

# Preoperative peak expiratory flow (PEF) for predicting postoperative pulmonary complications after lung cancer lobectomy: a prospective study with 725 cases

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## Lobectomy ; 肺葉部分切除術

**Background:** The study aimed to investigate the correlation between peak expiratory flow (PEF) and postoperative pulmonary complications (PPCs) for lung cancer patients undergoing lobectomy.

**Methods:** Patients who were diagnosed with resected non-small cell lung cancer (NSCLC) (n=725) were prospectively analyzed and the relationship between the preoperative PEF and PPCs was evaluated based on patients' basic characteristics and clinical data in hospital

**Results:** Among the 725 included patients, 144 of them were presented PPCs in 30 days after lobectomy, which were divided into PPCs group. PEF value ( $294.2 \pm 85.1$  vs.  $344.7 \pm 89.6$  L/min;  $P < 0.001$ ) were found lower in PPCs group, compared with non-PPCs group; PEF (OR, 0.984, 95% CI: 0.980–0.987,  $P < 0.001$ ) was a significant independent predictor for the occurrence of PPCs; based on an receiver operating characteristic (ROC) curve, with the consideration of balancing the sensitivity and specificity, a cutoff value of 300 (L/min) (Youden index: 0.484, sensitivity: 69.4%, specificity: 79.0%) was selected and a PEF  $\leq 300$  L/min indicated a 8-fold increase in odds of having PPCs after lung surgery (OR, 8.551, 95% CI: 5.692–12.845,  $P < 0.001$ ). With regard to PPCs rate, patients with PEF value  $\leq 300$  L/min had high PPCs rate than those with PEF  $> 300$  L/min (45.0%, 100/222 vs. 8.7%, 44/503,  $P < 0.001$ ); Meanwhile, pneumonia (24.8%, 55/222 vs. 6.4%, 32/503,  $P < 0.001$ ), atelectasis (9.5%, 21/222 vs. 4.0%, 20/503,  $P = 0.003$ ) and mechanical ventilation  $> 48$  h (5.4%, 12/222 vs. 2.4%, 12/503,  $P = 0.036$ ) were higher in the group with PEF value  $\leq 300$  L/min.

**Conclusions:** The presented study revealed a significant correlation between a low PEF value and PPCs in surgical lung cancer patients receiving lobectomy, indicating the potential of a low PEF as an independent risk factor for the occurrence of PPCs and a PPC-guided (PEF value  $\leq 300$  L/min) risk assessment could be meaningful for the perioperative management of lung cancer candidates waiting for surgery.

