

폐암 수술 후 발생하는 호흡기 합병증

- 진단과 평가

한양대학교병원

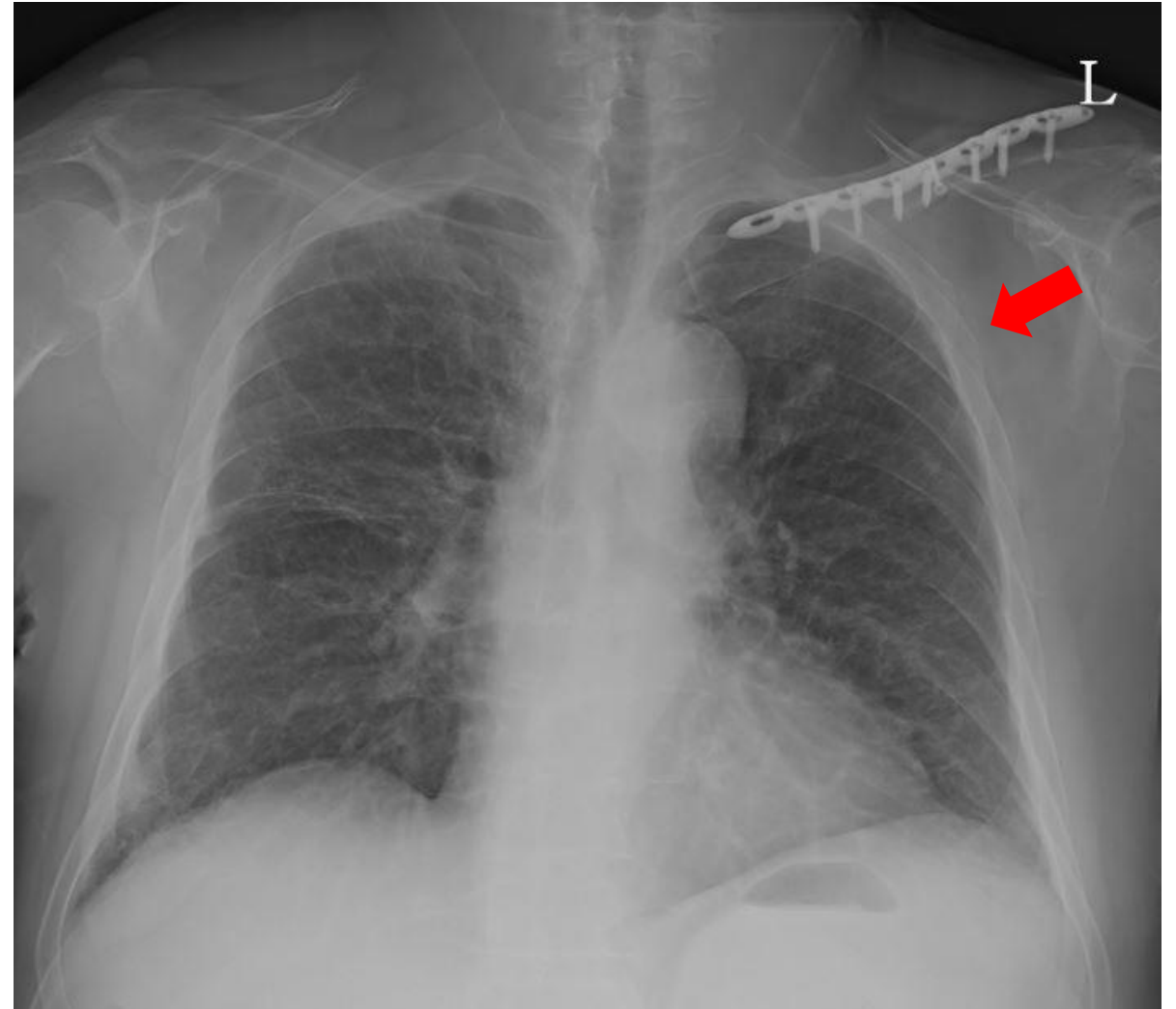
호흡기알레르기내과

박동원

dongwonpark@hanyang.ac.kr

Case

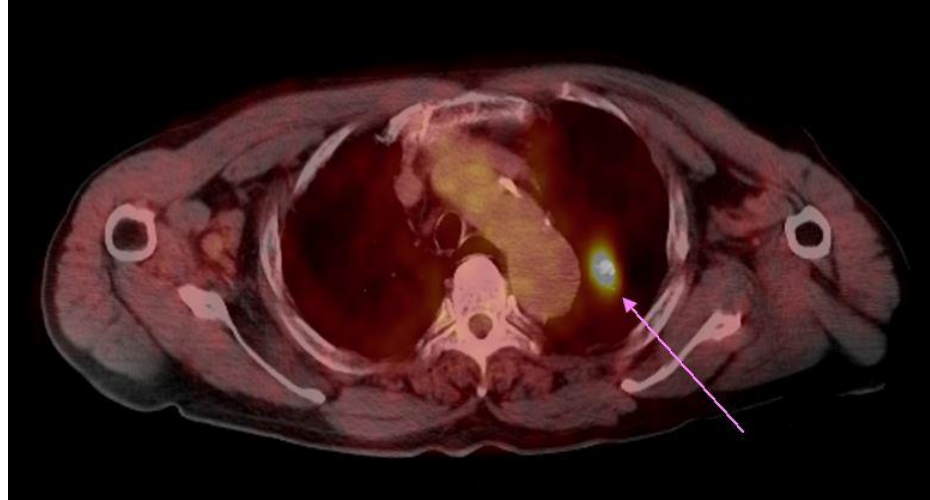
- M/74, 50PYS current smoker
- 건강검진에서 우연히 발견한 lung nodule 을 주소로 내원함.
- HTN, CKD stage 3
 - Baseline Cr 1.24 mg/dL (eGFR 57)



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Preoperative pulmonary function test

- PostBDR FEV1/FVC 58.23, FEV1 2.00L (70.88%)
- DLco 47.0%

Spirometry and Flow - Volume MVV

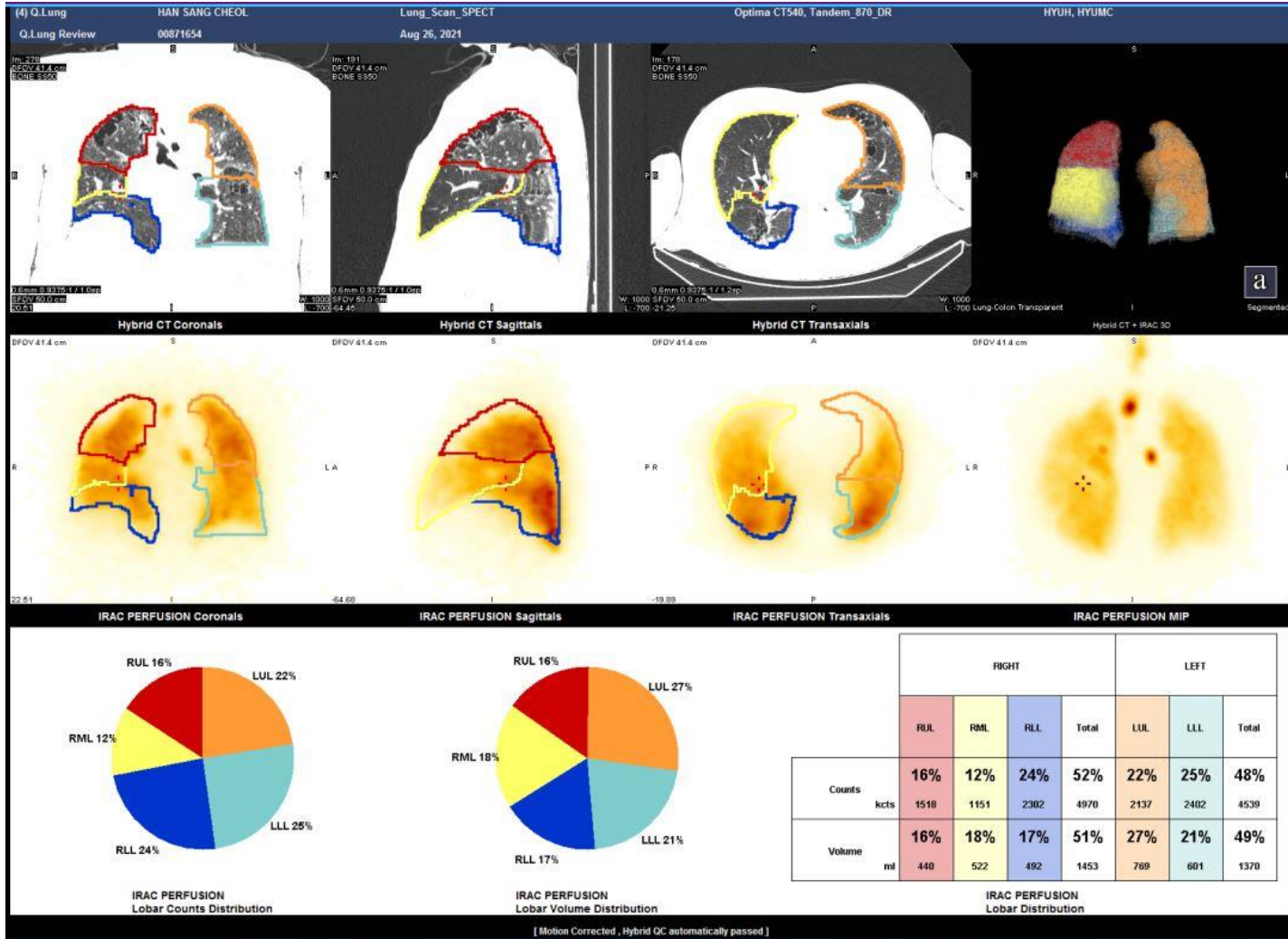
Last Name:	한	First Name:	상철
Identification:	00871654	Date of Birth:	1947-07-28
Sex:	male	Age:	74 Years
Height:	166 cm	Weight:	81 kg
Ward:	TS	Smoker:	0.75pk/40ys
Patient History:	Poor Cooperation	Diagnosis:	2021/08/26 Sitting

