

Institutional report - Thoracic general

Mortality, complications and loss of pulmonary function after pneumonectomy vs. sleeve lobectomy in patients younger and older than 70 years

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Received 22 April 2008; received in revised form 12 June 2008; accepted 17 June 2008

Abstract

Retrospective single institution analysis of all patients undergoing sleeve lobectomy or pneumonectomy between 2000 and 2005. Seventy-eight patients underwent pneumonectomy (65 patients <70 years, 13 patients >70 years) and 69 sleeve lobectomy (50 patients <70 years, 19 patients >70 years). Pre-existing co-morbidity, surgical indication and induction therapy was similarly distributed between treatment by age-groups. In patients <70 years, pneumonectomy and sleeve lobectomy resulted in a 30-day mortality of 3% vs. 0 and an overall complication rate of 26% vs. 44%, respectively. In patients >70 years, pneumonectomy and sleeve lobectomy resulted in a 30-day mortality of 15% vs. 0 and an overall complication rate of 23% vs. 32%. In both age groups, pneumonectomy was associated with more airway complications (NS) and a significantly higher postoperative loss of FEV₁ than sleeve lobectomy ($P < 0.0001$, $P < 0.03$). Age per se did not influence the loss of FEV₁ and DLCO for a given type of resection. Sleeve lobectomy may have a therapeutic advantage over pneumonectomy in the postoperative course of elderly patients.

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Keywords: Age; Pneumonectomy; Sleeve lobectomy; Pulmonary function; Morbidity; Mortality

1. Introduction

A recently published meta-analysis has demonstrated no significant difference in postoperative morbidity, mortality, recurrence rate and survival after pneumonectomy and sleeve lobectomy in patients with NSCLC [1]. Since major resections are increasingly performed in elderly patients [2–5], sleeve resections may be particularly useful in this age group in order to decrease the risk of postoperative mortality and complications while preserving lung function and quality of life. However, there are actually no data available which specifically compare the postoperative risk and loss of pulmonary function of pneumonectomy and sleeve lobectomy in different age populations.

In this retrospective single institution study of patients treated between 2000 and 2005, we assessed postoperative mortality, complications and loss of pulmonary function after pneumonectomy vs. sleeve resection in patients less than and in patients more than 70 years old.

2. Patients and methods

All patients qualifying for major pulmonary resection underwent preoperative pulmonary and cardiac evaluation

according to the algorithm of Bolliger [6] and Miller [7], respectively. Patients with predicted FEV₁ and DLCO of <80% underwent exercise testing and patients with Vo₂ max of <20 ml/kg/min had split function testing by ventilation/perfusion scan; resection was performed if a postoperative predicted Vo₂ max of ≥10 ml/kg/min was obtained. All patients >50 years and those with a history of heart disease underwent echocardiography and those with signs of ischemia myocardium scintigraphy or stress echocardiography. Resection was performed in the absence of signs of reversible ischaemia and preserved left ventricular function. Continuous peridural anaesthesia was offered to all patients in the absence of contraindications. Sleeve lobectomy was preferred to pneumonectomy whenever possible. If the extent of the disease required a pneumonectomy, resection was performed in the case of a postoperative predicted Vo₂ max of ≥10 ml/kg/min and normal echocardiography. All patients had muscle flap coverage of the bronchial stump or airway anastomosis. All patients underwent postoperative avoidance of fluid overload, prevention of atelectasis by early mobilisation and chest physiotherapy, and routine s.c. thrombo-prophylaxis. Patients with pneumonectomy had postoperative oral anticoagulation for three months.

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Table 1
Patient characteristics according to the surgical procedure and the age at operation

	Pneumonectomy		Sleeve lobectomy		P-value
	<70 years n=65 (%)	>70 years n=13 (%)	<70 years n=50 (%)	>70 years n=19 (%)	
Co-morbidities (total)	35	62	40	58	0.2
COPD	26	46	32	26	0.5
Coronary artery disease	8	15	12	32	0.06
Obesity	6	0	4	16	0.3
Diabetes	8	15	6	11	0.6
NSCLC ¹	75	85	79	79	0.7
Induction therapy	25	8	12	21	0.2
Right-sided pneumonectomy	49	15	–	–	0.03

¹Non-small cell lung cancer.

