ORIGINAL ARTICLE

One year prospective analysis of morbidity and mortality associated with thoracic surgery

Udita Naithani, M.D.*, Pramila Bajaj, M.D., F.I.C.S., F.A.M.S.**, Neelesh Bhatnagar, M.D.***, Narendra Prasad C. M.B.B.S.***

**Assistant Professor, **Sr. Professor & Head, ***PG Student*
Department of Anaesthesiology & Critical Care, R.N.T. Medical College, Udaipur (India)

Correspondence: Udita Naithani, Assistant Professor. Department of Anesthesiology & Critical Care, R.N.T. Medical College, Udaipur, (India)

ABSTRACT

Objectives: To evaluate the morbidity and mortality associated with thoracic surgery in adult patients over a period of one year.

Design: Prospective, descriptive, clinical study.

Methodology: Thirty patients (24 men and 6 women), who underwent various thoracic surgeries over a period of one year (1 December 2008 to 31 December 2009), w ere studied. The primary outcome was discharge from the hospital within 14 days after surgery.

Results: The mean age of the patients was 28.37±14.12 yrs. The surgical procedures were as follows: 13(43%) decortications, 6(20%) thoracoplasty, 6(20%) excision of a cyst, 2(7%) segmentectomy, 2(7%) lobectomy, and 1(3%) pneumonectomy. Mean duration of surgery and anaesthesia were 134.5±44.79 min and 144.5±45.59 min respectively and most of the patients [26/30(87%)] w ere extuabted in the operating room. T wenty (68.97%) patients were discharged from the hospital ²14 da ys, while 9(31.03%) required hospitalization for >14 days. Factors associated with prolonged hospital length of stay (>14 days) included: long duration of smoking, low FEV1, metabolic acidosis; higher intraoperati ve blood loss and long er duration of surgery.

Conclusion: We conclude that patients having above risk factors should be aggressively managed and monitored intra and postoperatively.

Keywords: Lung surgery; Outcome; Mortality; Postoperative complications

Citation: Naithani U, Bajaj P, Bhatnagar N, Prasad CN. One year prospecti ve analysis of morbidity and mortality associated with thoracic surgery. Anaesth Pain & Intensive Care 2011;15(2):86-92.

INTRODUCTION

Thoracic surgery is the means to diagnose and treat many benign and malignant lesions of the lungs[1]. Despite advances in anesthesia and perioperative care, complications such as myocardial ischemia, thromboembolism, infection and haemorrhage etc. still do occur .[2] T he incidence of perioperative mortality associated with thoracic surg ery ranges from 1-12%,[3,4] and postoperative cardiopulmonary complications may occur in 30-60% of cases.[5] Risk factors influencing outcome in lung surg ery are male g ender, polytrauma, advanced age, chronic smoking, previous stroke, severe chronic lung disease with FEV1<70% of the predicted value, prior radiation therapy, and underlying comorbid conditions including heart disease, uncontrolled diabetes, renal failure, and immunodeficiencies.[6] The risks and benefits must be weighed carefully for thoracic surgery.[7] The purpose of this study was to evaluate the morbidity and mortality associated with thoracic surg ery in adult patients at our institution and to identify risk factors associated with prolonged length of hospital stay.

METHODOLOGY

The hospital ethics committee approved the study, but waived the need for a consent since it was an observational study and the surgical approach and the perioperative interventions were not altered. All consecutive patients undergoing thoracic surgery for various indications over a one year period from 1 December 2008 to 31 December 2009 were included in this study.

Preoperative evaluation included a complete history, physical examination, complete blood count, biochemical profile, chest roentgenograms, ECG, arterial blood gas analysis, spirometry and computed tomographic scan of the chest and abdomen. The thoracotomy was performed through either a postero-lateral thoracotomy incision (with the patient in the lateral position) or an anterior minithoracotomy. All procedures were performed by the same surgeon and the periopertive care was delivered by the same group of anesthesiologists and chest physicians.

Patients were premedicated with glycopyrrolate, ondansetron, and fentanyl. Anesthesia was induced with intravenous thiopentone sodium or propofol, neuromuscular blockade was established with intravenous rocuronium or succinylcholine followed by intubation with either single or double lumen endotracheal tube. Anesthesia was maintained with isoflurane inhalation. Intravenous vecuronium/atracurium used as needed. At the end of surgery, reversal agents (neostigmine and glycopyrrolate) were given. Those patients who regained adequate muscle power and maintained a satisfactory arterial saturation were extubated; otherwise they were transferred to the Intensive Care Unit (ICU) for ventilatory support.

