

Emergency hospital readmission after major lung resection: prevalence and related variables

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Abstract

Objective: To evaluate the rate, causes and variables related to emergency hospital readmission after scheduled major lung resection. **Setting:** An university general hospital in a managed care health system. **Methods:** Databases of 727 patients undergoing scheduled major lung resection between 1994 and 2003 have been reviewed, excluding hospital mortality from the analysis. The studied outcome was the occurrence of emergency hospital readmission by any surgery-related cause, at any centre, during the first 30 days after discharge. Independent studied variables were: age of the patient, body mass index, predicted postoperative FEV1% (ppoFEV1%), type of surgery (lobectomy or pneumonectomy), postoperative morbidity and length of stay (LOS). Descriptive statistics have been performed and forward step-wise logistic regression has been used to select predictive variables. **Results:** Rate of emergency readmission was 6.9% (50 cases); 3 patients (6%) died. Pleural empyema without bronchial fistula (18 cases) was the most frequent cause of readmission. On logistic-regression analysis, pneumonectomy (odds ratio 3.84; 95%CI: 1.98–7.45) and major postoperative morbidity (odds ratio 2.42; 95%CI: 1.26–4.66) showed independent correlation to the outcome. **Conclusions:** Readmission rate after lung resection is around 7% and it is not influenced by LOS; patients experiencing major postoperative morbidity and pneumonectomy cases have the highest probability to be readmitted within 30 days after lung resection.

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1. Introduction

Hospital readmission after major surgery is not frequently quoted as an outcome in most published series. However, unplanned readmission after a surgical procedure is a valuable indicator of quality of care [1]. In the United States, Handy et al. [2], in a thorough study of lung resection patients, have reported an 18.9% overall readmission prevalence including outpatient emergency evaluation after hospital discharge. To our knowledge there is not information in the European literature concerning readmission after major lung resection.

The main objective of this report is to evaluate the rate, causes and predisposing variables for hospital emergency readmission following major lung resection. Due to the increasing pressure on short hospital stays in the last years, we have also tried to evaluate if readmission rates are

related to length of hospital stay (LOS) or have increased in the period 2000–2003.

2. Methods

2.1. Patient population

From January 1994 to December 2003, 759 patients were scheduled for major lung resection (lobectomy or pneumonectomy) at our unit. Selection criteria for operation consisted in the absence of major co-morbidity refractory to medical therapy, PO₂ at rest over 50 mmHg, PCO₂ under 46 mmHg and ppoFEV1% over 30% of the normal value. Calculation of the ppoFEV1% was based on the number of non-obstructed pulmonary segments to be resected [3]. Patients dying in hospital after resection (32 cases, 4.2%) have been excluded from the study. At discharge all the patients were able to self-assistance, chest pain was well controlled with non-opiates, had no fever and no

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pneumothorax or large pleural effusion (except in pneumonectomy cases) were seen at chest X-ray. In cases fulfilling previous criteria, PO₂ under 60 mmHg was not considered a contra-indication for discharge and home oxygen was temporarily indicated. All patients were cited for one single follow-up visit one month after discharge.

2.2. Analysed variables and outcomes

The independent variables included in the analysis were: age of the patient, date of surgery, LOS, body-mass index (BMI), ppoFEV1 value—as a percentage of the normal—extent of resection (lobectomy or pneumonectomy), post-operative major cardio-respiratory or technique-related morbidity (pulmonary atelectasis or pneumonia, need of mechanical ventilation at any time after extubation in the operating room, pulmonary thromboembolism, arrhythmia, myocardial ischemia or infarct, clinical cardiac insufficiency, pleural empyema, bronchial fistula and air leak through chest drains over five days, preventing patient discharge). All studied variables were recorded on a customized computerized database.

The studied outcome was the occurrence of emergency hospital readmission at any centre during the first thirty days after discharge. Information regarding readmission was obtained from hospital records if the patient was readmitted in the same centre, or by phone call in cases readmitted elsewhere. In the last cases, patients were asked to send medical records containing readmission diagnosis. All empyema cases were admitted or transferred to our centre and underwent bronchoscopy to evaluate the presence or absence of bronchial fistula. To assess the influence of the date of surgery on readmission rates, 'date of surgery' variable was converted in a binary one (1994–1999 and 2000–2003).

2.3. Statistics

Descriptive statistics have been performed. Influence of binary variables have been assessed by Fisher's exact test and influence of continuous variables by ANOVA test (parametric values) or Mann–Whitney test (non-parametric values).

All variables entered in a forward step-wise logistic-regression analysis. The likelihood-ratio test was the criterion for determining variables to be removed from the model. Goodness of fit was estimated by Hosmer and Lemeshow test.

3. Results

428 cases were operated on in the period 1994–1999 and 299 in the period 2000–2003. Surgery was indicated in most patients (83.5%) for lung neoplasm. Lobectomy was performed in 539 cases (74.1%) and pneumonectomy in

Table 1
Causes of readmission

Diagnosis	n	%
Pneumonia	5	10
Pleural empyema	18	36
Bronchial fistula	5	10
Pneumothorax	5	10
Wound infection or dehiscence	2	4
Respiratory insufficiency	3	6
Chylothorax	1	2
Cardiac insufficiency	3	6
Pulmonary embolism	2	4
Fever, unknown cause	4	8
Gastric bleeding	1	2
Metastatic disease	1	2
Total	50	100

188 (25.9%). Mean FEV1_{ppo} was 63.6% (SD 17.6); mean BMI was 25.6 (SD 4.2). Median LOS was 8.2 days (range 3–40). Major postoperative morbidity was recorded in 131 patients (18%). Readmission rate was 6.9% (50 patients), most of them (30 cases) were readmitted in our hospital. Although LOS was lower in the 2000–2003 period (1994–1999 median LOS 7 days; 2000–2003 median LOS 6 days; $P < 0.001$), no statistical differences were found in readmission rates depending on the date of surgery (1994–1999 period, 9%; 2000–2003 period, 5.4%; $P = 0.073$).