2.1. Follow-up

The charts of all patients undergoing sleeve lobectomy or pneumonectomy between 1 January 2000 and 30 June 2005 were revisited. Pre-existing co-morbidities, indications for surgery, induction therapy and side of pneumonectomy were noted for each patient as well as 30-day mortality and major postoperative morbidity including pneumonia, myocardial infarction, congestive heart failure, pulmonary embolism, cerebro-vascular accidents, airway dehiscence, broncho-pleural fistula, empyema or infections of the thoracotomy site. Minor complications were excluded such as atelectasis requiring <2 bronchoscopies, non-infected pleural effusion, residual air space, infections at the site of chest tubes and arrhythmias responding to medical therapy [8]. Postoperative pulmonary function testing (FEV₁, DLCO) performed between 3 and 6 months after the operation were recorded and were compared to preoperative values.

2.2. Statistical analysis

The χ^2 and Fisher's exact-test were used to determine differences in proportions. The Wilcoxon test was used to test the differences in loss of FEV₁ and DLCO. Two-sided P-values <0.05 were considered significant.

3. Results

One hundred and forty-three patients underwent pneumonectomy or sleeve resection at our institution between 1 January 2000 and 30 June 2005. Seventy-eight patients underwent pneumonectomy, 65 patients were younger and 13 patients older than 70 years at the time of operation. Sixty-nine patients underwent sleeve lobectomy, 50 patients were younger and 19 older than 70 years. NSCLC was the predominant indication for surgery accounting for 77% and 79% of patients requiring pneumonectomy and sleeve lobectomy, respectively. Pathological stage I, II and III NSCLC was found in 36%, 27% and 36% of patients requiring pneumonectomy, and 22%, 44% and 33% of patients requiring sleeve lobectomy (NS). Table 1 shows the distribution of pre-existing COPD, coronary artery disease, obesity and induction therapy for each of the four treatments by age-groups. There were no significant differences for these variables between the four groups. For patients undergoing pneumonectomy, a right-sided proce-

dures was more frequently performed in patients <70 years ($P=0.03$). The preoperative predicted FEV₁ and DLCO were $79.5 \pm 19.5\%$ and $72.8 \pm 20.9\%$ in patients <70 years, and $80.5 \pm 21.3\%$ and $72 \pm 20.8\%$ in patients >70 years, respectively, without significant difference between both age groups.

3.1. Postoperative mortality and complications

Table 2 indicates the 30-day mortality and the complications after pneumonectomy and sleeve lobectomy in patients <70 years. Pneumonectomy and sleeve lobectomy resulted in a 30-day mortality of 3% vs. 0 ($P=0.5$) and an overall complication rate of 26% vs. 44% ($P=0.05$). Two patients died after pneumonectomy, one from myocardial infarction and one from broncho-pleural fistula associated with multiorgan failure. Pneumonectomy was associated with more cardiac complications (NS) and broncho-pleural fistulas (NS), and sleeve lobectomy with more pulmonary complications ($P=0.01$).

Table 3 shows the 30-day mortality and the complications after pneumonectomy and sleeve lobectomy in patients >70 years. Pneumonectomy and sleeve lobectomy resulted in a 30-day mortality rate of 15% vs. 0 ($P=0.2$) and an overall complication rate of 23% vs. 32% ($P=0.7$). Two patients died after pneumonectomy, one from pneumonia and one from broncho-pleural fistula and ARDS. Pulmonary and cardiac complications were more frequent after sleeve lobectomy than after pneumonectomy (NS) and the incidence of airway dehiscence (BPF) was higher after pneumonectomy than after sleeve lobectomy (NS).

Table 2
Postoperative 30-day mortality and complication rate after pneumonectomy and sleeve lobectomy in patients <70 years of age

	Pneumonectomy n=65 (%)	Sleeve lobectomy n=50 (%)	P-value
30-day-mortality	3	0	0.5
Complications (total)	26	44	0.05
Pulmonary	20	42	0.01
Cardiac	5	0	0.3
Pulmonary embolism	3	2	1.0
Cerebro-vascular	2	0	1.0
Airway dehiscence	6	0	0.1
Empyema	2	2	1.0
Wound infection	3	0	0.5

Table 3
Postoperative 30-day mortality and complication rate after pneumonectomy and sleeve lobectomy in patients >70 years of age

	Pneumonectomy n=13 (%)	Sleeve lobectomy n=19 (%)	P-value
30-day-mortality	15	0	0.2
Complications (total)	23	32	0.7
Pulmonary	15	21	1.0
Cardiac	0	21	0.1
Pulmonary embolism	0	0	
Cerebro-vascular	0	0	
Airway dehiscence	8	0	0.4
Empyema	0	0	
Wound infection	0	0	

Table 4
Difference in preoperative and postoperative FEV₁ and DLCO after pneumonectomy and sleeve lobectomy according to the age of the patients at operation

