

## Bronchoanastomotic and Bronchoplastic Resections in Pulmonary Malignancy Retrospective Study 2000 - 2009

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### Rezumat

#### *Rezecțiile bronhoanastomotice și bronhoplastice în cancerul pulmonar - studiu retrospectiv 2000-2009*

Rezecțiile bronșice reprezintă procedeul chirurgical prin care se realizează întreruperea continuității bronșice, urmat de reconstrucția capetelor rezecate prin anastomoză termino-terminală sau prin diverse forme de plastie. Aceste proceduri sunt indicate în cazul tumorilor cu localizare centrală ca o alternativă a pneumonectomiei având rolul de a prezerva la maxim parenchimul pulmonar funcțional.

**Material și metodă:** Am luat în calcul rezecțiile bronhoanastomotice și bronhoplastice efectuate în clinică în perioada 2000-2009 pentru tumori bronhopulmonare maligne. Au fost 52 de rezecții bronhoanastomotice și 9 rezecții bronhoplastice, dintre acestea fiind luate în discuție 40 de rezecții bronhoanastomotice și 4 rezecții bronhoplastice (44 cazuri)  $\pm$  rezecții asociate. Am exclus cazurile cu patologie non-malignă sau la care datele necesare studiului au fost incomplete la începerea acestuia.

**Rezultate:** A fost calculată influența principalilor factori implicați în supraviețuirea postoperatorie, dintre aceștia luând în considerare tipul intervenției chirurgicale efectuate, tipul histologic implicat, stadiul TNM, precum și factori caracteristici lotului studiat (vârstă, sex). Conform studiului efectuat au fost găsite corelații semnificativ statistice ale prognosticului, legate de histopatologia afecțiunii maligne, cu o supraviețuire mai

bună în cazul carcinoidului pulmonar, în special a celui tipic. Stadiul TNM nu influențează semnificativ supraviețuirea, însă afectarea ganglionară N2 conform statisticii, prezintă un prognostic rezervat. Vârsta este un alt factor cu semnificație statistică asupra prognosticului, pacienții peste 65 de ani având o supraviețuire postoperatorie slabă.

**Concluzii:** În cadrul patologie maligne pulmonare, rezecțiile bronhoanastomotice și bronhoplastice reprezintă o soluție eligibilă, însă trebuie să ținem cont de vârsta pacienților propuși pentru operație, tipul histopatologic implicat precum și de afectarea ganglionară N2.

**Cuvinte cheie:** rezecții bronhoanastomotice, rezecții bronhoplastice, supraviețuire

### Abstract

Bronchial resections are surgical procedures in which bronchial continuity is interrupted, followed by reconstruction of resected ends through terminal anastomosis or various forms of plastic procedures. The purpose of these interventions is to preserve functional lung parenchyma. These procedures are indicated in tumors with central location as an alternative to pneumonectomies, serving to preserve maximum functional lung parenchyma.

**Material and Methods:** We considered bronchoanastomotic and bronchoplastic procedures performed in our clinic over the period 2000-2009, for malignancy. There were 52 bronchoanastomotic resections and 9 bronchoplastic resections of which we analysed 40 bronchoanastomotic resections and 4 bronchoplastic resections (44 cases)  $\pm$  associated resection. We excluded cases with non-malignant pathology or those with incomplete data at the beginning of the study.

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**Results:** The importance of the main factors involved in relation with survival was calculated. We considered the type of surgery performed, histological type, TNM stage, and characteristics of the study group (age, sex). We found statistically significant correlations between survival and histopathology of malignancy with a better survival for lung carcinoids, especially for typical carcinoid tumors. TNM stage did not significantly influence survival, but N2 nodal involvement, according to the statistics, shows a poor prognosis. Age is another statistical significant factor correlated with postoperative life expectancy, patients over 65 years old having a worse postoperative survival.

**Conclusions:** In the corresponding lung malignant pathology, bronchoanastomotic bronchoplastic resections are indicated, but one must take into account the patient's age before submission to surgery, the histopathologic type and N2 nodal involvement.

**Key words:** bronchoanastomotic resections, bronchoplastic resections, survival

## Introduction

Bronchoanastomosis represents the resection of a bronchial segment along the whole circumference, followed by rebuilding of the bronchial continuity (end-to-end). In bronchoplastic resections the bronchial wall is only partially sectioned and it is rebuilt by a plastic procedure: either by transverse suture "wedge - resection", or in some cases by coverage with a flap from the healthy side opposite to the lesion.