Diffusion Single - Breath Report

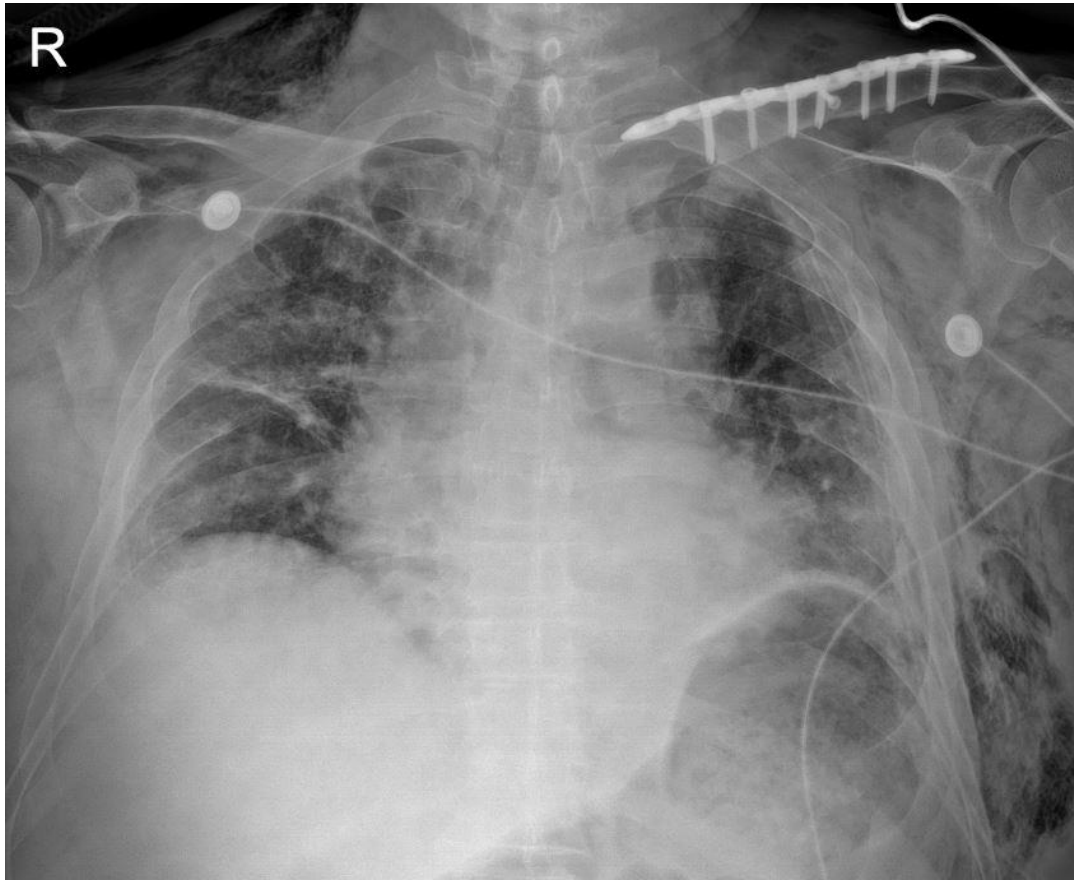
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		Pred	Act1	% (A1/P	Act2	% (A2/P	D% (A2/
FVC	[L]	4.36	3.48	79.8	3.43	78.8	-1.2
FEV 1	[L]	2.83	2.05	72.5	2.00	70.8	-2.4
FEV 1 % FVC	[%]	69.98	58.93	84.2	58.23	83.2	-1.2
FEV 1 % VC MAX	[%]	69.98	57.62	82.3	57.25	81.8	-0.6
PEF	[L/s]	7.02	6.67	95.0	5.54	78.9	-17.0
MEF 75	[L/s]	6.40	2.88	45.0	2.56	40.0	-11.2
MEF 50	[L/s]	3.11	1.09	35.0	1.07	34.5	-1.6
MEF 25	[L/s]	0.96	0.22	23.2	0.22	22.6	-2.7
MMEF 75/25	[L/s]	2.71	0.65	24.0	0.67	24.8	3.1
FVC IN	[L]	4.36	3.56	81.6	3.49	80.2	-1.7
FIV1	[L]		3.49		3.49		-0.1

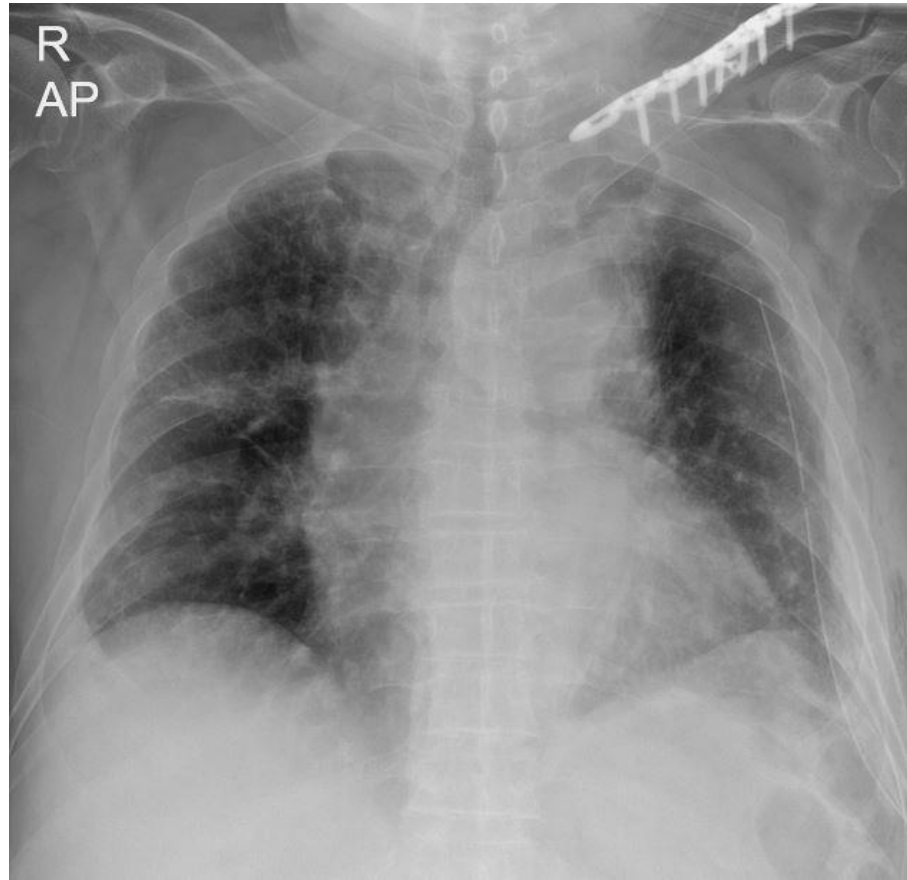
		Pred	Act1	% (Act1/Pre	Act2	D% (Act2/Ac
RV-SB	[L]	2.28	1.13	49.6		
RV%TLC-SB	[%]	36.93	25.23	68.3		
TLC-SB	[L]	6.10	4.47	73.3		
VA	[L]		4.30			
TA	[s]		11.40			
FI He	[%]		8.94			
FA He	[%]		6.24			
FI CO	[%]		0.300			
FA CO	[%]		0.131			
Hb	[g/100ml]		12.80			
VIN	[L]	3.73	3.35	89.8		
DLCO SB	[mL/min/mmHg]	26.22	12.32	47.0		
DLCO/VA	[mL/min/mmHg/L]	4.49	2.87	63.9		



- LULobectomy를 시행한다면,
- DLco 49%
→ ppoDLco 38.22%
- FEV1 70.88% (2.00L)
→ ppoFEV1 1.56L (55.28%)
- Lingular segment saving LULobectomy with mediastinal LN dissection



POD #7



POD #11

POD #13
(ROT시행)

Another postop complication

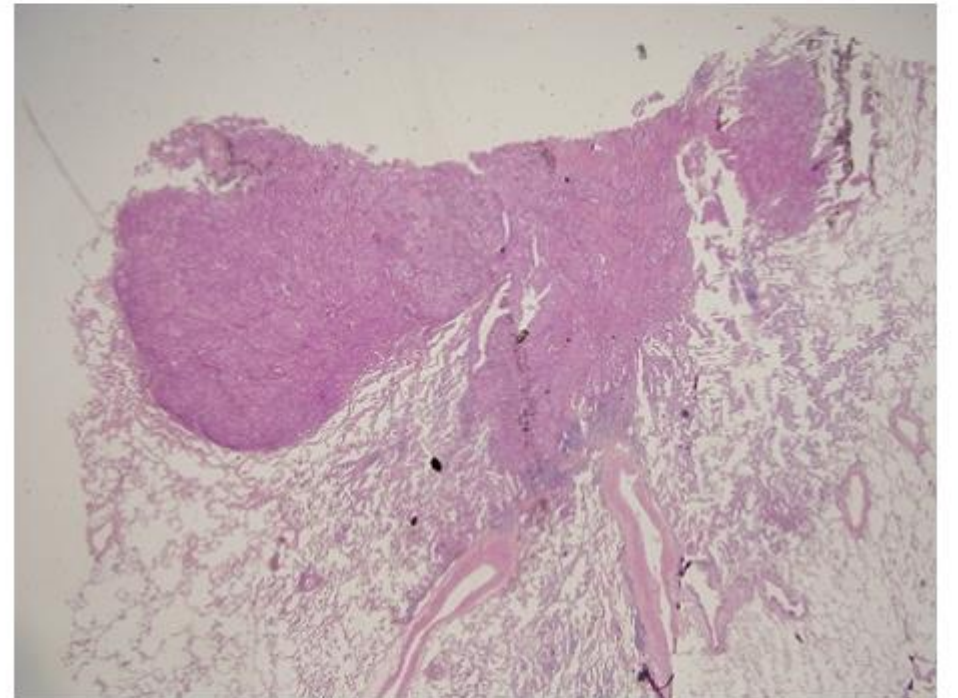
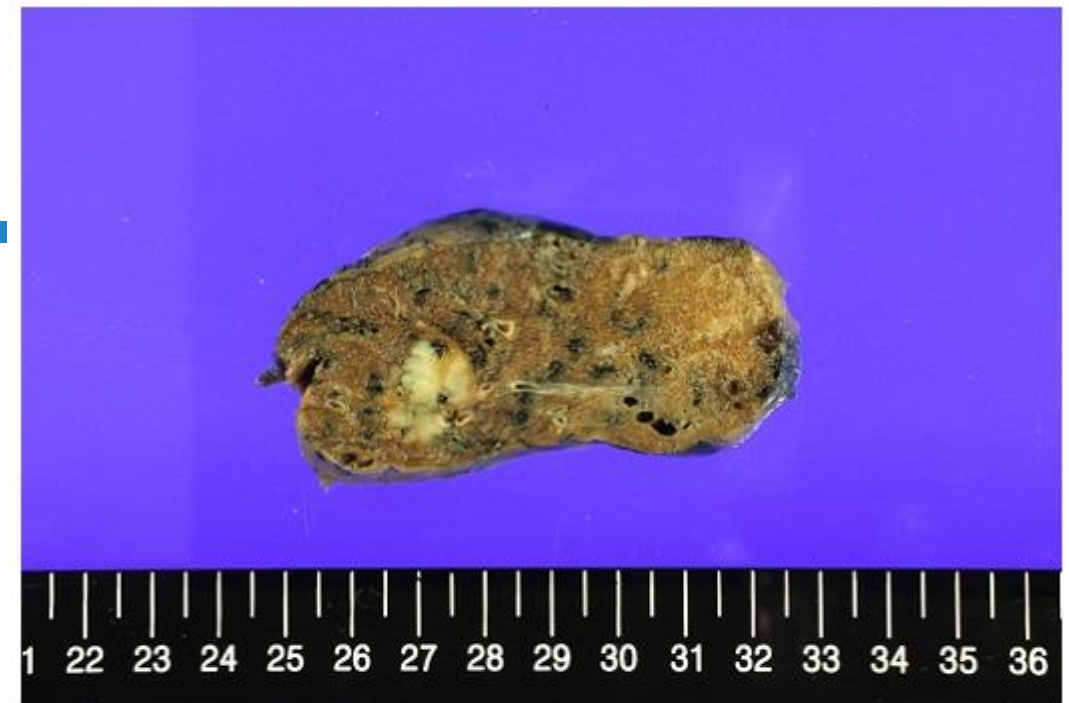
- Baseline Cr 1.24 mg/dL (eGFR 57)
- POD#3 Cr 3.72 mg/dL (eGFR 15)

→ AKI on CKD s/p **CRRT** (POD#3~POD#8)
- POD#35 Cr 1.29 mg/dL (eGFR 50)

조직검사

- Adenocarcinoma, 2.2cm pT1cN1 > IIB stage
- Poorly differentiated, VPI(-)

- Adjuvant CTx 필요
→ 환자는 항암치료 거절



Today

- Postoperative pulmonary complication (PPC) after lung resection surgery의 종류와 진단
- lung cancer surgery 이후의 PPC의 위험요인
- lung cancer surgery 환자에 대한 Preoperative evaluation

Postoperative pulmonary complication (PPC)

- Incidence of PPC in major surgery → 1-23%
- Cardiothoracic surgery vs. Noncardiothoracic surgery
→ 8-39% vs. 2-19%
- 6% of 165,196 patients in major abdominal surgery
- 2.0~5.6% in general surgical population

Factors related to PPCs

Patients-related risk factors

Operation/Anesthetic-related risk factors
(Procedure)

Risk factors related postoperative care

Modifiable

vs.