Prophylactic antibiotics, bronchodilators, steroids were given routinely to all patients.

Patient's preoperative clinical characteristics, investigations, diagnoses, surgical and anesthesia details and postoperative complications were recorded in proforma.

- Operative mortality was defined as any death occurring within 30 days of operation or after 30 days, in patients who remained admitted in the hospital since the time of operation.
- Major complications were defined as non-fatal life-threatening events occurring within the first 30-postoperative days, if pharmacological or technical support was required, permanent disability ensued or if life expectancy was threatened, and classified as
- **Cardiovascular:** Myocardial infarction, hypotension requiring vasopressors, heart failure, arrhythmias, pulmonary embolism etc.
- **Respiratory:** Respiratory failure requiring ventilatory support, persistent intercostal drainage for more than two weeks and/or persistent air leak for more than seven days.
- Central nervous system complication - Stroke, convulsion etc.
- Renal complication - renal insufficiency
- Reoperation
- Haemorrhage
- Minor complication - fever, localized wound infection etc.

Statistical analysis:

Adverse outcome was defined as delayed discharge of patient (>14 days) assuming that any postoperative complication within 30 days will cause delay in the discharge of patient.

Risk factors for adverse outcome were calculated by univariate analysis, using chi-square and student t-test with $p<0.05$ as significant. Multivariate logistic regression analysis was done to determine true independency of variables.

RESULTS

Thirty patients underwent thoracic surgery over a period of one year period with a mean age of 28.37±14.12 yrs; 24(80%) males and 6(20%) females (Fig. 1). All patients presented with dyspnea (n=30), cough was present in 26(86.7%), chest pain in 19(63.3%) and history of tuberculosis in 24(80%). 17(56.67%) patients were smokers of which 10 (33.3%) stopped smoking before surgery (Table 1). The chest radiographs showed opacities in 21 (70%) patients and pleural effusion in 17 (57%) patients. Comupterized tomography (CT) of the chest showed fibrosis in 26(86.7%) and pleural effusion in (22(73.3%). Preoperative ABG analysis and FEV1 is shown in Table 2.

Patients' preop diagnoses are shown in Table 3.

All the patients received antibiotic, bronchodilator & steroids treatment while 18(60%) patients had had postural

Table 1 : Distribution of patients according to history of smoking and duration

	Duration (yrs)	No. (%)
	<5	2(6.67)
Positive history	5-10	4(13.33)
	10-15	3(10)
	15-20	4(13.33)
	> 20	4(13.33)
	Total	17(56.67)
	<1	1(3.33)
Stopped Smoking	1-6	3(10.00)
	6-12	1(3.33)
	>12	5(16.66)
	Total	10(33.33)

Table 2: Preoperative arterial blood gas (ABG) analysis & FEV1

ABG parameters		No. (%) (n=30)
pH	Mean pH = 7.41 ± 0.08	
	< 7.35	5(16.7)
	7.35-7.45 (N)	14(46.7)
	> 7.45	11(36.7)
pCO2	Mean pCO2 = 39.36 ± 7.72 mmHg	
	< 35	6(20)
	35-45 (N)	21(70)
	> 45	3(10)
pO2	Mean pO2 = 70.85 ± 25.02 mmHg	
	> 60 (N)	30(100)
HCO3	Mean HCO3 = 24.63 ± 3.93 mEq/L	
	< 22	8(26.7)
	22-28 (N)	15(50)
	> 28	7(23.3)
BE	Mean BE = -0.04 ± 4.33 mEq/L	
	< -3	8(26.7)
	-3 to +3 (N)	15(50)
	> +3	7(23.3)
FEV1 (%)	Mean FEV1= 68.38±14.95%	
	³80 (nor mal)	8(26.7)
	79-60 (mild)	15(50)
	59-40 (moderate)	5(16.7)
	39-30 (severe)	2(6.7)

drainage before surgery. Surgeries were done in either left lateral, right lateral or supine position in 18(60%), 9(30%) and 3(10%) of the patients respectively. Single lumen tube was used in 27(90%) and double lumen endotracheal tube in 3(10%). Intraoperatively, 8(26.7%) patients had episodes of hypotension out of which 3(10%) required dopamine infusion. Mean blood loss w as 499.0±287.79 ml. Blood was transfused in 17(56.67%) patients. Mean duration of surgery and anesthesia w ere 134.5±44.79 min and 144.5±45.59 min respectively (Table 3).