Bronchial anastomoses include bronchial resections without removal of lung parenchyma (right main stem bronchial resection, left main stem bronchial resection, intermediary bronchial resection) and also those that associate lung parenchyma removal (upper right lobectomy, upper left lobectomy, middle lobectomy, upper bilobectomy, lower bilobectomy "reverse sleeve - resection" and lower left lobectomy).

Bronchoplastic resections include interventions without lung parenchyma involvement - "wedge bronchial resection" and those that involve lung parenchyma: upper right lobectomy, middle lobectomy, upper left lobectomy, lower left lobectomy, and lower right lobectomy with its two variants: "stair" bronchial resection (Horvat procedure) and "flap" bronchial resection (1).

Bronchoanastomoses and bronchoplastic procedures are most often indicated for lung cancer, but also for benign endobronchial tumors, benign bronchial stenoses, and, rather infrequently, for post-traumatic bronchial ruptures.

## Material and Methods

In the Thoracic Surgery Clinic (Central Military Hospital - Oncology Institute of Bucharest) 52 bronchoanastomotic

and 9 bronchoplastic resections for various pathologies were performed over a period of 10 years (2000-2009). Out of these 44 surgical interventions for lung cancer (40 bronchoanastomotic resections and 4 bronchoplastic resections) were taken into account.

The analysed lot comprised of 37 men (84.09%) and 7 women (15.91%), with ages ranging from 16 to 78 years, the mean age being 54 years.

The analysed data was obtained from surgical notes, patient charts, pathology report archives, survival being calculated with the help of information obtained from the Population Records Service as well as individual follow-up of postoperative evolution of patients included in the study. Statistical analysis was performed with the help of specialized software.

## Results

According to type the following surgical interventions were performed: 28 bronchoanastomotic upper right lobectomies, 3 bronchoanastomotic upper left lobectomies, 3 bronchoanastomotic upper right bilobectomies, 2 bronchoplastic upper left lobectomies, 2 right pneumonectomies with tracheobronchial anastomosis, 2 intermediary bronchus segmentary resections, one bronchoplastic lower right lobectomy, one main left bronchus segmentary resection, one bronchoplastic middle lobectomy, one upper right lobectomy tracheobronchial anastomosis.

Out of these some interventions associated other types of resections: partial pericardial resection followed by pericardoplasty along with right pneumonectomy with tracheobronchial anastomosis, pulmonary artery angioplasty during a bronchoanastomotic upper right bilobectomy and a non-anatomical Fowler segment resection along with a bronchoanastomotic upper right lobectomy.

The cases presented above had diverse malignant pathologies, limiting often times the indication for segmentary bronchial resection. These were performed for bronchial carcinoid tumors (2 intermediary bronchus segmentary resections and one segmentary resection of left main bronchus for an atypical carcinoid tumor). Bronchoanastomoses and bronchoplastic resections with lung parenchyma removal were performed for a wider range of pathologies, as follows: bronchoplastic and bronchoanastomotic lobectomies were performed for 8 atypical carcinoids, 5 typical carcinoids, but also for 15 epidermoid carcinomas, and 8 adenocarcinomas. Upper bilobectomies were performed in three cases diagnosed with epidermoid carcinoma, and the 2 right pneumonectomies with tracheobronchial anastomosis were performed for adenocarcinoma (1 case) and epidermoid carcinoma (1 case).

We calculated statistical correlations between survival rate and the type of surgical intervention on our lot of patients. The lot was divided in 4 groups according to the number of surgical interventions performed. In "other" surgical interventions which were performed less than 3 times and for which we couldn't have otherwise calculated statistical correlation to survival. We obtained a  $p =$

0,121001974 – without statistical significance between the type of surgical intervention and survival (Fig. 1).

According to the histological type of malignancy we identified: 19 cases of epidermoid carcinoma, 9 cases of adenocarcinoma, 9 cases of atypical carcinoids and 7 cases of typical carcinoids, the analysis performed showing a statistically significant correlation between the type of cancer being resected and survival with a  $p=0,010613811$  (Fig. 2).