Non-modifiable

Procedure-related risk factors in general

Postoperative Respiratory Failure After Major Noncardiac Surgery

Variable	Odds Ratio (95% Confidence Interval)
Type of surgery	
Abdominal aortic aneurysm	14.3 (12.0–16.9)
Thoracic	8.14 (7.17–9.25)
Neurosurgery, upper abdominal, or peripheral vascular	4.21 (3.80–4.67)
Neck	3.10 (2.40–4.01)
Other surgery†	1.00 (reference)
Emergency surgery	3.12 (2.83–3.43)
Albumin (<30 g/L)	2.53 (2.28–2.80)
Blood urea nitrogen (>30 mg/dL)	2.29 (2.04–2.56)
Partially or fully dependent status	1.92 (1.74–2.11)
History of COPD	1.81 (1.66–1.98)
Age (years)	
≥70	1.91 (1.71–2.13)
60–69	1.51 (1.36–1.69)
<60	1.00 (reference)

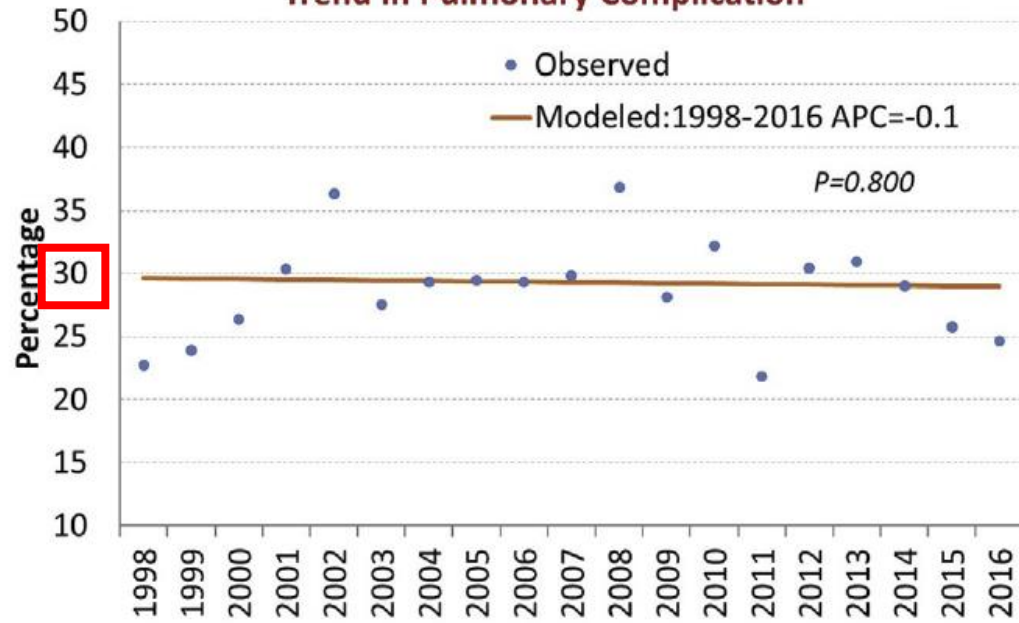
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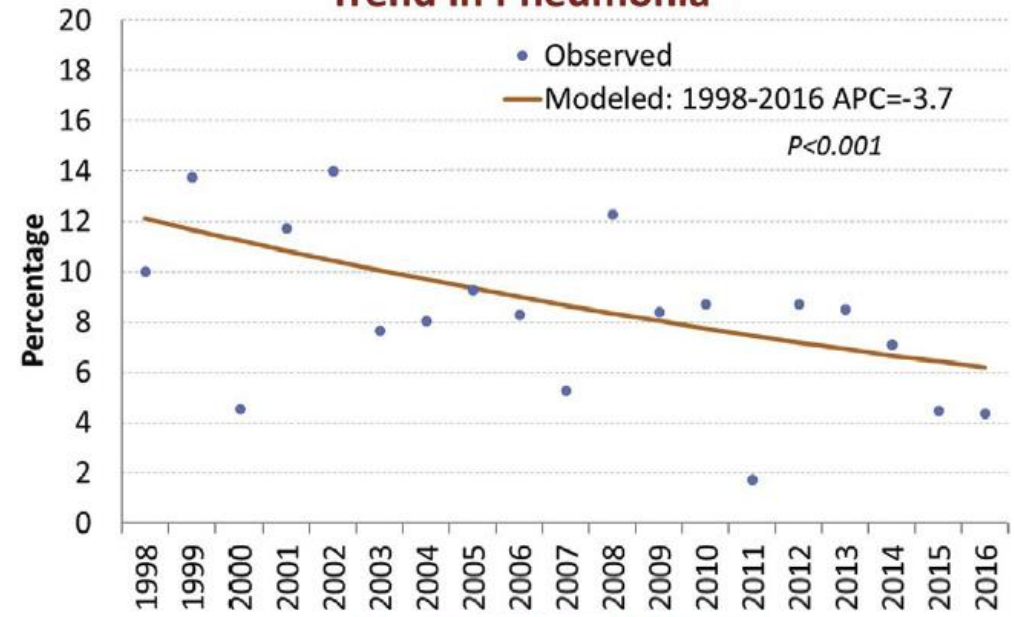
Time Trends of Perioperative Outcomes in Early Stage NSCLC Resection Patients

- 3,045 patients with clinical I/II NSCLC who underwent lung resection
- University of Texas MD Anderson Cancer Center between Jan 1998 and Dec, 2016.
- Rates of periop pulmonary Cx, pneumonia, and cardiovascular Cx; and 30-day/90-day mortality, each year
- Pulmonary complications occurring within 30 days of surgery
 - ✓ Pneumonia, aspiration, ARDS, prolonged air leak
 - ✓ Atelectasis requiring bronchoscopy,
 - ✓ Bronchopleural fistula, pleural effusion, pneumothorax,
 - ✓ Pulmonary insufficiency, Pulmonary embolus,
 - ✓ Reintubation, respiratory arrest, tracheostomy,
 - ✓ Postoperative ventilator support
 - ✓ Discharge on home oxygen or with chest tube.