Table 3: Duration of surgery and day of discharge in v arious surgical procedures

	Decortication (n=13)	Thoracoplasty (n=6)	Excision (n=6)	Segmentectomy (n=2)	Pneumonectomy (n=1)	Lobectomy (n=2)	Total (n=30)
(A) **Duration of surgery (min) Mean=134.5±44.79**							
90-120	2	1	5	2	0	0	10
120-150	7	3	1	0	0	0	11
150-180	2	1	0	0	0	1	4
>180	2	1	0	0	1	1	5
(B) **Discharge (days) Mean=14.03±8.41**							
0-10	4	3	3	1	0	0	11
10-20	6	1	2	1	1	2	13
20-30	2	0	0	0	0	0	2
>30	1	1	1	0	0	0	3

26(86.7%) patients were extubated in the OT as compared to 3 patients (10%), who w ere extubated in the ICU (p=0.001), and one patient (3.3%) could not be extubated and died on 4th day.

Mean duration of discharge was was 14.03±8.41 da ys (range 6-38 days). 20 (68.79%) patients were discharged ² 14 days defined as better outcome (Group A) and 9 (31.03%) were discharged > 14 days defined as poor outcome (Group B). Mean duration of discharge was significantly less in Group A (9.842 da ys) as compared to Group B (23.77 days) ($p < 0.05$).

Outcome analysis: Outcome analysis , including complications is given in Table 4.

Risk factors for adverse outcome (Table 5): Age was not found as risk factor since mean ag e was comparable in

Table 4: Distribution of major and minor complications (n=14)

Patient No.	Major complications (N=6)		Minor complications (N=16)			
	Vent. Support	Persistent intercostal damage	Hypotension	Fever	Wound infection	Day of discharge
1		+				38
2		+		+		20
3	+		+	+		23
4	+			+		9
5	+				+	15
6				+		19
7				+		12
8				+		9
9					+	14
10					+	37
11				+	+	16
12				+	+	10
13				+	+	30
14				+		16
Total N(%)	3 (10%)	2 (6.67%)	1 (3.33%)	10 (33.3%)	6 (20%)	268 (14)

Note: One patient expired.

Table 5: Comparison of patients with better vs, adverse outcome*

Factor	Total (n=29)	Group A (Better outcome) (n=20)	Group B (Adverse outcome) (n=9)	p
Female (n)	n=6	n=6	n=0	0.000
Non-smoker (n)	n=13	n=12	n=1	0.010
Duration of smoking (yrs)	7.0±8.19	3.60±6.17	12.56±6.98	0.002
FEV1 (%)	68.38±14.95	75.06±9.14	58.0 ± 15.62	0.002
HCO3 (mEq/L)	24.63±3.93	25.29 ± 3.67	21.62 ± 2.82	0.037
BE (mEq/L)	-0.04±4.33	0.84 ±4.13	-3.32 ± 3.69	0.040
SPO2 (%)	97.7±1.78	98.25 ± 1.65	96.78 ± 1.56	0.032
Blood loss (ml)	499.0±287.79	396.0±148.34	616.67±283.95	0.010
Duration of surgery (min)	134.5±44.79	117.0±26.33	173.33±56.24	0.001
Duration of anesthesia (min)	144.5±45.59	127.0±27.02	183.89±57.33	0.001
No episode of hypotension (n)	22	18	4	0.003
No blood transfusion (n)	13	11	2	0.020
Extubation in OT (n)	26	19	7	0.03
Postoperative complications (n)	14	5	9	0.00

*Values expressed as number (n) or mean±SD.