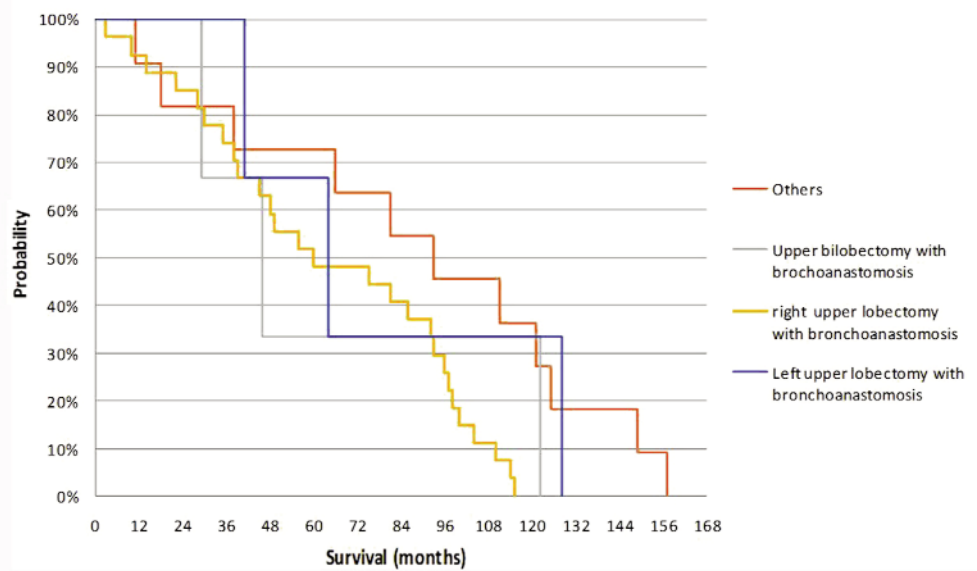
According to the 7<sup>th</sup> TNM staging we analysed 19 stage I cases (18 stage IB and 1 stage IA), 15 stage II cases (8 stage IIA and 7 stage IIB), and 10 stage III cases (9 stage IIIA and 1 stage IIIB). We looked for statistical correlation between survival and TNM stage, and also according to T and N. (Tables. 3, 4, 5).

We can observe better survival rates, statistically significant, for patients with stage IIA disease, without finding significant correlations for the other stages.

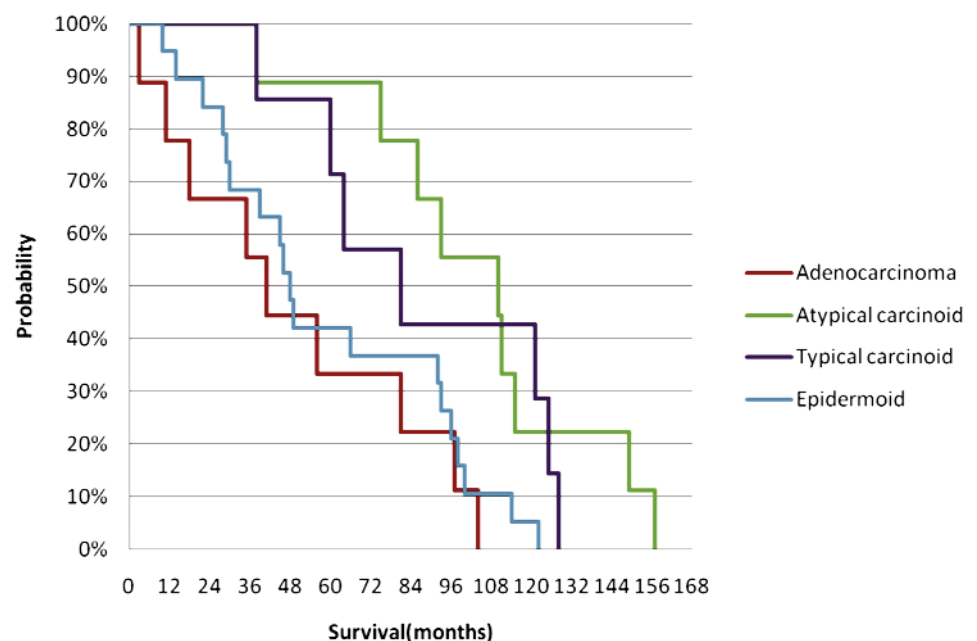
Patients with T1, T1a respectively, have the best survival rates, this being statistically significant. On the other hand patients with T3 at the time of surgery have a poorer prognosis, without attaining statistical significance in our lot of patients. N2 involvement is associated with lower survival rates, highly significant statistically, N0 and N1 having better survival rates without statistical significance.

Patient age influences postoperative prognosis, patients over 65 years of age having a nefarious evolution comparatively –  $p=0.048863564$  (Fig. 3).