Causes of readmission are depicted in Table 1, pleural empyema without bronchial fistula being the most frequent (18 cases). Three readmitted patients died (6%). Causes of death were: bronchial postpneumonectomy fistula, pulmonary embolism and undisclosed metastatic disease, one case each.

On Tables 2 and 3, respectively, univariate analysis of binary and continuous variables are shown. LOS had no influence on readmission rate (median LOS was 7 days in both groups; $P = 0.13$).

Pneumonectomy ($P < 0.01$; odds ratio: 2.42; 95%CI: 1.26–4.66) and postoperative morbidity ($P < 0.01$; odds ratio: 3.84; 95%CI: 1.98–7.45) were the variables independently related to readmission on logistic regression analysis (Table 4).

Table 2
Univariate analysis of binary variables (Fisher's exact test)

		Readmitted, n (%)	P
Type of resection	Pneumonectomy (n = 188)	23 (12.2)	0.001
	Lobectomy (n = 539)	27 (5)	
Diagnosis	Neoplasm (n = 607)	46 (7.6)	0.06
	Other (n = 120)	4 (3.3)	
Postoperative morbidity	No (n = 596)	30 (5)	<0.001
	Yes (n = 131)	20 (15.3)	

Table 3
Comparison of continuous variables

	Age, Mean (SD)	ppoFEV1%, Mean (SD)	BMI, Mean (SD)	LOS, Median (range)
Non-readmitted <i>n</i> = 677	62 (11.7)	64 (17.3)	25.6 (4.3)	7 (3–40)
Readmitted <i>n</i> = 50	64.8 (7.9)	57.7 (20.4)	25.3 (3.6)	7 (4–28)
<i>P</i> value	0.1*	0.03*	0.73*	0.13**

BMI, body mass index; ppoFEV1%, predicted postoperative FEV1%; LOS, length of stay; *, ANOVA; **, Mann-Whitney test.

4. Discussion

Controversy exists over the validity of early readmission as an indicator of quality of care [4,5]. For years, readmission has been associated to pressure on medical resources and inappropriate short LOS [6], but several medical [7] and surgical [8] studies failed to demonstrate a correlation between short LOS and readmission. Even extra-short LOS has not been reported to increase readmission rates [9,10]. On the contrary, prolonged LOS seems to be related to readmission [1,11–13] maybe because more complex patients need more in-hospital days [1,14]. In our series, we have found a tendency to higher readmission rates in the years 2000–2003 but differences are not statistically significant. Today, there is enough evidence correlating substandard medical care and readmission rates, hence the importance of recording readmission as a significant outcome in clinical settings [4,15].

In the medical literature, readmission has been defined in several ways. Early emergency readmissions are the most relevant to be measured since they result from the medical intervention rather than from the natural evolution of disease, thus resulting preventable outcomes [1]. In the only publication we have found dealing readmission following lung resection [2], the authors have included admission in the emergency department, without further in-hospital period, as a readmission episode. In this publication, the rate of readmissions is 18.9% but only half of their readmitted cases need in-hospital stay; then, in-hospital readmission in their series is around 9% comparable to our data. In coronary bypass patients, decreasing length of stay is followed by increased use of post acute services [8,11]; probably, Handy et al. [2] rate of emergency department visits could have been reduced implementing a more intensive follow-up program.

Knowledge of variables related to readmission facilitates designing specific programs to avoid preventable readmissions. Our study and Handy's et al. report [2] coincide to underline that pneumonectomy cases have higher readmission rate; then, specific follow-up programs should be developed. Three variables have been reported to increase the readmission risk in surgical patients: long

Table 4
Multivariate logistic-regression model for readmission

Variable	β	<i>P</i>	Odds ratio (95%CI)
Pneumonectomy	0.884	0.008	2.42 (1.26–4.66)
Major morbidity	1.347	<0.001	3.84 (1.98–7.45)
Constant	–3.368	<0.001	

Hosmer–Lemeshow statistic *P* = 0.48.

surgical stay, a high Charlson co-morbidity index score [16] and 6-months previous non-surgical hospitalisation [1]. In this study, LOS shows no correlation to readmission and we have not analysed previous episodes or co-morbidity index. According to Birim et al. [17], Charlson index is strongly correlated with high risk of lung cancer surgery. In a previous report [18] we failed to demonstrate correlation between co-morbidity and post-operative major postoperative morbidity, then we excluded co-morbidity from this analysis.

We have shown that postoperative morbidity is related to readmission episodes. These have to be clarified, for we have included cardio-respiratory and technical morbidity as a whole in this series. It can be assumed that prolonged air-leak can be related to several readmission diagnosis such as pneumothorax or pleural empyema but we lack statistical power to calculate due to limited number of cases.

Studying preventable readmissions, no specific time interval has been justified in the literature. According to some reports, most preventable readmissions occur in the period 10–31 days after discharge [1,18,19]; so we have selected a 30 day cut-off. In Handy's et al. report [2] it is stated that many readmissions are missed if only 30 days post-discharge are considered. In our opinion, readmissions after 30 days of discharge are more probably not directly related to the operation but we have to admit a possible bias due to studied period of time.

To conclude, readmission rate after lung resection is around 7% and it is not influenced by LOS; patients experiencing postoperative morbidity and pneumonectomy cases have the highest probability to be readmitted 30 days after lung resection. Further studies are needed, including larger databases, to evaluate the influence of different types of postoperative morbidity on readmission risks.

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