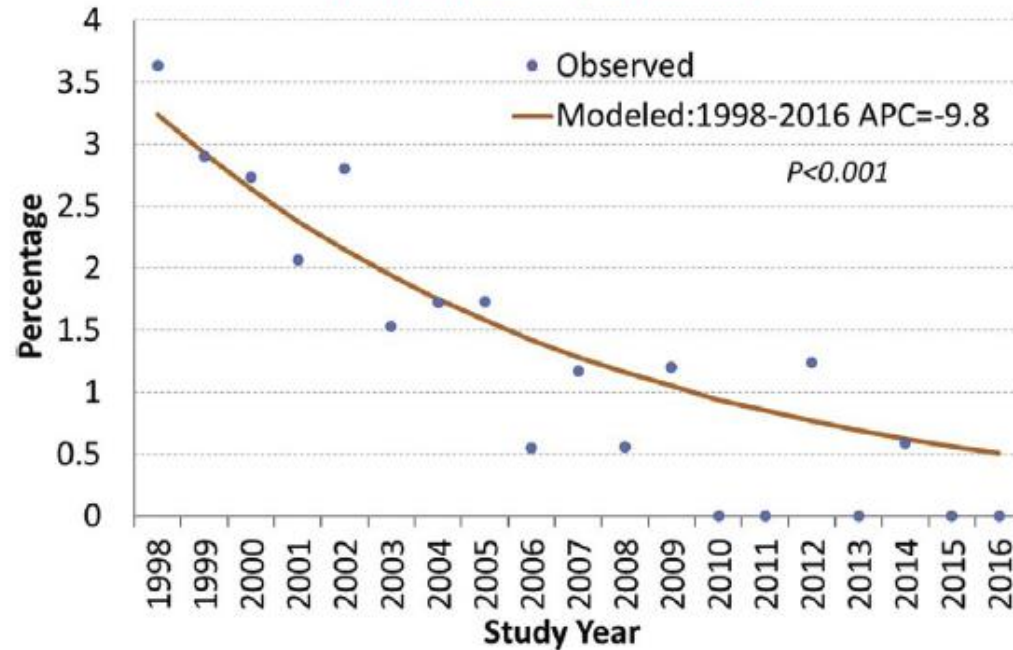
Trend in Pulmonary Complication



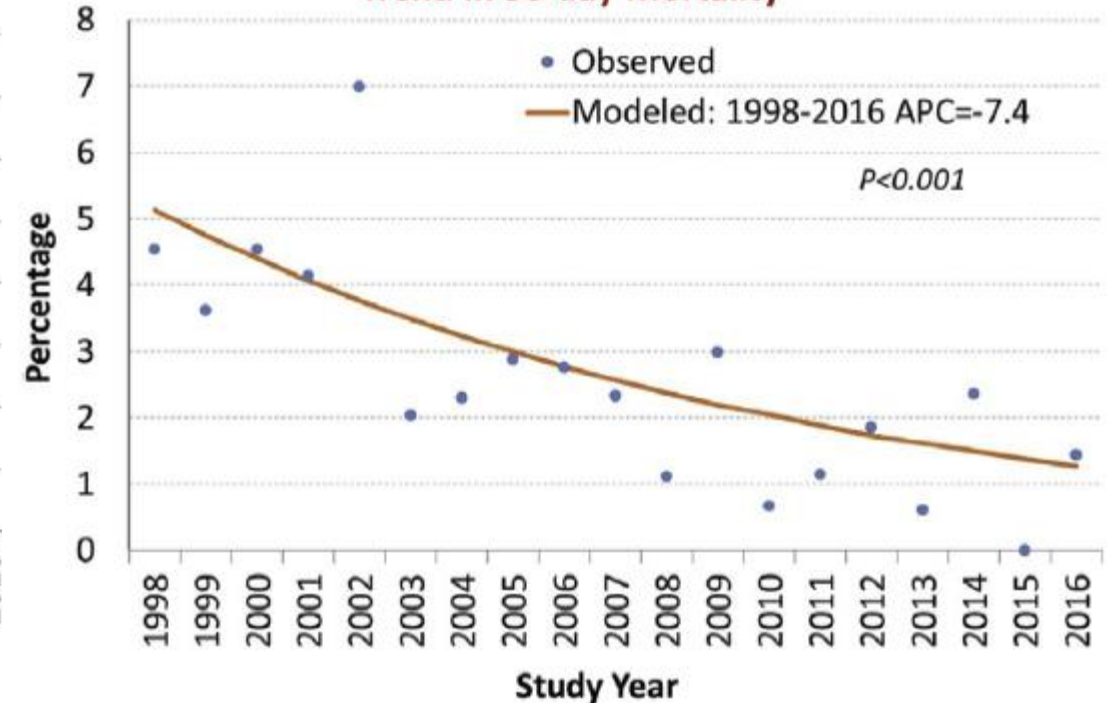
Trend in Pneumonia



Trend in 30-day Mortality

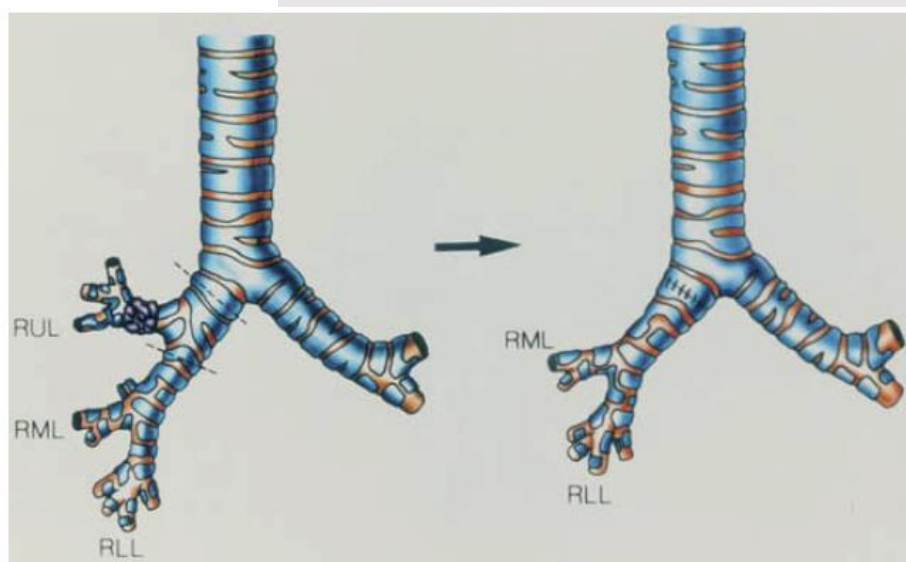


Trend in 90-day Mortality

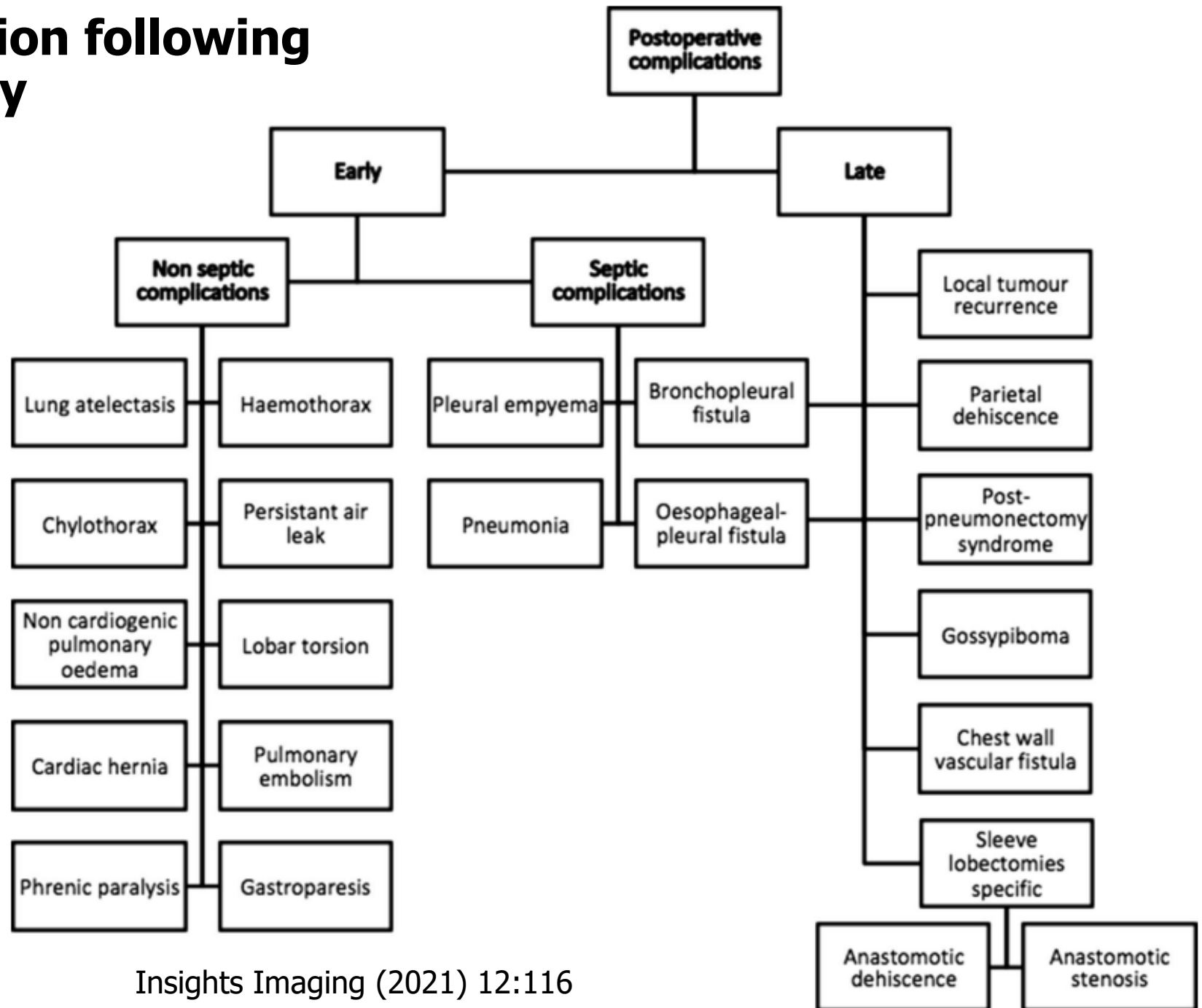


Lung resection surgery

Surgical Procedure	Complications	
	Early	Late
Pneumonectomy	Empyema, cardiac herniation, pulmonary edema (cardiogenic, permeability), chylothorax, hemothorax, bronchopleural fistula, wound infection, esophagopleural fistula	Postpneumonectomy syndrome, recurrent tumor, esophagopleural fistula
Lobectomy, sleeve lobectomy	Space problems, persistent air leak, postoperative lobar torsion, ischemic necrotizing pneumonia, nonobstructive atelectasis, pulmonary edema, anastomotic dehiscence, hemothorax, bronchopleural fistula, wound infection, esophagopleural fistula	Anastomotic stricture, recurrent tumor, gossypiboma, esophagopleural fistula



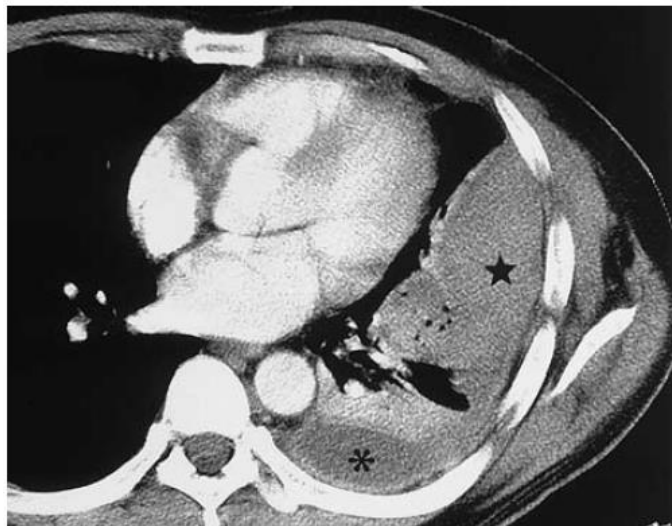
Pulmonary complication following lung resection surgery



Insights Imaging (2021) 12:116

Hemothorax (1.3%)

- Major hemorrhage following thoracotomy and resection is most commonly the result of inadequate hemostasis of a bronchial artery or systemic vessels in the chest wall
- The overall mortality rate associated with uncontrolled bleeding is less than 0.1%

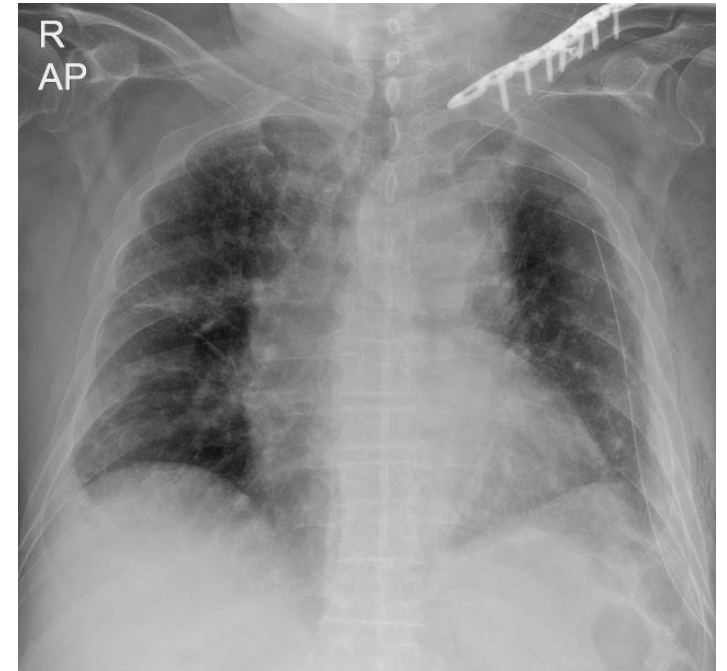


Chylothorax (1%)

- Triglyceride concentrations >110 mg/dL in the pleural fluid
- accumulation of chyle in the pleural space caused by disruption of the thoracic duct or one of its major divisions.
- Sites of potential thoracic duct injury during pneumonectomy include
 - ✓ (a) the inferior right hemithorax in the paravertebral area during extrapleural resection,
 - ✓ (b) the pericarinal and subaortic areas during radical nodal dissection
 - ✓ (c) the inferior pulmonary ligaments on either side during standard resection

