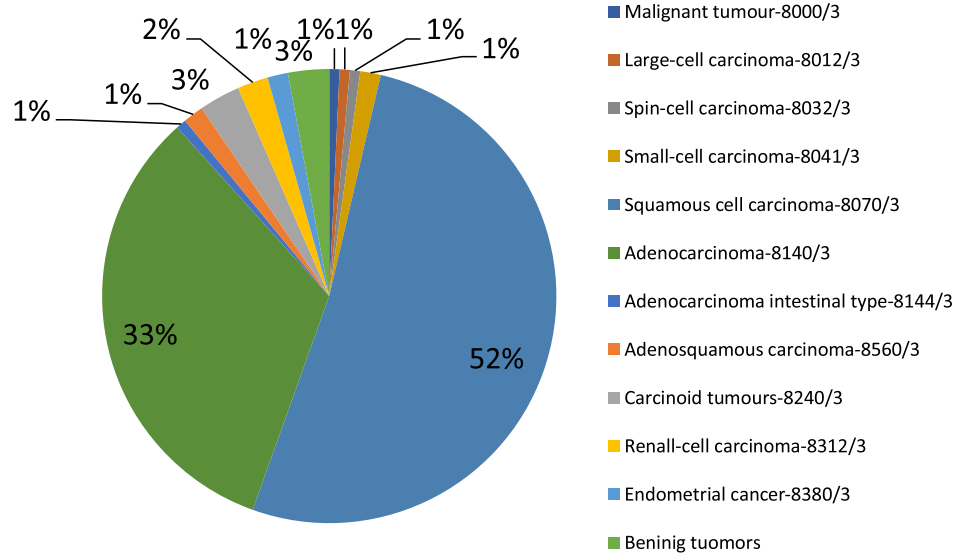
The volume of surgery in lung cancer patients (n=137)



**Figure 1.**

Radicality of resection and tumor size as per TNM 7 (n=137)

**Figure 2.**  
Distribution of the morphological forms of the disease in NSCLC patients (n=137)



**Table 4.**  
The incidence of lymph node involvement depending on the main histological forms of lung cancer (n=137)

	Large cell carcinoma - 8012/3	Spindle cell carcinoma - 8032/3	Small cell carcinoma - 8041/3	Squamous cell carcinoma - 8070/3	Adenocarcinoma - 8140/3	Adenosquamous carcinoma - 8560/3	Carcinoid tumor - 8240/3
n1	0	0	1	13	5	0	0
n2	0	0	0	16	13	0	1
n3	0	0	0	0	3	0	0

Postoperative histology revealed: squamous cell cancer – 51.8%, adenocarcinoma – 32.8%, adenosquamous carcinoma – 1.5%, carcinoid tumor – 2.9%, and other cancers - in single cases. Thus, smallcell carcinoma was found in 1.5%, non-differentiated carcinoma – 0.7%, large cell carcinoma – 0.7%, spindle cell carcinoma – 0.7%. Three (2.2%) patients had secondary tumor lesions of the lungs, another 4 (2.9%) had no malignant cells detected (Figure 2).

The histological examination of the surgical material revealed no lesion to the lymph nodes (N0) in 79 (57.7%) patients, first-order lymph node metastasis (N1)– in19 (13.9%), second-order (N2)– in 31 (22.6%), third-order (contralateral side) (N3)– in 3 (2.2%) patients. In 5 (3.6%) cases, the postoperative status of regional lymph nodes remained unknown (NX) due to the operation’s palliative purpose. It was decided to abstain from systematic lymph node dissection not to burden the patient’s condition. Another reason was the spread of tumor metastasis outside the lymph node to adjacent structures (so-called «bulky») (Table 4).

Table 4 shows that the first and second-order lymph nodes were most often affected by metastases in squamous cell carcinoma and adenocarcinoma of the lung: 29 (21.2%) and 18 (13.1%) cases, respectively. Third-order or contralateral side lymph

nodes were affected in 3(2.1%) patients with adenocarcinoma of the lung.

