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Original Research

Surgery for lung tumors in the elderly: A retrospective cohort study on the influence of advanced age (over 80 years) on the development of complications by using a multivariate risk model

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ABSTRACT

Background: The prevalence of lung cancer and other tumors is increasing among the elderly people. The purpose of this study was to examine the influence of advanced age (80 + years) on the immediate perioperative outcome as well as to define potential risk factors that may lead to increasing morbidity and mortality after lung resections.

Methods: A retrospective cohort analysis of the data from an electronic database of 208 elderly patients (165 patients ≥70 years, 45 patients ≥80 years) undergoing pulmonary anatomical resection for lung tumors during January 2013–December 2016 was conducted. The patients were initially observed and then divided into two groups: septuagenarians and octogenarians. The risk of developing postoperative complications in association with the numerous observed factors, which appeared significant in univariate tests, was assessed using univariate and multivariate logistic regression analyses to construct a risk model that assesses the highest chance of developing complications. Readmission rate and mortality within 90 days were recorded.

Results: There were 140 men and 68 women with the mean age of 76 ± 4 years. A total of 15 pneumonectomies (7.2%), 11 bilobectomies (5.3%), 27 segmentectomies (13%), and 155 lobectomies (74.5%) were performed through 84 thoracotomies (40.4%) and 124 video-assisted thoracoscopic surgery (VATS) procedures (59.6%). Ninety-one patients (44%) exhibited at least one of 113 postoperative complications. There were four deaths (1.9%). Readmission rate was 12%, and 90-day mortality was 5.3%.

There was no difference in postoperative morbidity among the groups according to their age (RR = 0.95; p = 78). According to multivariate logistic regression, adjusted Charlson Comorbidity Index≥11, $FEV_1 \leq 0.72$, DLCO≤0.57, male gender, and nonsegmentectomies appeared to be strong predictors for the development of complications.

Conclusions: In this cohort, age more than 80 years was not found to be significant for the development of complications, when compared to the septuagenarians. Female gender, better lung function (FEV1 > 72%, DLCO > 57%), less comorbidities (ACCI < 11), and segmentectomy type of lung resection were associated with improved outcomes.

1. Introduction

Lung cancer causes more deaths annually than those due to prostate, colon, and breast cancer combined [1]. It is an illness of the elderly, as the incidence of lung cancer increases with age, increasing after the age of 70 years and accelerating further after the age of 80 years [2]. Both lung cancer and metastatic lesions to the lung exhibit similar epidemiology. In particular, metastatic lung disease from colon, breast, and prostate cancers reaches its peak incidence after the age of 70 years [2].

As life expectancy increases [3], we anticipate a parallel increase in comorbidities, with approximately 67% of the elderly population having two or more comorbidities, while 14% may have six or more chronic conditions [4].

1.1. The purpose of the study

The purpose of this research was to examine the influence of advanced age (80 + years) on the immediate perioperative outcome after surgery for lung tumors as well as to distinguish among potential risk factors that may lead to increasing morbidity and mortality.

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2. Material and methods

2.1. Patient selection

This is a retrospective cohort study of data from an electronic database of a single-certified lung cancer center during January 2013–December 2016.

Exclusion criteria were preoperatively diagnosed nonmalignancy, age below 70 years, and nonanatomical lung resections.

Two hundred eight patients met the eligibility criteria and were further divided into two comparable groups. Group A consisted of 165 patients aged less than 80 years, and Group B consisted of 43 patients aged at least 80 years at the time of the surgery.

The groups were analyzed and compared according to several surgical and baseline variables that may have possible influence on the perioperative outcome; these variables included age, gender, lung function (FEV_1, FEV_1/FVC, and DLCO), body mass index (BMI), age-adjusted Charlson Comorbidity Index score (ACCI), neoadjuvant chemotherapy, neoadjuvant radiotherapy, smoking within 7 days before surgery, type of procedure (thoracotomy and video-assisted thoracoscopic surgery [VATS]), type of resection (segmentectomy, lobectomy, bilobectomy, and pneumonectomy), operating time, size of a tumor, TNM stage (8th edition) for those having lung cancer, and blood loss. All patients underwent lymph node dissection.

Postoperative mortality was defined as an occurrence of death within the hospital stay or within 30 days after surgery.

Postoperative morbidity was defined as an occurrence of complications within the hospital stay or within 30 days after surgery.

Readmission rate and mortality within 90 days were recorded.

2.2. Definitions of postoperative complications

Major complications were defined according to the general thoracic surgery database definitions of the European Society of Thoracic Surgery (ESTS) and Society of Thoracic Surgery (STS) [5].

A couple of other complications appearing in this cohort but missing in the database were also included: esophagus perforation – defined as the presence of communication between the lumen of the esophagus with surrounding structures such as the pleura or pleural cavity and/or mediastinum; heart failure – defined according to the guidelines of the European Society of Cardiology (ESC) [6]; hemothorax – postoperative bleeding with a need for surgical intervention; and pleural effusion – a symptomatic collection of fluid in the pleural cavity with a need for surgical intervention.