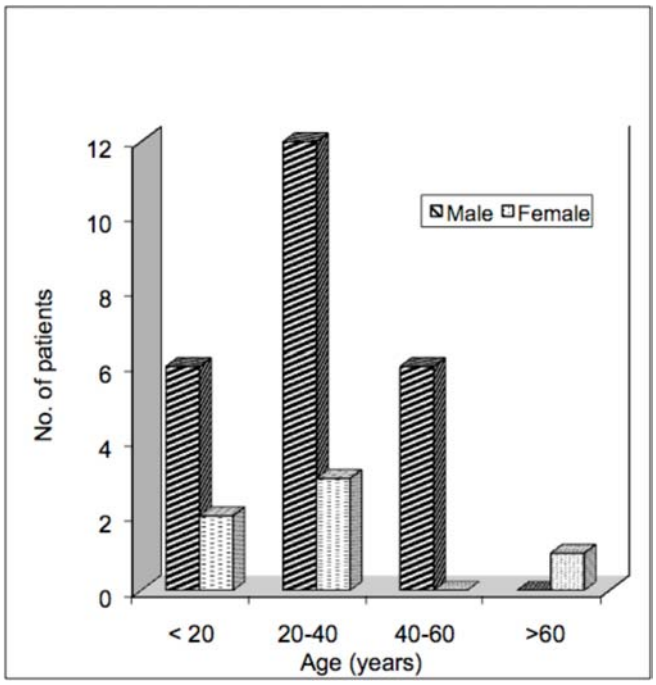

Fig 1: Distribution of patients according to age and sex

group A and B (24.75 and 34.56 years respectively). Female gender (p = 0.00) and non-smoking (p = 0.01) were associated with better outcome. Longer duration of smoking (p = 0.002), low FEV1 (p = 0.002), low SpO2 (p = 0.032), metabolic acidosis shown by lower HCO3- (p = 0.037) and lower base excess (p = 0.04) were associated with adverse outcome.

The patients who did not have any episode of hypotension (p = 0.003), did not receive blood transfusion (p = 0.02) and were extubated in OT (p = 0.030) had better outcome. More blood loss (p = 0.01) and longer duration of surgery (p = 0.001) were found as risk factors for adverse outcome.

However when multivariate analysis was done, none of the above risk factors was found to be independently associated with adverse outcome.

DISCUSSION

Outcome analysis studies determining the potential risk factors for adverse outcome are useful for many reasons[8], since they allow the medical team to weigh the risks of an operative procedure against the risk of death from an untreated lesion or opt for less invasive procedures or non-surgical alternatives in very high risk cases. Furthermore, the outcome data provide the basis of quality control management in a particular institute and comparison of therapeutic strategies with other institutes.

The present outcome analysis included all types of lung surgeries undertaken for variable diagnoses; however, most of the authors conducted outcome analysis in a specified group of lung carcinoma[8, 9], hydatid cyst, [10] pneumonectomy[8,12,13] or lobectomy[11] to determine risk factors for poor outcome. We found higher incidence of lung surgery among males (80%) comparing well with other authors (80%[8], 70%[14], 64%[12]). Mean age has been shown to be higher in patients operated for lung cancer (62 and 56.1 years)[8,14] as compared to our study, which comprised of all types of cases. A study done in patients of pulmonary hydatid cyst compares with our study (26.4 vs. 28.4 years).[10]

The incidence of TB was 48.8% in a study done in lung volume reduction surgeries[15] as compared to our study (80%). There were 30% patients having coexisting anaemia in our study though it was not found as a risk factor for poor outcome as reported earlier[16]. In our study comorbidities involving other systems were not present in any patient, in contrast to other studies where coronary artery disease, heart disease, ASA III & IV were reported as independent risk factors for poor prognosis .[8,17,18,19]

DLT was used in 10% surgeries including lobectomy (n=2) and pneumonectomy (n=1) in our study, rest were done using single lumen tube since adequate surgical access could be achieved for most of the lung surgeries without collapsing a lung, by ventilating the patient with smaller tidal volumes and the surgeon using a retractor.20 However, if the surgeon is not used to operating with an inflated lung, or if the tumor resection is technically difficult, one lung ventilation (OLV) will be required. Thoracoscopic surgery is impossible without collapsing a lung. OLV is also indicated to protect the other (healthy) lung from becoming contaminated by blood, pus or debris . During the course of one lung anesthesia mean PaO2 values using FiO2 of 1 falls from approximately 400 mmHg to a nadir of 200 mmHg at 20-30 min. So OLV should be used when necessary and for minimum period.[20] The use of highest possible FiO_2 during one lung anaesthesia21, continuous positive airway pressure (CPAP) to the non-ventilated lung[22] and a trial of adding 5 cm PEEP to the ventilated lung is warranted.[23]

In present study, incidence of mortality (3.33%) was comparable to others (2.2%[11], 2.9[12], 3.28). Life threatening complications were reported in 2%[8], 8.8%[12], 27%[11] by other authors, as found in our study (20% major complications).