Pain intensity was another criterion of postoperative cure quality. The pain was assessed on a digital scale from 0 to 10: Grade 1 (1-3 points) – minor, Grade 2 (4-6 points) – moderate, Grade 3 (7-9 points) – expressed[10]. Twenty-two (16.1%) patients assessed postoperative pain as minor, 93 (67.9%) – moderate, and another 22 (16.1%) – expressed.

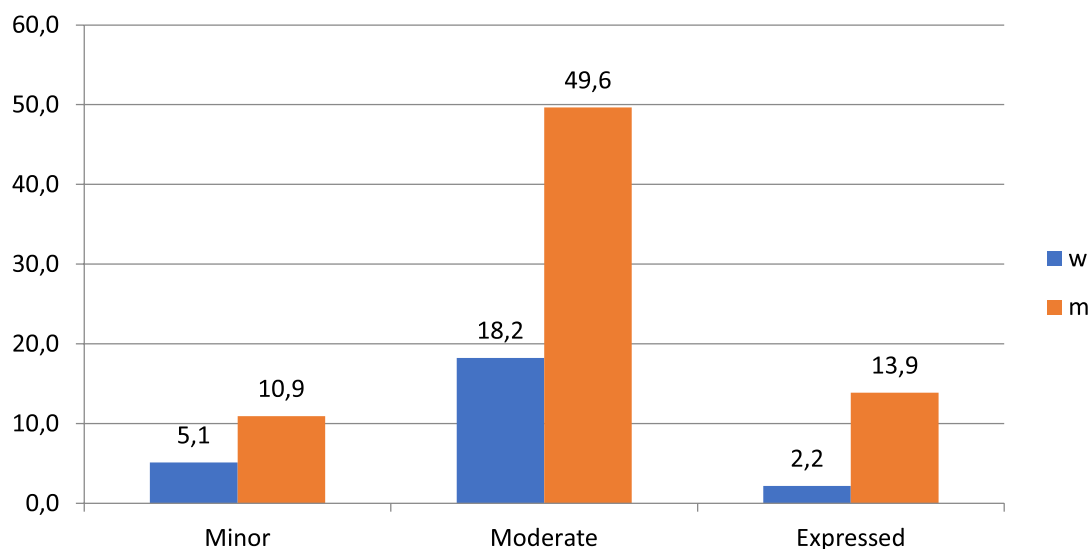
At that, women tolerated pain better than men (Figure 3).

According to Thoracic Morbidity and Mortality System classification of complications [11,12], 14(10.2%) of patients had grade 3-5 early postoperative complications (Table 5).

Most patients, 123 (89.8%), had no complications of such grade.

During lung surgery with separate pulmonary ventilation using double-lumen endotracheal tubes, a rare intraoperative anesthesia-related complication [13] is possible in the form of iatrogenic perforation of the lower third of the trachea membranous part and right main bronchus by the endotracheal tube. This pathology was detected in one patient (0.7%) and managed intraoperatively, without changing the extent of surgery. The complication developed on the background of the patient’s ana-