Persistent Air Leak

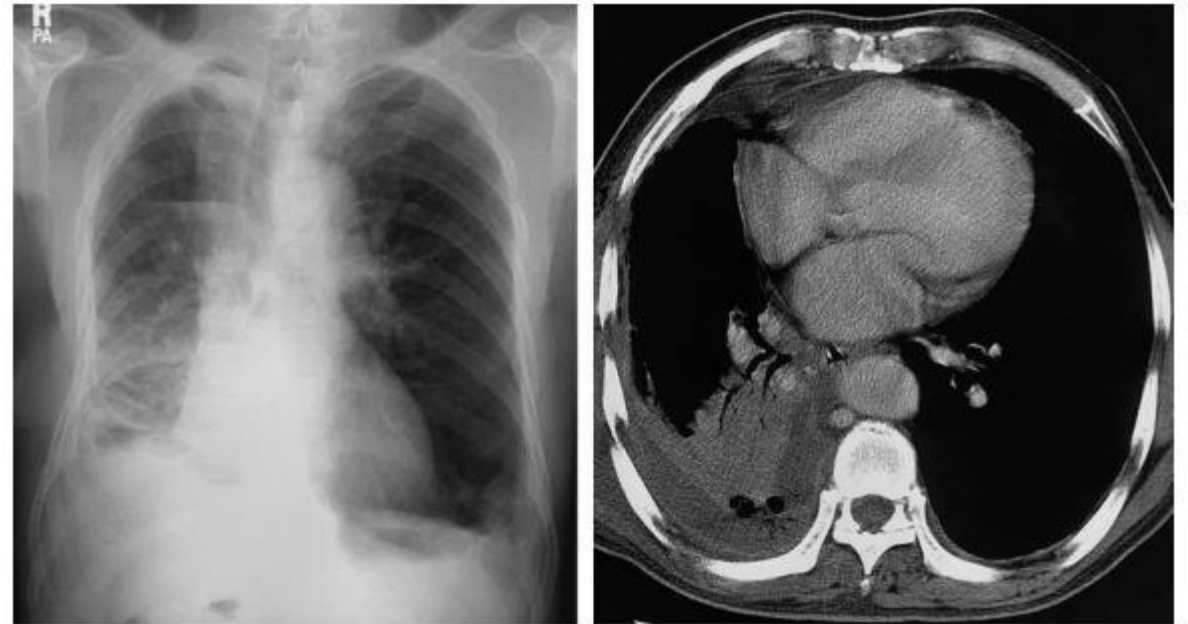
- Nearly all patients undergoing lobectomy or segmentectomy can be expected to experience some degree of postoperative air leakage.
- This complication occurs more frequently when interlobar fissures are incomplete or absent. It is also common in pulmonary resection performed in older patients with emphysema.
- Nearly all air leaks originating from the periphery of the lung **stop within 24–48 hours after surgery.**
- By definition, persistent air leak continues beyond the normal hospital stay (**usually 7 days**). This condition usually leads to prolonged hospitalization and increased costs; however, it does **not directly imply a higher morbidity and mortality rate.**



POD #7

Atelectasis

- Atelectasis occurs in **5%–10% of sleeve resections** and is the result of local edema at the anastomotic site, interruption of the ciliary epithelium and lymphatic vessels, or partial denervation of the reimplemented lobe.
- It is seen more often after the sleeve resection of lower lobes because anastomotic kinking is greater when securing the anastomosis between the upper lobar bronchus and the proximal main bronchus.
- In some patients, infection may be superimposed on unresolved atelectatic areas or may result from unrecognized episodes of aspiration.



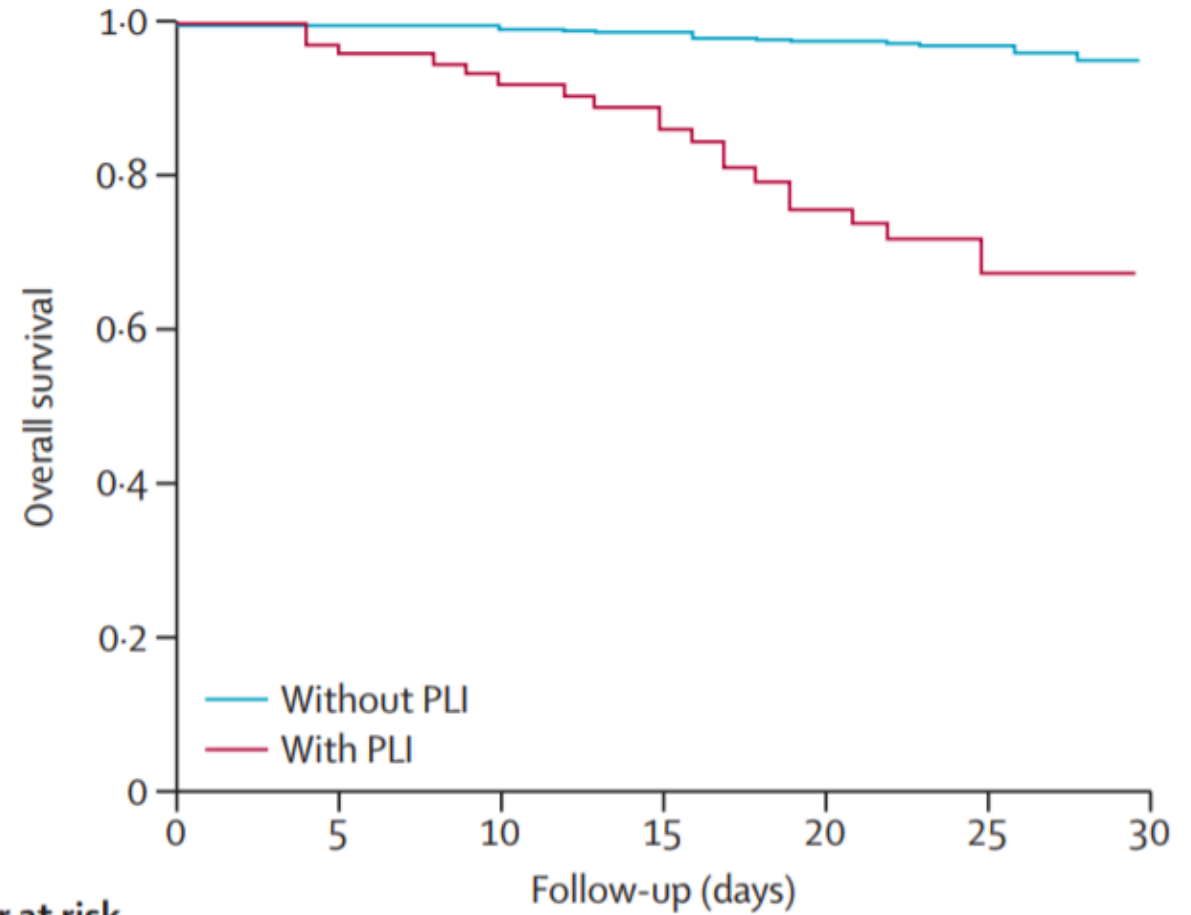
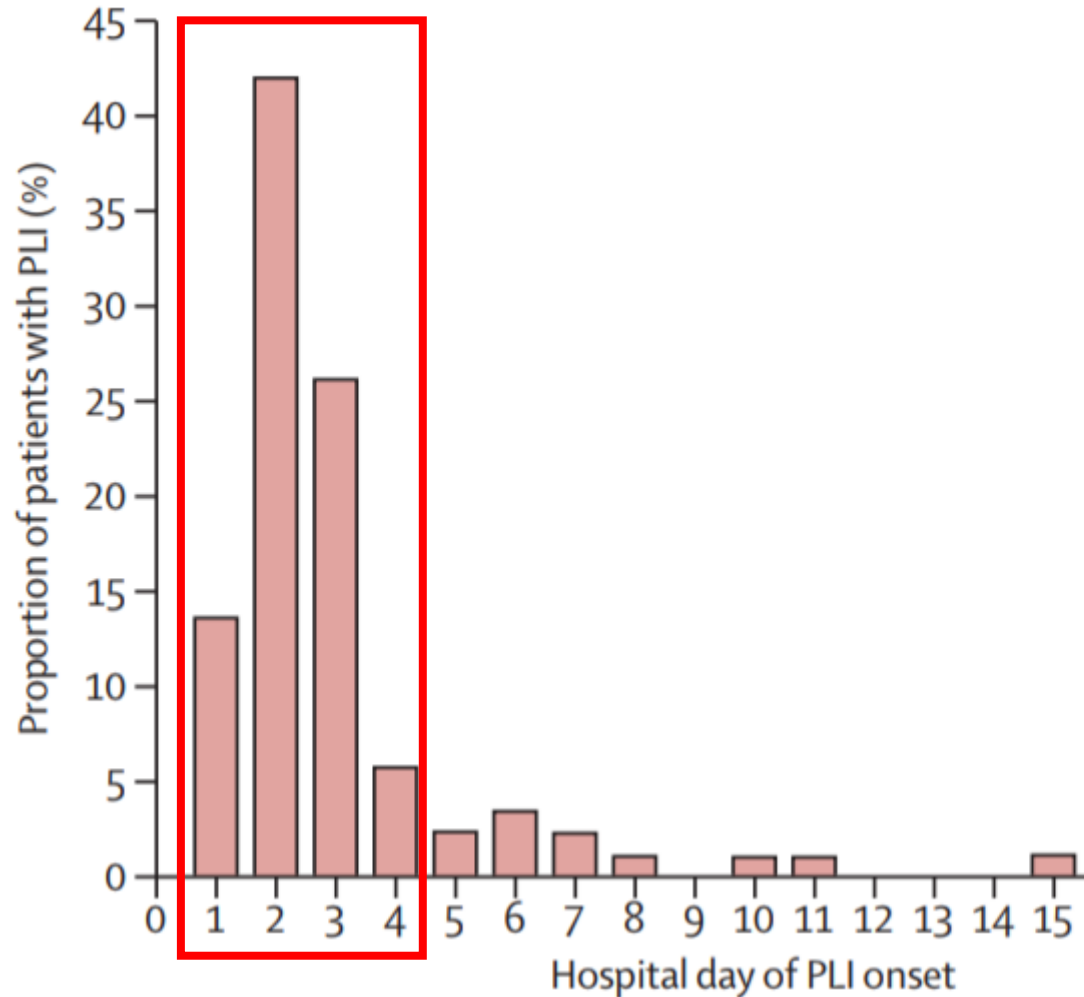
Bronchopleural Fistula (2–13%)

- BPF remains the most dreaded complication following thoracic surgery.
- Prevalence - between 2% and 13%, Mortality rates - from 30% to 70%
- The most common cause of death is aspiration pneumonia with subsequent ARDS
- Frequently occur
 - ✓ After Rt pneumonectomy than after Lt pneumonectomy
 - ✓ associated with postoperative MV
- Predisposing factors
 - preoperative uncontrolled pleuropulmonary infection, trauma, and
 - preoperative radiation therapy
- In the immediate postoperative period, bronchial leaks are rare and are usually due to faulty closure of the bronchus. Delayed BPF is much more common and is usually due to infection or recurrent tumor of the bronchial stump.
- BPF usually develops in the bronchial stump after pneumonectomy or lobectomy and is usually diagnosed with bronchoscopy

Postoperative Acute Lung Injury (PALI)

- Low incidence but, life-threatening complication that develops 2–3 days after pulmonary resection, usually after pneumonectomy, lobectomy, or bilobectomy.
- 2.6–7% in pneumonectomy and 1–3% in lobectomy.
- Rapidly progressing dyspnea, hypoxemia and diffuse lung infiltration, or ARDS
- Treatment of postoperative ALI is based on the management strategies of ARDS, which include general supportive care with lung protective ventilation and restrictive fluid management.