Most of the authors[11,12] determined risk factors for adverse outcome defined as mortality or major complications. In

contrast, in our study, the sample size was small (n=30) and hence the incidence of mortality and major complications was small to calculate statistically significant risk factors, so we have determined risk factors for adverse outcome which was defined as delayed discharge of patient (> 14 days).

Age more than 70 years[11] or 65 years[24] has been reported as an independant risk factor associated with the development of postoperative pulmonary complications which necessitated an increased length of hospital stay or other adverse outcome in contrast to our study.

Male gender has been reported as a risk factor for adverse outcome[12]. In our study female gender was associated with a better outcome and all females patients were discharged in < 14 days. All females in our study were non-smokers. Smoking has been reported by many as a risk factor for adverse outcome[11,12] and significantly more pulmonary complications occur in smokers as compared to non-smokers.[25] In our study out of 13 non-smokers, 12 (92.3%) were in group A indicating non-smoking is associated with better outcome (p = 0.01)and long duration of smoking was found to be a risk factor for adverse outcome (p = 0.02).

We observed low FEV1 < 70 as a risk factor for adverse outcome as found by others.[9,17,12] Low SpO_2 and metabolic acidosis (low HCO_3 and base excess) were also associated with adverse outcome as reported earlier that preoperative arterial pO_2 and pCO_2 have been suggested as predictors for long term morbidity.[26]

Survival rates have been found significantly better in the non-transfusion group, with an exception of non-small cell lung carcinoma patients.[16,27,28] Similarly in our study the patients who did not receive transfusion (p = 0.02) and not had any episode of hypotension (p = 0.003) during surgery had better outcome. Our observation that longer duration of surgery and anaesthesia was associated with adverse outcome compared well with earlier reports.[11,18,19] The presence of postoperative major complications caused delay of discharge of patients as reported previously.[19,24]

There were some limitations of our study; it was a single centre study and extended over a small time period of one year resulting in a small sample size of only 30 patients. So risk factors could not be calculated for mortality/major complications, instead adverse outcome was taken as delayed discharge of patient.

CONCLUSION

We conclude that better outcome was associated with female gender, no episode of hypotension, no blood transfusion and early extubated in the OR. Preoperatively, long duration of smoking, low FEV1, metabolic acidosis; intraoperatively more blood loss, long duration of surgery and development of postoperative complication/s were found as risk factors for adverse outcome. High level of vigilance and expert intraoperative and postoperative management is essential to avoid adverse outcome.

A multicentre study, extending over a longer period, allowing a larger sample size, should be undertaken to calculate risk factors for major complications as well as mortality.

REFERENCES

1. Norman M et al. Improved lung function and quality of life following increased elastic recoil after lung volume reduction surgery in emphysema. Respiratory Medicine 1998;92:653-658.

2. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg 2002;183:630-641.

3. Wada H, Nakamura T, Nakamoto K, Maeda M, Watanabe Y. Thirty-day operative mortality for thoracotomy in lung cancer. J Thorac Cardiovasc Surg 1998;115:70-73.

4. Weiss W. Operative mortality and five-year survival rates in men with bronchogenic carcinoma. Chest 1974;66:483-487.

5. Duque JL, Ramos G, Castrodeza J, Cerezal J, Castanedo M, Yuste MG, Heras F, Grupo Cooperativo de Carcinoma Bronchogenico de la Sociedad Espanola de Neumologia y Cirugia Toracica. Early; complications in surgical treatment for cancer: a prospective multicentre study. Ann Thorac Surg 1997;63:944-950.

6. Ohbuchi T, Morikawa T, Takeuchi E, Kato H. Lobectomy: video-assisted thoracic surgery versus posterolateral thoracotomy. Jpn J Thorac Cardiovasc Surg 1998;46:519-22.

7. Jablons D, et al. Neoplasms of the lung. In: LW Way, GM Doherty, eds., Current Surgical Diagnosis and Treatment, 11th ed. 2003; New York: McGraw-Hill: p.395-407.

8. Licker M, De Perrot M, Hohn L, Tschopp J M, Robert J, Frey J G, Schweizer A, Spiliopoulos A. Perioperative mortality and major cardio-pulmonary complications after lung surgery for non-small cell carcinoma. Eur J Cardiothorac Surg 1999;15:314-319.

9. Ploeg AJ, Kappetein AP, Van Tongeran RB, Pahlplatz PV, kastelein G W, Breslau P J. Factors associated with perioperative complications and long-term results after pulmonary resection for primary carcinoma of the lung. Eur J Cardiothorac Surg 2003;23:26-29.