**Figure 3.**  
Postoperative pain intensity distribution in lung cancer patients, by gender, % (n = 137)

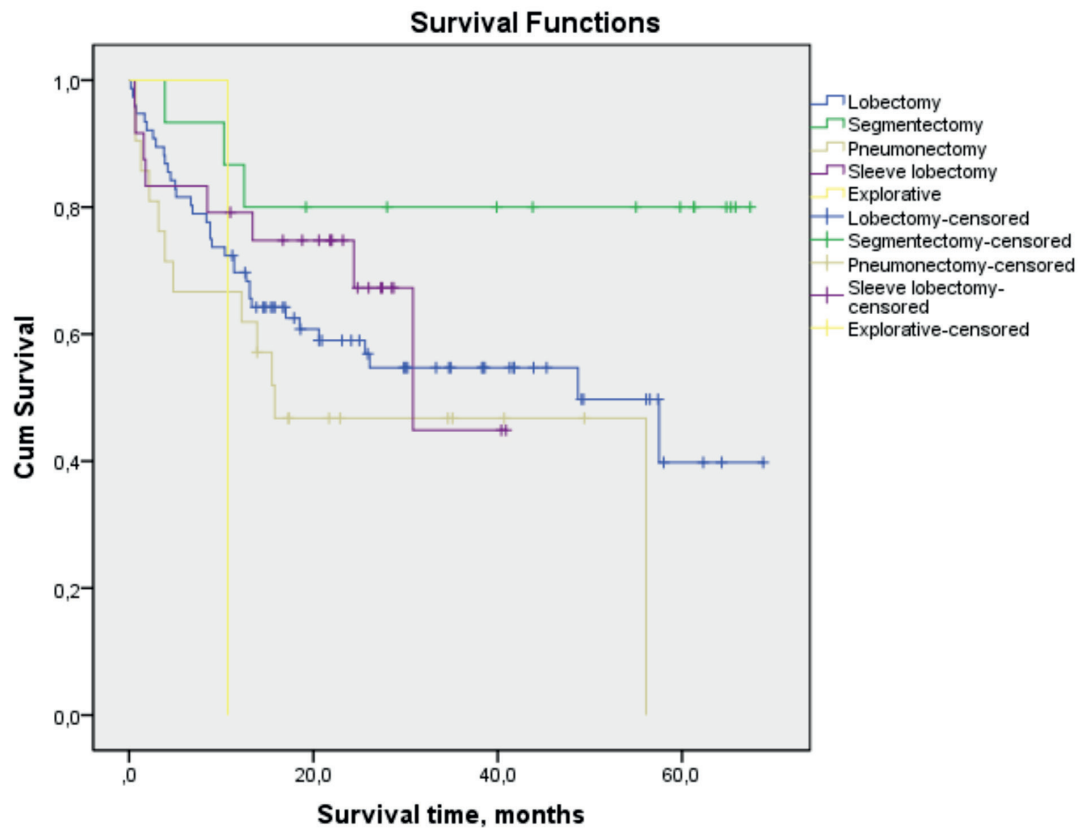
Complication	Grade	Frequency, abs.	%
Intrapleural bleeding	IIIB	3	2.2
Bronchial fistula	IVB-V	5	3.6
Parenchymal fistula	IIIA	3	2.2
Iatrogenic perforation of the lower third of the trachea membranous part and the right main bronchus	IIIB	1	0.7
Chronic renal insufficiency	IVB	1	0.7
Interbronchial anastomosis leak	V	1	0.7
<b>Total</b>		<b>14</b>	<b>10.2</b>

**Table 5.**  
Grade 3-5 postoperative complications' distribution after lung cancer surgery (n=137)

No.	Age, years	Complication	Outcome	
1	63	Bronchial fistula	Death	Rhetoracotomy, suturing of stump, thoracostomy
2	71	Alveolar fistula	Death	Drainage
3	66	Erosive-purulent endobronchitis. Postoperative deformity of the left main bronchus with partial obstruction.	Death, AMI	Non-surgical
4	66	Alveolar fistula	Death within a month	Drainage
5	63	Chronic renal insufficiency (CRI)	Death due to CRI progression within a month	Non-surgical
6	67	Bronchial fistula (the upper lobar bronchus stump membranous wall necrosis) on 02.05.2018	Death	Rhetoracotomy. para-pericardial timus pacefollower transposition, plastics of the upper lobar bronchus stump defect
7	68	Anastomotic leakage after sleeve surgery	Death	Rhetoracotomy leftward (06.03.2018) – left lung pneumonectomy. Bronchial fistula. Left pleural cavity empyema. Mediastinitis.
8	72	Bronchial fistula	Death	Tracheal stenting of the right main bronchus, mediastinitis.

**Table 6.**  
Complications with fatal outcome after lung cancer surgery (n = 137)

**Figure 4.**  
Survival rate by Kaplan-Meier depending on the extent of surgery



tomical features associated with the hypersthenic constitution and cervical osteochondrosis.

The intrapleural bleeding occurred in 3 cases (2.1%). Two cases required re-thoracotomy for surgical hemostasis; one case was managed conservatively. Intraoperative bleeding after re-thoracotomy originated from the lower pulmonary vein due to a suture failure.