Postoperative lung injury in general



Number at risk

Follow-up (days)	Without PLI	With PLI
0	2782	89
5	2100	74
10	1241	65
15	637	55
20	369	38
25	254	27
30	107	13

Risk factors of postoperative ALI following lobectomy for NSCLC

- Retrospective study (Jan 2012 to Dec 2015), 354 cases in **South Korea**
- Postop ALI (PALI) was defined as bilateral diffuse pul infil on CXR, P/F<300, and absence of sign of LVF
- The overall incidence of PALI was **2.79%** (8/287); 4 of pn with ARDS, 4 of ALI

Logistic regression to evaluate risk factors.

Variables	OR	95% CI	P-value
Ischemic heart disease	7.568	1.207–47.444	0.031
Interstitial lung disease	30.363	2.296–401.524	0.010
Amount of intravascular crystalloid during surgery (ml/kg)	1.099	1.004–1.202	0.040
Intraoperative transfusion	56.400	3.529–901.393	0.004

Clinical outcomes following PALI.

Variables	PALI	Non-PALI	P-value
ICU admission	6 (75.0%)	3 (1.1%)	<0.001
MV care	6 (75.0%)	2 (0.7%)	<0.001
Duration of postoperative hospital stay (days)	23.5 ± 7.54	8.52 ± 5.23	<0.001
Mortality	2 (25.0%)	2 (0.7%)	0.004

Early corticosteroid treatment for Postop ALI after lung cancer surgery

- 7593 patients with lung cancer surgery between Jan 2009 and Dec 2016
- 58 patients (0.8%) patients developed ALI.
- 42 (72%) - corticosteroid Tx < 72 h after ALI (early Tx group)
- 16 (28%) received corticosteroid Tx ≥72 h after ALI (late Tx group).

D0: mPDS 1–2 mg/kg (loading)
 D1-14: 1 mg/kg/day
 D15-21: 0.5 mg/kg/day
 D22-25: 0.25 mg/kg/day
 D26-28: 0.125 mg/kg/day

	Total (n = 58)
Age, years	70 (62–72)
Male	53 (91)
Comorbidities	
COPD	30 (52)
Interstitial lung disease	10 (17)
Hypertension	24 (41)
Diabetes mellitus	18 (31)
Other malignancies	10 (17)
Pulmonary function test	
FEV ₁ % predicted postoperative	63 (54–75)
DL _{CO} % predicted postoperative	51 (44–61)
Approach type	
Open thoracotomy	39 (67)
Minimal invasive surgery	19 (33)
Type of operation	
Partial resection	4 (7)
Lobectomy	43 (74)
Bilobectomy	4 (7)
Pneumonectomy	7 (12)

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 D22-25: 0.25 mg/kg/day
 D26-28: 0.125 mg/kg/day

	Total (n = 58)	Early treatment (n = 42)	Late treatment (n = 16)	p value
Response to corticosteroid treatment ^a	51 (88)	40 (95)	11 (69)	0.014
Weaning from MV within 7 days	22 (51)	17 (57)	5 (39)	0.332
Improvement in LIS	46 (79)	36 (86)	10 (63)	0.072
Weaning from MV	28 (65)	21 (70)	7 (54)	0.305
Complications during corticosteroid treatment				
Arrhythmia	17 (29)	11 (26)	6 (38)	0.520
Delirium	20 (35)	10 (24)	10 (63)	0.012
Superimposed infection	25 (43)	18 (43)	7 (44)	1.0
Surgical site complications				
Persistent air leakage	18 (31)	13 (31)	5 (31)	0.356
Bleeding	1 (2)	0	1 (6)	
ICU mortality	21 (36)	15 (36)	6 (38)	1.0
Length of ICU stay, days	9 (4–28)	8 (4–29)	17 (8–27)	0.247
28-day mortality	7 (12)	6 (14)	1 (6)	0.660
In-hospital mortality	24 (41)	18 (43)	6 (38)	0.773
Length of hospital stay, days	33 (21–46)	30 (21–44)	37 (21–54)	0.254

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PPCs after lung cancer surgery in early-stage COPD

- Prospective study (Jul 2012 and Oct 2014) in **South Korea**
- 351 with NSCLC, 343 patients with FEV1≥70%, 230 (normal PFT), 113 (COPD)
- At least one PPC occurred in 57 (**16.6%**) patients.

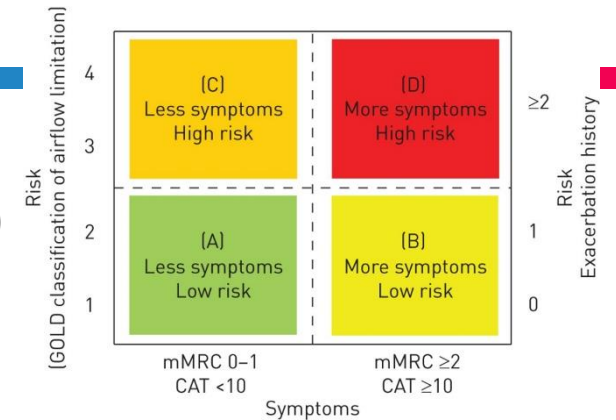


Table 3 Postoperative outcomes

	Total (n=343)	Normal PFT (n=230)	Early COPD			P-value	P-value
			Total (n=113)	Group A (n=71)	Group B (n=42)		
PPCs	57 (16.6)	23 (10.0)	34 (30.1)	17 (23.9)	17 (40.5)	0.064	<0.001
Persistent air leak	30 (8.7)	15 (6.5)	15 (13.3)	9 (12.7)	6 (14.3)	0.807	0.037
Bacterial pneumonia	28 (8.2)	11 (4.8)	17 (15.0)	7 (9.9)	10 (23.8)	0.045	0.001
Atelectasis requiring BFS	8 (2.3)	4 (1.7)	4 (3.5)	3 (4.2)	1 (2.4)	1.000	0.299
Reintubation within 48 hours	5 (1.5)	5 (2.2)	0 (0.0)	0 (0.0)	0 (0.0)	–	0.176
Prolonged MV	4 (1.2)	4 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)	–	0.306
Tracheostomy	3 (0.9)	3 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	–	0.554
AIP	1 (0.3)	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	–	1.000
Empyema	1 (0.3)	0 (0.0)	1 (0.9)	0 (0.0)	1 (2.4)	0.372	0.329
Hospital LOS, days	7.8 (3–157)	7.3 (3–157)	8.7 (4–37)	8.6 (4–34)	9.0 (5–37)	0.114	0.265
In-hospital death	3 (0.9)	3 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	–	0.554

Long-term impact of PPCs after lung surgery

- Melbourne, prospective observational study (2010~2014)
- 670 patients who underwent pulmonary resections
- 86 of 670 patients (13%) developed a PPC

Gender	Male	377 (66%)
	Female	293 (44%)
Type of surgery	Lobectomy	497 (74%)
	Subsegmentectomy/wedge	111 (16%)
VATS	Pneumonectomy	37 (6%)
	Exploratory/biopsy	13 (2%)
	Sleeve	8 (1%)
	Chest wall	4 (1%)
	Yes	62 (9%)
	No	608 (91%)
Analgesia	Epidural	254 (38%)
	Intrathecal morphine	146 (22%)
	Morphine Infusion	63 (9.5%)
	PCA	50 (7.5%)
	Paravertebral	146 (22%)
	Other	5 (1%)
COPD	Yes	176 (26%)
	No	494 (74%)
COPD severity (FEV ₁ % predicted)	Mild (<80)	51 (29%)
	Moderate (50-80)	95 (54%)
	Severe (30-50)	27 (16%)
Smoking status	Current	149 (22%)
	Ex	391 (68.5%)
	Never	129 (22.5%)

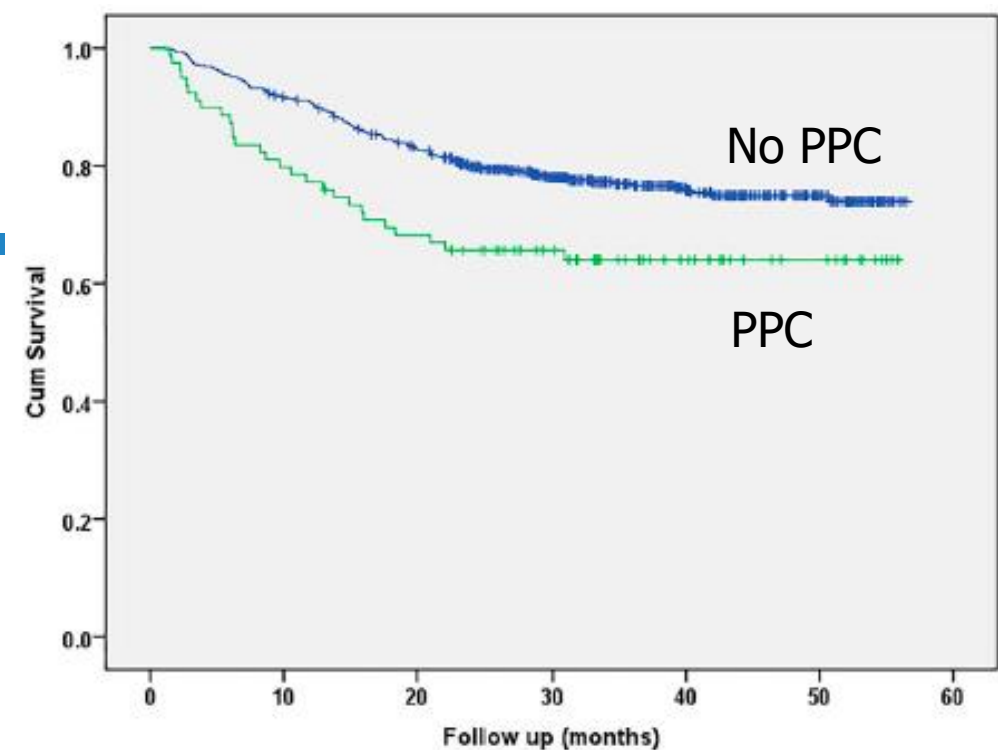


Table 4 Significant Independent risk factors for late deaths in patients with non-small cell lung cancer

Variables	Estimate	SE	p Value	HR	95% CI
PPC	0.69	0.25	0.006	2.00	1.19 to 3.20
Staging II/IVB	1.07	0.22	<0.001	2.92	1.89 to 4.56
Staging IIIA	1.28	0.25	<0.001	3.60	2.20 to 5.85
Staging IIIB	1.91	0.61	0.002	6.72	1.61 to 18.90
Age	0.03	0.01	0.003	1.04	1.01 to 1.06
Readmission (30 days)	0.62	0.23	0.008	1.86	1.15 to 2.89

PPCs after lung cancer surgery in early-stage COPD

- Prospective study (Jul 2012 and Oct 2014)
- 351 with NSCLC, 343 patients with FEV1 \geq 70%
- At least one PPC occurred in 57 (16.6%) patients.