**Table 1** Baseline and clinical characteristics between the PPCs groups and non-PPCs group

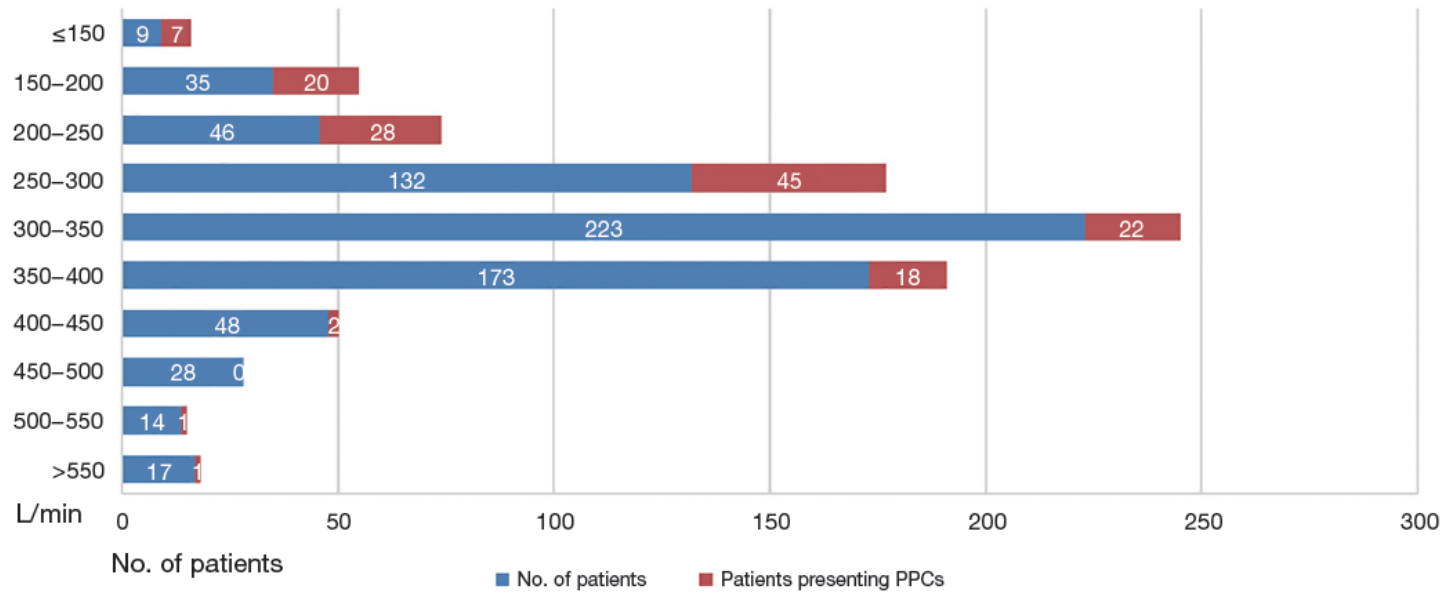
Variables	PPCs group (N=144)	Non-PPCs group (N=581)	P value
Age, mean $\pm$ SD	62.6 $\pm$ 8.3	61.2 $\pm$ 8.9	0.078
Gender (n, %)			0.502
Male	86 (59.7)	329 (56.6)	
Female	58 (40.3)	252 (43.4)	
Smoking status (n, %)			0.362
Current smoking	48 (33.3)	171 (29.4)	
Ex- or non-smokers	96 (66.7)	410 (70.6)	
Cardio-pulmonary function, mean $\pm$ SD			
FEV1 (L)	1.83 $\pm$ 0.57	2.00 $\pm$ 0.69	0.007
FVC (L)	2.88 $\pm$ 0.60	2.89 $\pm$ 0.66	0.884
PEF (L/min)	294.2 $\pm$ 85.1	344.7 $\pm$ 89.6	<0.001
Comorbidities (n, %)			
COPD	32 (22.2)	82 (14.1)	0.018
Diabetes mellitus	48 (33.3)	147 (25.3)	0.053
Hypertension	16 (11.1)	56 (9.6)	0.597
Coronary heart disease	20 (13.9)	56 (9.6)	0.138
Pathological stage (n, %)			0.066
Stage I	74 (51.4)	332 (57.1)	
> Stage I	70 (48.6)	249 (42.9)	
Surgical approach (n, %)			0.306
VATS	99 (68.7)	373 (64.2)	
Open	45 (31.3)	208 (35.8)	
Amount of blood loss (mL)	106.3 $\pm$ 225.6	80.7 $\pm$ 98.5	0.057
Operation time (min)	113.8 $\pm$ 63.4	106.4 $\pm$ 47.8	0.121
Length of stay, mean $\pm$ SD			
Total	13.77 $\pm$ 5.29	9.71 $\pm$ 4.41	<0.001
Preoperative	5.59 $\pm$ 1.84	5.55 $\pm$ 3.52	0.0509
Postoperative	7.82 $\pm$ 4.83	4.16 $\pm$ 2.50	<0.001
In-hospital expense (¥), mean $\pm$ SD			
Total	51,143.1 $\pm$ 12,293.2	48,603.6 $\pm$ 12,636.0	0.030
Material cost	22,470.0 $\pm$ 7,614.8	23,501.5 $\pm$ 7,088.8	0.124
Drug cost	9,959.6 $\pm$ 3,966.1	8,086.7 $\pm$ 4,484.8	<0.001

Data are presented as mean  $\pm$  SD, median (range) or n (%). PEF, peak expiratory flow; FEV1, forced expiratory volume in 1 s; COPD, chronic obstructive pulmonary disease; FVC, forced vital capacity.