10. Esme H, Fidan H, Cekirdekci A. The problems and advantages of one lung ventilation during surgical intervention in pulmonary hydatid cyst disease. Ind J Thorac Cardiovasc Sur 2006;22:137-140.

11. Licker M, Spiliopoulos A, Frey JG, De Perrot M, Chevalley C, Tschopp J M. Management and outcome of patients undergoing thoracic surgery in a regional chest medical centre. Eur J Anaesthesiology 2001;18:540-547.

12. Myrdal G, Gustafsson G, Lambe M, Horte L G, Stahle E. Outcome after lung cancer surgery. Factors predicting early mortality and major morbidity. Eur J Cardiothorac Surg 2001;20:694-699.

13. Licker M, De Perrot M, Spiliopoulos A, Robert J, Diaper J, Chevalley C, Tschopp JM. Risk factors for acute lung injury after thoracic surgery for lung cancer. Anesth Analg 2003;97:1558-1565.

14. Fujimoto T, Teschler H, Hillejan L, Zaboura G, Stamatis G. Long-term results of lung volume reduction surgery. Eur J Cardiothorac Surg 2002;21:483-488.

15. Tong L, Sheng-cai H, Hui L, Bin H, Jin-bai M, Zhen-kui Z, Yang W, Yi-li F, Bin Y. Short- and long-term outcomes of lung volume reduction surgery. Chinese Medical Journal 2006;119:769-773.

16. Panagopoulos ND, Karakantza M, Koletsis E, Apostolakis E, Sakellaropoulos G C, Filos K S, Eleni T, Dougenis D. Influence of blood transfusions and preoperative anemia on long-term survival in patients operated for non-small cell lung cancer. Lung Cancer 2008;62:273-280.

17. Bernard A, Ferrand L, Hagry O, Benoit L, Cheynel N, Favre J P. Identification of prognostic factors determining risk groups for lung resection. Ann Thorac Surg 2000;70:1161-1167.

18. Chatila W, Furukawa S, Criner G J. Acute respiratory failure after lung volume reduction surgery. Am J Respir Crit Care Med 2000;162:1292-1296.

19. Algar FJ, Alvarez A, Salvatierra A, Baamonde C, Aranda JL, Pujol FJL. Predicting pulmonary complications after pneumonectomy for lung cancer. Eur J Cardiothorac Surg 2003;23:201-208.

20. Slinger P, Suissa S, Triolet W. Predicting arterial oxygenation during one-lung anaesthesia. Can J Anaesth 1992;39:1030-5.

21. Caplan LM, Turndorf H, Patel C, Ramanthan S, Acinapura A, Chalon J. Optimization of arterial oxygenation during one-lung anaesthesia. Anesth Analg 1980;59:847-51.

22. Hogue CW. Effectiveness of low levels of non-ventilated lung CPAP in improving arterial oxygenation during one-lung ventilation. Anesth Analg 1994;79:364-7.

23. Cohen E, Eisenkraft JB. Positive end-expiratory pressure during one-lung ventilation improves oxygenation in patients with low arterial oxygen tensions. J Cardiothorac Vasc Anesth 1996; 10:578-82.

24. Ayed AK, Bazerbashi S, Chandrasekaran C, Sukumar M, Jamaleddin H. Pulmonary complications following major lung resection for benign and malignant lung diseases. Med Princ Pract 2006; 15:114-119.

25. Barrera R, Shi W, Amar D, Thaler HT, Gabovich N, Bains MS, White DA. Smoking and timing of cessation: Impact on pulmonary complication after thoracotomy. Chest 2005; 127:1977-83.

26. Wisser W, Senbaklavaci O, Ozpeker C, Ploner M, Wanke T, Tschernko E, Wolner E, Klepetko W. Is long-term functional outcome after lung volume reduction surgery predictable?. Eur J Cardiothorac Surg 2000; 17:666-672.

27. Little A G, Wu H S, Ferguson M K, Ho C H, Bowers V D, Segalin A, Staszek V M. Perioperative blood transfusion adversely affects prognosis of patients with stage I non-small-cell lung cancer. American J Surg 1990; 160:630-632.

28. Penalver JC, Padilla J, Jorda J, Escriva J, Ceron J, Calvo V, García A, Pastor J, Blasco E. Use of blood products in patients treated surgically for stage I non-small cell lung cancer. Arch Bronconeumol 2005; 41:484-488.