Table 4 Multivariate analysis of risk factors for PPCs

Variable	OR	95% CI	P-value
All patients			
COPD	3.42	1.775–6.596	<0.001
Post-TB lesion on CXR	2.73	1.178–6.345	0.019
BMI, kg/m ²	0.77	0.688–0.870	<0.001
DL _{CO} , % pred	0.97	0.957–0.991	0.003
Operation time (minutes)	1.01	1.002–1.012	0.004
Patients with early COPD			
BMI, kg/m ²	0.80	0.681–0.941	0.007
DL _{CO} , % pred	0.97	0.944–0.996	0.024
Operation time (minutes)	1.01	1.004–1.018	0.003
Non-COPD patients			
Post-TB lesion on CXR	4.43	1.248–15.690	0.021
Sex, male	3.39	1.059–10.858	0.040
BMI, kg/m ²	0.71	0.589–0.851	<0.001
DL _{CO} , % pred	0.97	0.943–0.990	0.005

PPCs following thoracic surgery: any modifiable factors?

- A prospective observational study, Oct 2007~Oct 2008 in UK
- 234 subjects following lung resection via thoracotomy
- 34 of 234 subjects (14.5%) had clinical evidence of PPC.

Table 3 Statistically significant risk factors for developing PPC

	PPC group (n=34)	Non-PPC group (n=200)	p Value
Median (95% CI) age (years)	71 (43 to 83)	65 (31 to 80)	0.005
BMI \geq 30 kg/m ²	36.4% (n=12)	18.2% (n=34)	0.001
Activity <400 m	52.9% (n=18)	26.8% (n=52)	0.025
ASA \geq 3	84.8% (n=28)	51.5% (n=102)	<0.001
Current smoking	35.2% (n=12)	11.9% (n=23)	<0.001
COPD	38.2% (n=13)	11.9% (n=23)	<0.001
Mean \pm SD %FEV ₁	72 \pm 18	83 \pm 19	0.014
Mean \pm SD PPO FEV ₁	58 \pm 17	66 \pm 19	0.048

ASA, American Society of Anesthesiologists; BMI, body mass index; COPD, chronic obstructive pulmonary disease; FEV₁, forced expiratory volume in 1 s; PPC, postoperative pulmonary complications; PPO, predicted postoperative.

Smoking Cessation on Surgical Outcome in Primary Lung Cancer

- Retrospective study on 666 patients with stage I to III primary lung cancer (between 2012 and 2016)
- All 660- 256 (38.4%) were never smokers and 410 (61.6%) were smokers. (Japan)
- 86 of 660 patients (13%) developed a PPC

Table 3. Univariate and Multivariate Analyses to Identify Predictors of Pulmonary Complication

Variable	Univariate Analysis			Multivariate Analysis		
	Odds Ratio	95% CI	p Value ^a	Odds Ratio	95% CI	p Value
Age	1.034	1.009–1.060	0.008	...	...	...
Sex: male	3.922	2.193–6.897	<0.001	...	...	...
Smoker versus never smoker	6.346	3.121–12.905	<0.001	2.832	1.203–6.670	0.017
Smoking status (pack-year)	1.020	1.020–1.020	<0.001	...	...	...
Current smoker or not	3.676	1.927–6.993	<0.001	...	...	...
%VC < 80%	2.488	1.294–4.784	0.006	...	...	...
FEV _{1.0} /FVC < 0.7	3.715	2.304–5.991	<0.001	2.656	1.481–4.764	0.001
%DLCO < 40%	5.909	3.275–10.661	<0.001	4.217	2.238–7.946	<0.001
Surgical procedure	1.543	0.916–2.602	0.103	...	...	...
Cancer stage c-II and III versus I	3.754	2.336–6.032	<0.001	2.320	1.293–4.163	0.005

Smoking Cessation on Surgical Outcome in Primary Lung Cancer

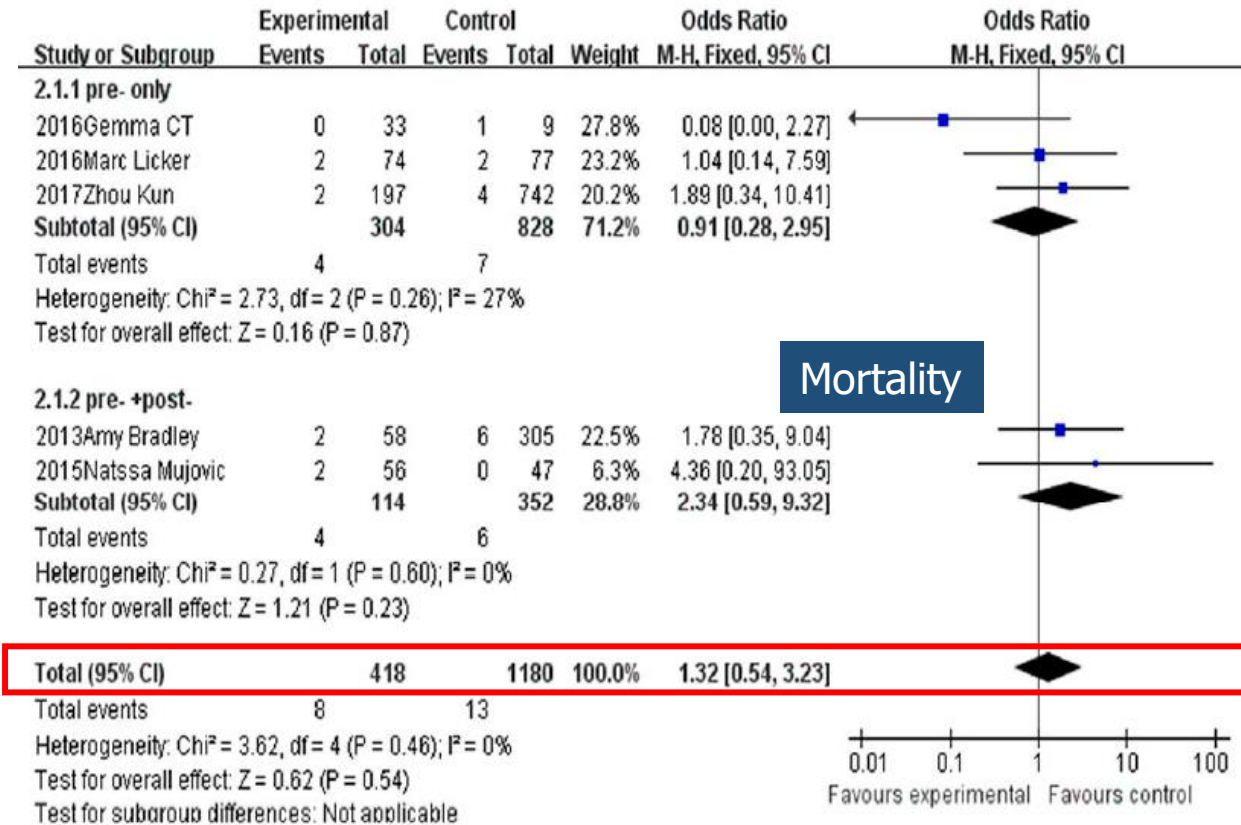
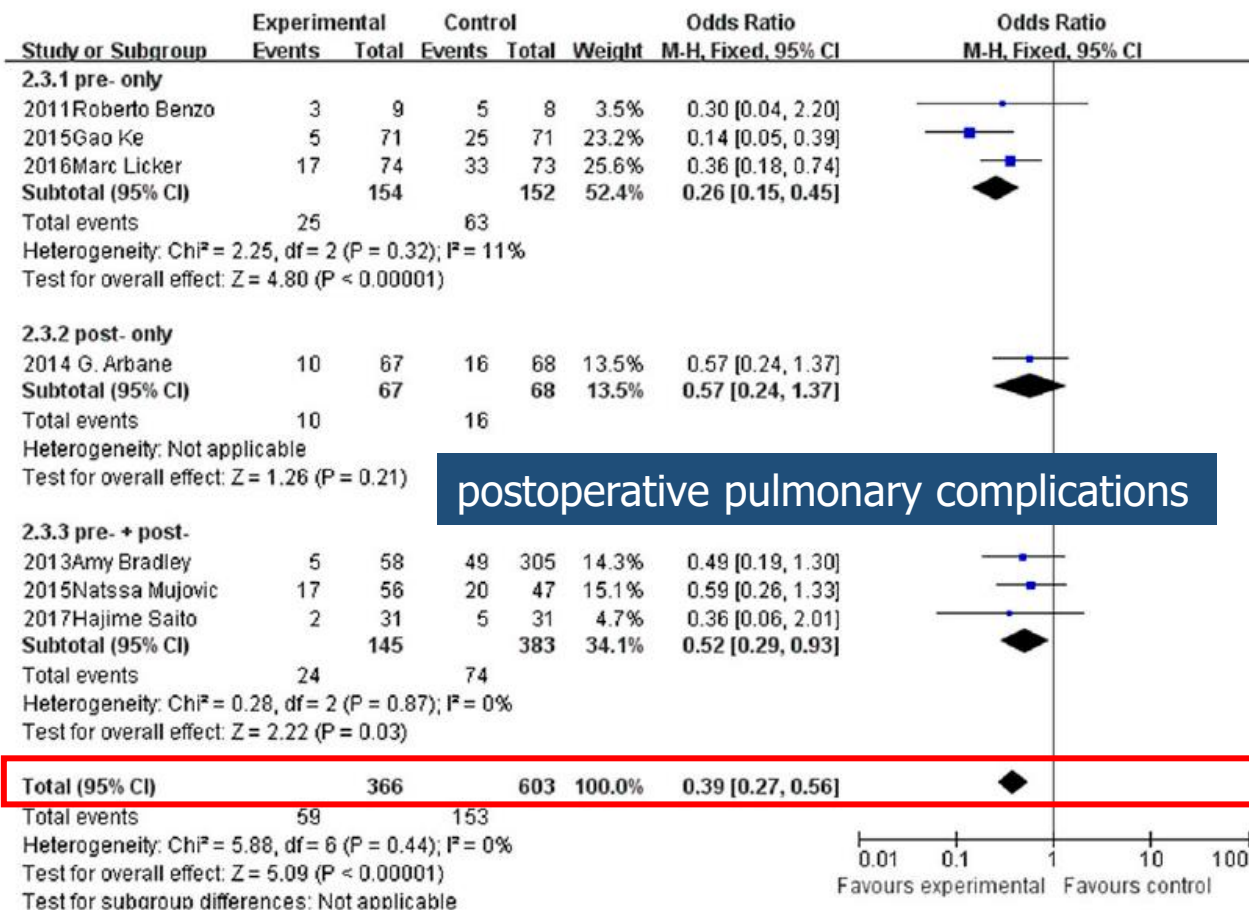
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Table 4. Pulmonary Complications by Smoking Status

Variable	Number	Pulmonary Complications, n (%)	Odds Ratio ^a	95% CI	p Value
Overall	660	86	...	...	...
Never smoker	256	9 (3.5)	...	...	...
Smoker	410	77 (22.3)	6.346	3.12–12.91	<0.001
Preoperative smoking cessation duration					
Current	50	16 (32.0)	12.915	5.294–31.509	<0.001
<1 month	22	6 (27.3)	10.292	3.258–32.508	<0.001
1–3 months	21	5 (23.8)	8.576	2.572–28.602	<0.001
3–6 months	16	4 (25.0)	6.333	1.530–26.222	0.011
6–12 months	28	5 (17.9)	5.966	1.845–19.295	0.003
>12 months	248	38 (15.3)	4.966	2.347–10.508	<0.001

^a Compared with never smoker.