	ΔFEV ₁ (% pred) (mean±S.D.)	ΔDLCO (% pred) (mean±S.D.)
Pneumonectomy		
<70 years (n=35)	31.8±15	33.8±23
>70 years (n=8)	21.8±10	26.7±8
Sleeve lobectomy		
<70 years (n=32)	14.6±13	20.5±18
>70 years (n=9)	2.1±18	23.2±18

3.2. Postoperative loss of pulmonary function

Table 4 shows the differences in preoperative and postoperative predicted FEV₁ and DLCO for each treatment group. There was a significant difference between preoperative and postoperative FEV₁ and DLCO values for both procedures in both age groups ($P<0.05$), except for FEV₁ in patients >70 years undergoing sleeve lobectomy (NS). In patients <70 years, the postoperative loss of FEV₁ and DLCO were significantly higher after pneumonectomy than after sleeve lobectomy ($P<0.0001$, $P=0.008$); in patients >70 years, the same holds true for FEV₁ ($P=0.03$) but not for DLCO (NS). Patients <70 years undergoing pneumonectomy had a similar loss of FEV₁ and DLCO as patients >70 years undergoing pneumonectomy (NS). The same holds true for sleeve lobectomy (NS).

4. Discussion

It has been shown that life expectancy of persons aged 70 and 80 years in western countries is 14 years and 8.6 years, respectively, and that at least 75% and 50% of the rest of their lives are spent living independently [9, 10]. Elderly patients are therefore no longer excluded from NSCLC surgery solely on the base of short life expectancy or decreased quality of life.

Although there is no definition of an elderly patient, individuals who are 70 years or older have decreased cardiopulmonary reserves and are at an increased risk of developing postoperative complications after lung resection [2]. However, several studies confirm the feasibility and the survival benefit of major resections in properly selected patients older than 70 years, with a reported postoperative mortality rate ranging from 1% to 21% [2–5]. This wide

range of postoperative mortality may be related to differences in patient selection, peri- and postoperative management and the rate of pneumonectomy which varied from 0–29%. A review of the literature and a recently published case-control study revealed a postoperative mortality rate of 16–20% [11] and 11% [12] after pneumonectomy in patients >70 years, respectively, indicating that pneumonectomy should be avoided in the elderly whenever possible.

Sleeve lobectomy has gained increasing acceptance as an alternative to pneumonectomy in patients requiring resection for NSCLC. A recently published meta-analysis in this respect revealed a pooled postoperative mortality and complication rate for sleeve resection and pneumonectomy of 3.5% vs. 5.7% and 31% vs. 32%, respectively, without significant difference [1]. However, the mean age of the studied population ranged from 59 to 65 years for sleeve lobectomy and from 58 to 67 years for pneumonectomy. There is actually no study available assessing the risk of sleeve resection and pneumonectomy in specific age populations.

In this retrospective study, we compared 30-day mortality, major complications and loss of pulmonary function after sleeve resection vs. pneumonectomy in patients less than and in patients more than 70 years old. There was no significant difference in pre-existing co-morbidity, induction therapy and preoperative pulmonary function (FEV₁ and DLCO) between the treatment by age-groups.

Patients <70 years had a similar 30-day mortality after sleeve lobectomy and pneumonectomy (0 vs. 3%) which corresponds to those reported in the literature. Pneumonectomy was associated with more cardiac complications (5% vs. 0) and broncho-pleural fistulas (6% vs. 0), and sleeve lobectomy with more pulmonary complications (42% vs. 20%).

In patients >70 years, pneumonectomy resulted in a higher 30-day mortality rate than sleeve lobectomy (15% vs. 0). The high mortality rate after pneumonectomy in this age group was similar to that reported in the literature and may be related to induction therapy and right-sided procedures which are both known to increase the mortality after pneumonectomy. In addition, 8% of the patients with pneumonectomy developed a broncho-pleural fistula, whereas no airway complications were observed after sleeve lobectomy in this age group.

There are actually no data available comparing the loss of pulmonary function after pneumonectomy and sleeve lobectomy in different age populations. In our series, pneumonectomy was associated with a significantly higher postoperative loss of FEV₁ than sleeve lobectomy in both age groups. However, age per se did not influence the loss of pulmonary function for a given type of resection: patients <70 years undergoing pneumonectomy had a similar loss of FEV₁ and DLCO with patients >70 years undergoing pneumonectomy and the same holds true for sleeve lobectomy.

In conclusion, our results suggest that sleeve resections may bear a therapeutic advantage compared to pneumonectomy, especially in elderly patients, but further studies with larger sized treatment by age-groups are necessary to confirm these results.

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