**Figure 1.** Correlations between survival rate and the type of surgical intervention



**Figure 2.** Correlation between the type of cancer being resected and survival



**Table 1.** Correlation between survival and TNM stage

Stage	Median survival (months)	Standard deviation	Correlation (Pearson coefficient)	p
IA	125.00	0.00	0.20	0.18
IB	70.67	30.60	-0.01	0.93
IIA	99.57	40.74	0.29	0.05
IIB	71.00	41.91	-0.00	0.98
IIIA	50.44	39.64	-0.26	0.08
IIIB	18.00	0.00	-0.20	0.18

**Table 2.** Correlation between survival and descriptor T

Descriptor	Median survival (months)	Standard deviation	Correlation (Pearson coefficient)	p
T1	119.5	29.23	0.37	0.01
T1a	157	0	0.32	0.03
T1b	107	22.68	0.23	0.11
T2	72.78	33.58	0.04	0.75
T2a	73.37	35.23	0.03	0.8
T2b	81.14	36.40	0.10	0.49
T3	52.3	45.14	-0.25	0.09
T4	49.5	31.5	-0.11	0.44

**Table 3.** Correlation between survival and descriptor N

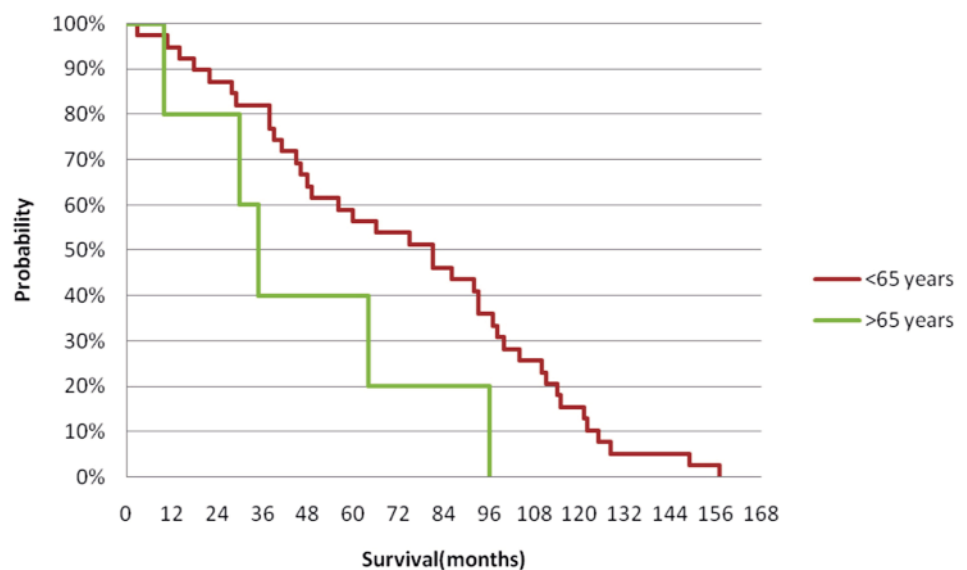
Descriptor	Median survival (months)	Standard deviation	Correlation (Pearson coefficient)	p
N0	74.84	37.15	0.10	0.51
N1	86.42	37.13	0.23	0.13
N2	32.86	31.27	-0.42	0.005

Overall survival by years, we obtained a 77.27% survival rate at 3 years postoperatively, 54,55% at 5 years and 11,36% at 10 years.

We also obtained some data pertaining to survival rate and disease stage and lymph node involvement (Table 4).

## Discussion

The importance of bronchoanastomotic and bronchoplastic resections is not to be neglected. There are a number of patients diagnosed with pulmonary neoplasm, limited respiratory

**Figure 3.** Postoperative prognosis according to patient age

**Table 4.** Overall survival by years according nodal involvement and TNM stage

Survival	N0	N1	N2
1 years	100.00%	100.00%	57.14%
3 years	84.00%	83.33%	28.57%
5 years	67.00%	66.67%	14.29%
10 years	12.00%	8.33%	0.00%
Survival	Stage I	Stage II	Stage III
1 years	100.00%	93.33%	70.00%
3 years	89.47%	80.00%	40.00%
5 years	52.63%	60.00%	30.00%
10 years	5.26%	13.33%	0.00%

function, who could not tolerate a pneumonectomy and for whom resections with preservation of lung parenchyma is a saving solution.