After surgery, five (3.6%) patients developed a bronchial fistula due to the main bronchus stump insolvency – four (2.9%), or a lobar bronchus stump insolvency – one (0.7%). Interbronchial anastomosis failure occurred in one (0.7%) case. These complications required three re-thoracotomies. Two cases of suture failure were caused by the bronchial wall necrotic changes. In one patient, the suture cut out after a pronounced cough reflex. One patient (0.7%) developed chronic renal failure.

The mortality among operated patients of 5.8% (8/137 cases) was mainly caused by the bronchus or parenchyma seam integrity failure. The performed re-thoracotomies using various sealing techniques were not successful. Therefore, the timing of fistula detection and its early abolition are extremely important risk factors (Table 6).

Survival was calculated using SPSS tables. Postoperative mortality up to one month after surgery amounted to 5.8% SE2. One-year survival was 72% SE 4 (median survival time (MST) – 57.5 months).

One-year survival was dependent on the extent of surgery and amounted to 70% SE4 (MST – 51.6 months) for lobectomy, 87% SE9 (MST – 60 months) for segmental resections, 79% SE8 (MST – 36 months) for bronchoplastic, lobar resections. Pneumonectomy was associated with the lowest one-year survival of 67% SE10 (MST – 20.6 months). Exploratory thoracotomy was associated with the survival of 10.7 months (n=1) (Figure 4). The difference in median survival was statistically significant:  $\chi^2 = 9.7$ ,  $p = 0.045$ .

## Discussion

The presented surgical technique was adapted for anatomical lung resections (also sleeve lobectomy, segmentectomy). Its introduction and improvement at Almaty Oncology Center allow expanding indications for invasive operations without increasing the frequency of intra- and postoperative complications and mortality. The use of contrast-enhanced CT-modeling with 3D image reconstruction reduced the frequency of trial thoracotomies to 0.7%. The pulmonary artery blood flow control allows a safe vascular resection and vascular suture. A systemic ipsilateral lymph node dissection ensures correct staging of the case and a better long-term disease prognosis [14-16]. Oncological radicality was not compromised since R0 resections in 83.9% of cases, and R1 in 13.1% of cases totaled to 97%. Unresectable tumor invasion R2 was detected in 2.9% of cases.

In our study, the lung parenchyma integrity was maintained in 83.8% of cases. Pneumonectomies amounted to 15.3%. The one-year survival was highest in segmental resections and amounted to 87% SE9 (MST – 60 months). In most leading thoracic clinics performing complex surgical interventions for lung cancer, the frequency of postoperative complications still ranges from 9 to 26.4% of the number of operations. Postoperative mortality also persists at the level of 6-9% on average [17]. A bronchial stump suture failure with the development of bronchopleural fistula and pleural empyema is one of the most severe and dangerous postoperative complications. Over the past decades, its frequency after pneumonectomy has notably decreased from 28% to 10% [18-20]. However, it remains the cause of high mortality from 16% up to 71% [21]. In our study, bronchopleural fistula developed in 3.6% of cases, but the mortality in that group of patients was rather high (60%). Anastomotic leak is a specific threatful complication of bronchial sleeve surgery, which amounts to 1.9% to 14.3% of cases [20,22]. We observed

that complication in one (4.1%) of 24 cases. Urgent surgical intervention in the amount of pneumonectomy did not save the patient's life. These figures correspond to Corinna Ludwig et al., who reported anastomotic leak during bronchoplastic lobectomy in eight (6.9%) of 116 patients, with postoperative mortality of 4.3%. The main bronchus stump failure occurred in seven (3.6%) of 194 patients, with postoperative mortality of 4.6%. 5-year survival amounted to 39% after bronchoplastic lobectomy and 27% after pneumonectomy [24].

## Conclusion

The lowest one-year survival of 67% SE10 (MST – 20.6 months) was registered after pneumonectomy, while after bronchoplastic, lobar resections, it amounted to 79%SE8 (MST – 36 months). The difference in median survival was statistically significant:  $\chi^2 = 9.7$ ,  $p = 0.045$ . Thus, we consider the extent of surgery a risk factor. The organ ectomies should be minimized since our data and the literature report high one-year mortality and low 5-year survival after such surgeries.

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