Pneumonia, which was also defined according to the definition of the ESTS and STS, was not observed separately from bronchitis, which was defined as the presence of a new onset of purulent sputum or fever (with no other cause) existing with a worsening of cough and/or dyspnea with or without an alteration in gas exchange with increased oxygen requirements, with increase or decrease in leucocytes (< 4000 or > 12000 WBC/mm^3), and with or without lung infiltrations radiographically and requiring antibiotic treatment together with other therapies.

2.3. Postoperative management

Pain management generally included one opioid (oxycodone) combined with a nonsteroidal anti-inflammatory medication (metamizol) at the maximum dose. This regimen was adjustable as needed for patient comfort.

After surgery, all the patients participated in active physiotherapy provided by the physiotherapy department of the certified lung cancer center. None of them received prolonged prophylaxis for deep vein thrombosis, except that they developed such complication during the hospital stay or they already had it preoperatively. None of the patients received prophylaxis for atrial fibrillation, except when those medications were introduced before admission in our department.

Table 1
Univariate analysis of the cohort stratified according to age.

Variable	Octogenarians (n = 43)	Septuagenarians (n = 165)	p
Age, years (SD)	82(2)	74(3)	
Male gender, No. (%)	29(67)	111(67)	0.98
Lung function tests			
FEV_1%(SD)	79(2)	80(2)	0.7
FEV_1/FVC (SD)	0.72(0.12)	0.71(0.11)	0.86
DLCO %(SD)[a]	75(2)	72(2)	0.36
Smoking within 7days before surgery, No. (%)	4(9)	29(18)	0.12
BMI, kg/m^2 (SD)	24(6.4)	25.5(4,8)	0.16
Preoperative chemotherapy, No. (%)	4(9)	23(14)	0.37
ACCI, Median score (IQR)	9(7–13)	9(6–11.5)	0.11
ACCI < 11	28	124	0.19
ACCI ≥ 11	15	41	
Surgery approach, No. (%)			0.9
Thoracotomy	17(40)	67(41)	
VATS	26(60)	98(59)	
Type of resection, No. (%)			
Pneumonectomy	4(9)	11(7)	0.59
Bilobectomy	1(2)	10(6)	0.2
Lobectomy	34(80)	121(73)	0.42
Segmentectomy	4(9)	23(14)	0.61
Operating time, min (SD)	178(53)	181(52)	0.77
Blood loss, Median, ml (IQR)[b]	300(200–500)	300(200–500)	0.91
Lymph nodes, Median, No. (IQR)	18(12.5–28.5)	20(15–30)	0.43
Tumor size, Median, cm (IQR)	3.5(2.1–6.35)	3.5(2.2–5)	0.4
NSCLC, Stage, 8th edition, No. (%)			
I	17(40)	53(32)	0.36
II	5(12)	36(22)	0.19
III	13(30)	50(30)	0.98
IV	4(9)	10(6)	0.49
Metastasis in the lung, No. (%)	3(7)	14(9)	0.73
Benign tumor, No. (%)	1(2)	2(1)	0.5
Complication, No. (%)	18(42)	73(44)	0.86
Mortality, No. (%)	2(4.6)	2(1)	0.19
LOS, Median, days (IQR)	10(7–13.5)	10(7–15)	0.47

SD: standard deviation; IQR: interquartile range.
FEV_1: forced expiratory volume in one second; FEV_1/FVC: Tiffeneau index; DLCO: diffusion capacity for carbon monoxide; BMI: body mass index; ACCI: age-adjusted Charlson Comorbidity Index score; VATS: video-assisted thoracoscopic surgery; NSCLC: non–small-cell lung cancer; LOS: length of hospital stay.
[a] Available for 196 patients.
[b] Available for 201 patients.

3. Statistical analysis

Statistical analysis was performed with SPSS v.23. Continuous data were compared using the unpaired *t*-test, provided that the data showed normal distribution. For the data not showing normal distribution, the Mann–Whitney *U* test as well as the Kruskal–Wallis test and Spearman's rank correlation coefficient were used. The chi-square test and Fisher's exact test were used to compare categorical variables as appropriate.

The risk of developing postoperative complication in association with the numerous observed factors, which appeared significant in previous tests, was assessed using two sets of logistic regression: a univariate model for each of the predictors to explore its independent contribution to perioperative morbidity and a multivariate logistic model to determine joint predictors for the development of the complications. The Hosmer–Lemeshow chi-square test and R-square were used to evaluate the goodness of fit of the final model. AUC – area under ROC curve – was used to measure the accuracy of the final model.

Finally, a bootstrap method involving 1000 resampling and Mersenne Twister seed with bias corrected and accelerated (BCa) confidence intervals was utilized to test whether the risk factors were robust among subsets. This work has been reported in line with the STROCSS criteria [7].