The immediate and late postoperative complications of pneumonectomies are not generally encountered after bronchoanastomotic or bronchoplastic resections. The 30-day post-surgery mortality rate is also reduced in comparison to that of pneumonectomies (1.3-4.1%). In our case the rate was zero.

The survival rate for lung parenchyma sparing resections is much higher compared to the survival rate for pneumonectomies. Within our study, the survival rates were 54.55% at 5 years, better than data previously published in the literature (46-48%) and 11.36% at 10 years, this being inferior to previously published data.

Of all types of bronchial resections with or without preservation of lung parenchyma, bronchoanastomotic upper right lobectomies rank first in frequency (63, 63% - in our study), with a frequency close to those presented in other studies (2-de Lyn). Frequency was much lower for other interventions: 4.54% for segmentary bronchial resections or for right pneumonectomies with tracheobronchial anastomosis, and 2.27% for upper right lobectomy with tracheobronchial anastomosis. This fact determined us to include low frequency resections in a single group, in order to obtain statistical correlations. As a result, 4 groups were formed: upper right lobectomies with bronchial anastomosis, upper left lobectomies with bronchial anastomosis, upper right by lobectomies with bronchial anastomosis and other surgical interventions. No statistically significant correlation between the type of the surgical intervention and survival rates was found. We have to mention though, the encouraging results the case of a 48 year old patient (at the date of the surgery) diagnosed with stage III lung cancer (epidermoid carcinoma), who has undergone a right pneumonectomy with carinal resection and is still alive at the date when this study was begun, with a survival of 66 months. We have also analysed within our study bronchoplastic lower right and upper left lobectomies for atypical carcinoids with survivals of 157, and 149 months respectively – still alive, no relapse.

The type of the neoplasia influenced the prognosis, statistically significant, with a remarkable prognosis for atypical carcinoids, close to the prognosis of typical carcinoids, not validating published data related to the aggressiveness of

this type of neoplasia. Of course, in this situation we have to consider the stage of the disease, as well as the characteristics of the studied lot. Patients suffering from an atypical carcinoid were diagnosed in an early stage compared to the ones diagnosed with adenocarcinoma or epidermoid carcinoma.

Histopathology also justifies the type of the performed intervention. If limited bronchial resections have been performed for carcinoids, these being known as clearly delimited tumors (1), extended resections have been primarily performed for adenocarcinomas and epidermoid carcinomas.

With regard to the TNM stage, according to our study, there is a 5-year survival rate which is comparable to the data for stage I published in literature, but superior for stages II and III (69.7% stage I, 37.1% stage II, and 8.3% stage III)(2).

Survival shows statistically significant correlation for stage IIA, while for the other stages although recording expected survival rates, the correlation is not statistically significant. The study's limit was due to the low number of patients in stages IA and IIIB (one patient for each stage), so we could not determine the statistical significance of these cases.

Concerning nodal involvement, opinions are divided with regards to performing bronchoplastic and bronchoanastomotic resections as opposed to performing pneumonectomies. While some authors agree with limited resections with preservation of lung parenchyma as long as they allow a complete resection, respecting oncological principles, there are other authors who consider these resections as useful for N0, but not for N1 and N2, regarding pneumonectomies as being more appropriate in these situations. Their argument is involvement of the peribronchial lymphatics, pneumonectomies being a curative solution for N1 and N2. (3).

The data obtained from our study shows considerable and close survival rates for N0 and N1, only N2 presenting a low survival rate, confirming the feasibility of these interventions for pulmonary neoplasia without mediastinal nodal involvement. The low survival for N2, statistically significant, confirms the controversy related to the opportunity of bronchoplastic and bronchoanastomotic resections in these situations and, according to our study, they are not indicated for N2.

There haven't been any statistically significant correlations between T and survival, except T1 where we had an index  $p=0.01$ . Even though the advanced T stages show a weaker survival rate, there is no statistically significant correlation

between the tumoral T and survival in advanced stages. There are no studies in the literature to compare our results with in this matter.

The influence of the characteristics of the lot on the survival was also calculated, and the only significant factor in late postoperative survival found was age. According to our study, ages over 65 are a negative prognosis factor.

## Conclusions

Late survival for bronchoanastomotic and bronchoplastic resections is influenced in a statistically significant manner by the histological type of the tumor, and by the stages T1 and N2 of the disease.

Although there is no statistically significant correlation between the type of surgical intervention and survival, in carefully selected cases we can obtain satisfying results despite laborious interventions.

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