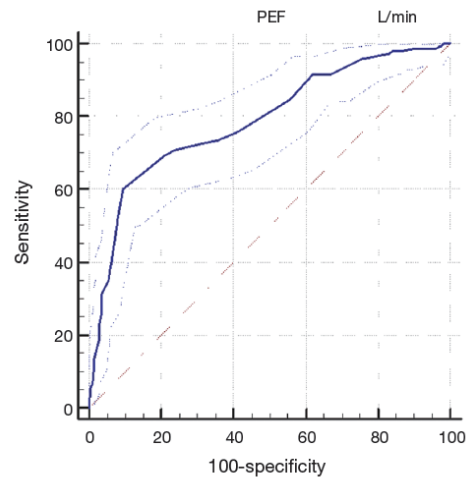
**Table 2** Relationships between postoperative pulmonary complications and clinical characteristics

Variables	Description	Univariate analysis			Multivariate analysis		
		OR	P value	95% CI	OR	P value	95% CI
Age	Per 1 year increase	1.019	0.078	0.998–1.042	0.990	0.427	0.965–1.015
Gender (M)	Yes	1.136	0.502	0.784–1.646	–	–	–
Smoking status	Yes	1.199	0.362	0.812–1.770	–	–	–
Hypertension	Yes	1.172	0.597	0.651–2.110	–	–	–
Diabetes mellitus	Yes	1.476	0.053	0.996–2.188	1.525	0.082	0.948–2.455
COPD	Yes	1.739	0.018	1.101–2.746	1.584	0.099	0.917–2.737
CHD	Yes	1.512	0.138	0.875–2.612	0.970	0.928	0.498–1.888
FVC	Per unit decrease	0.979	0.884	0.739–1.298	–	–	–
FEV1	Per unit decrease	0.673	0.007	0.506–0.896	0.978	0.904	0.687–1.393
PEF	Per unit decrease	0.993	<0.001	0.991–0.995	0.984	<0.001	0.980–0.987
Blood loss	Per unit increase	1.001	0.057	1.000–1.002	1.001	0.175	1.000–1.002
Operation time	Per unit increase	1.003	0.121	0.999–1.006	1.000	0.942	0.996–1.005
VATS procedure	Yes	0.815	0.306	0.551–1.205	–	–	–

PEF, peak expiratory flow; FEV1, forced expiratory volume in 1 s; COPD, chronic obstructive pulmonary disease; FVC, forced vital capacity; CHD, coronary heart disease.



**Figure 1** The distribution of peak expiratory flow (PEF) in patients with and without postoperative complications (PPCs).



AUC	95% CI	P value	Cutoff-point value	Sensitivity	Specificity	Youden index
0.789	0.758 to 0.819	<0.001	300 (L/min)	69.4%	79.0%	0.484

**Figure 2** Area under the receiver operating characteristics (ROC) curves for the risk of postoperative pulmonary complications as determined by peak expiratory flow (PEF).

**Table 5** Categories of PPCs between group with PEF  $\leq$ 300 and PEF  $>$ 300

Categories	PEF $\leq$ 300 (N=222)	PEF $>$ 300 (N=503)	Total (N=725)	P value
Pneumonia	55 (24.8)	32 (6.4)	87 (12.0)	$<$ 0.001
Atelectasis	21 (9.5)	20 (4.0)	41 (5.7)	0.003
Pulmonary embolism	2 (0.9)	2 (0.4)	4 ( $<$ 1.0)	0.590
Air leak	14 (6.3)	23 (4.6)	37 (5.1)	0.328
Mechanical ventilation $>$ 48 h	12 (5.4)	12 (2.4)	24 (3.3)	0.036
Empyema	6 (2.7)	8 (1.6)	14 (1.9)	0.380
Chylothorax/bronchopleural fistula	4 (1.8)	4 (0.8)	8 (1.1)	0.257
Respiratory/heart failure or ADRS	7 (3.2)	9 (1.8)	16 (2.2)	0.249
Re-intubation	2 (0.9)	2 (0.4)	4 ( $<$ 1.0)	0.590
Back to ICU or needing tracheotomy	4 (1.8)	7 (1.4)	11 (1.5)	0.744

Data are presented as n (%). PPC, postoperative pulmonary complication; PEF, peak expiratory flow.

肺葉部分切除術の患者さんに対して、PEFが  
300L/mi.（当院のば場合5L/sec.）あるか否かは  
必ずチェックしましょう！！