Pulmonary Rehab in reducing PPCs and Mortality of Lung Cancer Resection: A Systematic Review and Meta-Analysis



Pulmonary rehabilitation may **not affect the mortality** of pulmonary resection patients, however, it could **decrease the number of** postoperative complications, **especially pulmonary complications.**

Risk factors for postop pneumonia after lung cancer surgery

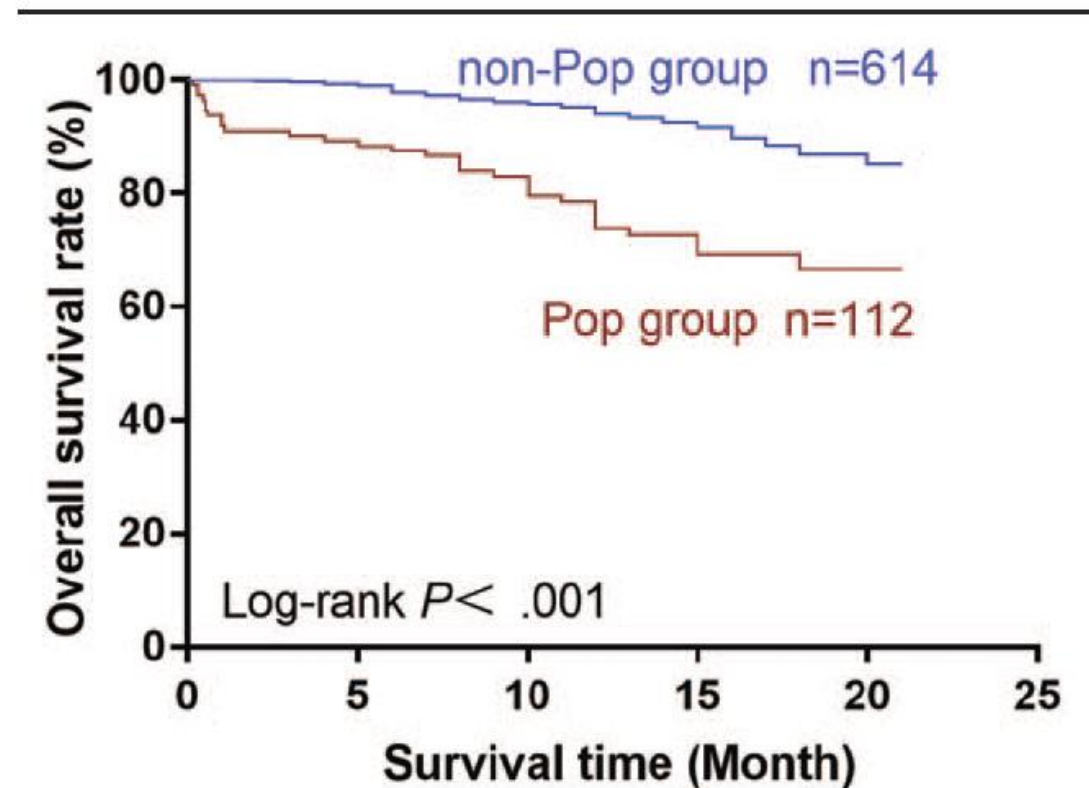
- Retrospective study (Aug 2017~Jul 2018)
- 726 patients who underwent surgery for stages I–III lung cancer at a single institution in **China**
- 112 patients with POP (112/726, **15.43%**) during the follow-up period (30 days).

Multivariate logistic regression analyses for postoperative pneumonia.

Variable	OR for POP (95%CI)	P
Smoking (current or former)	2.672 (1.586–4.503)	<.001
DLCO (% predicted)		.001
60%–79% vs ≥80%	1.319 (0.771–2.258)	.313
40%–59% vs ≥80%	4.328 (1.976–9.481)	<.001
<40% vs ≥80%	4.725 (1.352–16.514)	.015
AGR (≤1.69)	2.108 (1.257–3.535)	.005
Resection type		<.001
Anatomic segmentectomy vs lobectomy	0.248 (0.032–1.926)	.183
Wedge resection vs lobectomy	0.613 (0.113–3.220)	.570
Pneumonectomy vs lobectomy	10.563 (3.828–29.146)	<.001
Sleeve resection vs lobectomy	12.832 (2.855–57.676)	.001
EIBL (mL)		.006
100–199 vs <100	1.274 (0.485–3.347)	.623
≥200 vs <100	2.741 (1.111–6.767)	.029
nCT	4.817 (1.204–19.265)	.026
APACHE II (≥10)	2.304 (1.382–3.842)	.001

Risk factors for postop pneumonia after lung cancer surgery

- Retrospective study (Aug 2017~Jul 2018)
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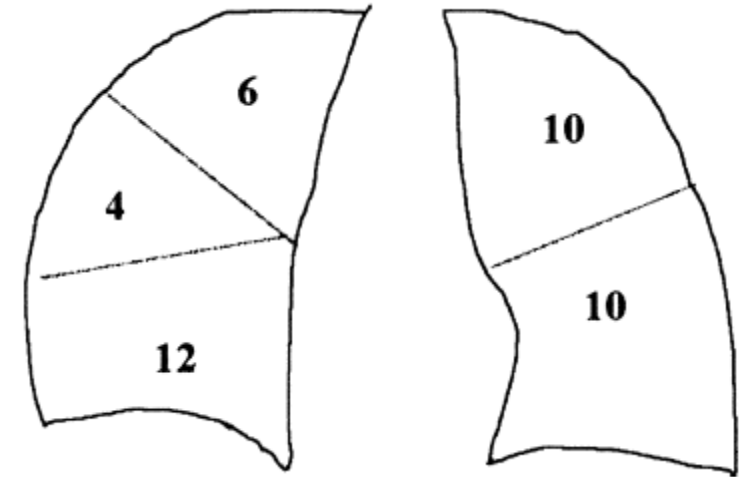


Today

- Postoperative pulmonary complication (PPC) after lung resection surgery의 종류와 진단
- lung cancer surgery 이후의 PPC의 위험요인
- lung cancer surgery 환자에 대한 Preoperative evaluation

Lung Mechanical Function, Spirometry

- predicted postoperative(ppo) FEV1 or DLco
- The **ppoFEV1** is the most significant independent predictor of complications among a variety of historical, physical, and laboratory tests for patients.
- ppoFEV1(or DLco)%
= preoperative FEV1%(or DLco) x (1 - % functional lung tissue removed /100)
- In 156 patients with lung cancer who underwent resection,
 - ✓ ppoFEV1 <40% - major respiratory complications could be seen
 - ✓ ppoFEV1 <30% required postoperative mechanical ventilator support→ Special attention to postoperative management is needed for patients with **ppoFEV1 <30%**

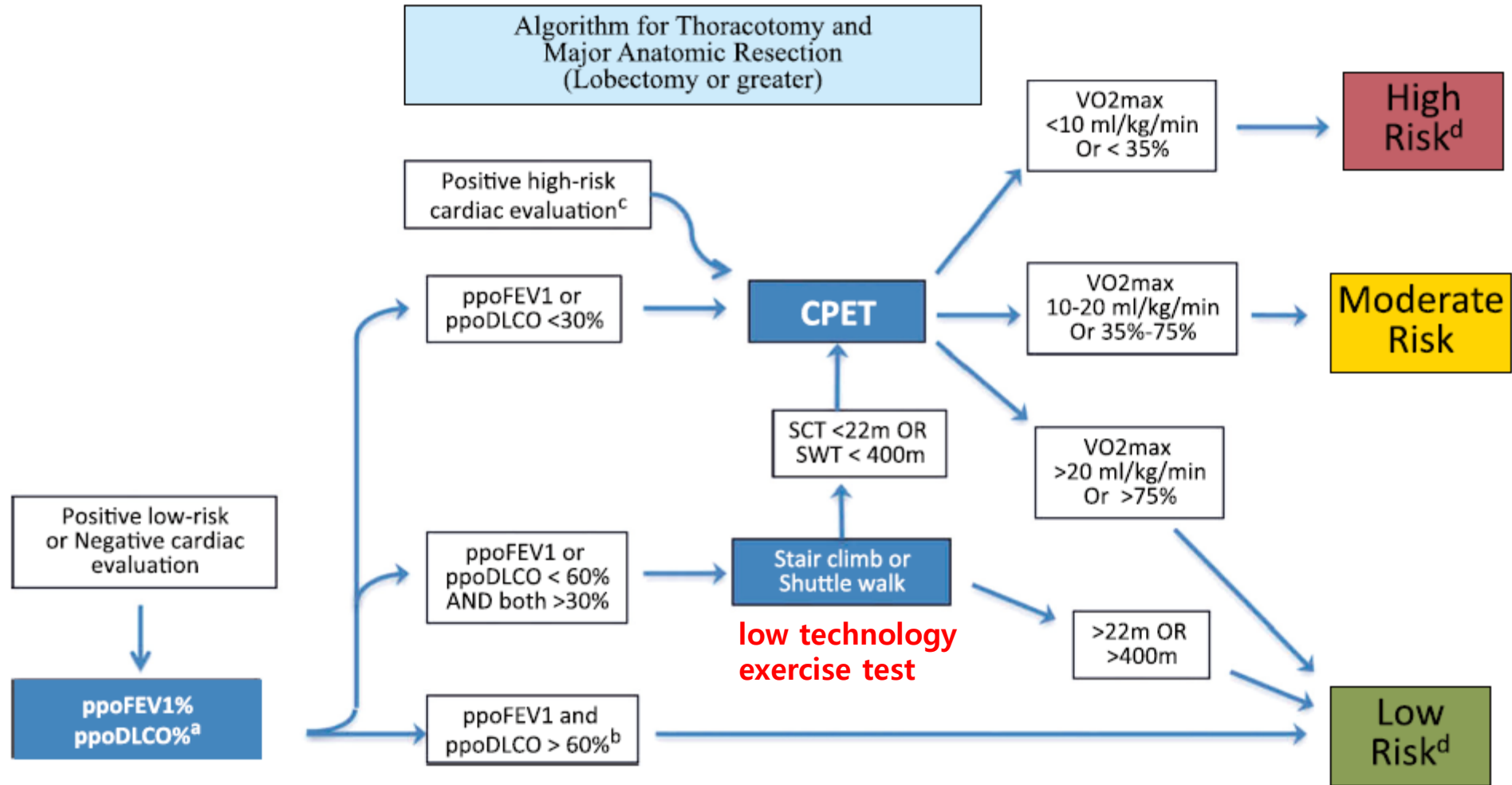


ACCP Guideline 2013

- The preoperative physiologic assessment should begin with **spirometry** to measure the FEV1 and the diffusing capacity for carbon monoxide (DLco).
 - **Predicted postoperative (PPO) lung functions** should be calculated.
- ppoFEV1 and ppoDLco values are both **> 60%**
 - **low risk** of anatomic lung resection, and no further tests are indicated.
- ppoFEV1 and ppoDLco values are **within 60% and 30%** predicted,
 - a **low technology exercise test** should be performed as a screening test.
 - * satisfactory : stair climbing test altitude > 22 m or shuttle walk test distance > 400 m → **low risk**
 - not satisfactory : stair climbing test altitude < 22 m or shuttle walk test distance < 400 m
- ppoFEV1 and ppoDLco values are (or both) **<30%** or low technology exercise test is **not satisfactory**
 - **A cardiopulmonary exercise test is indicated.**

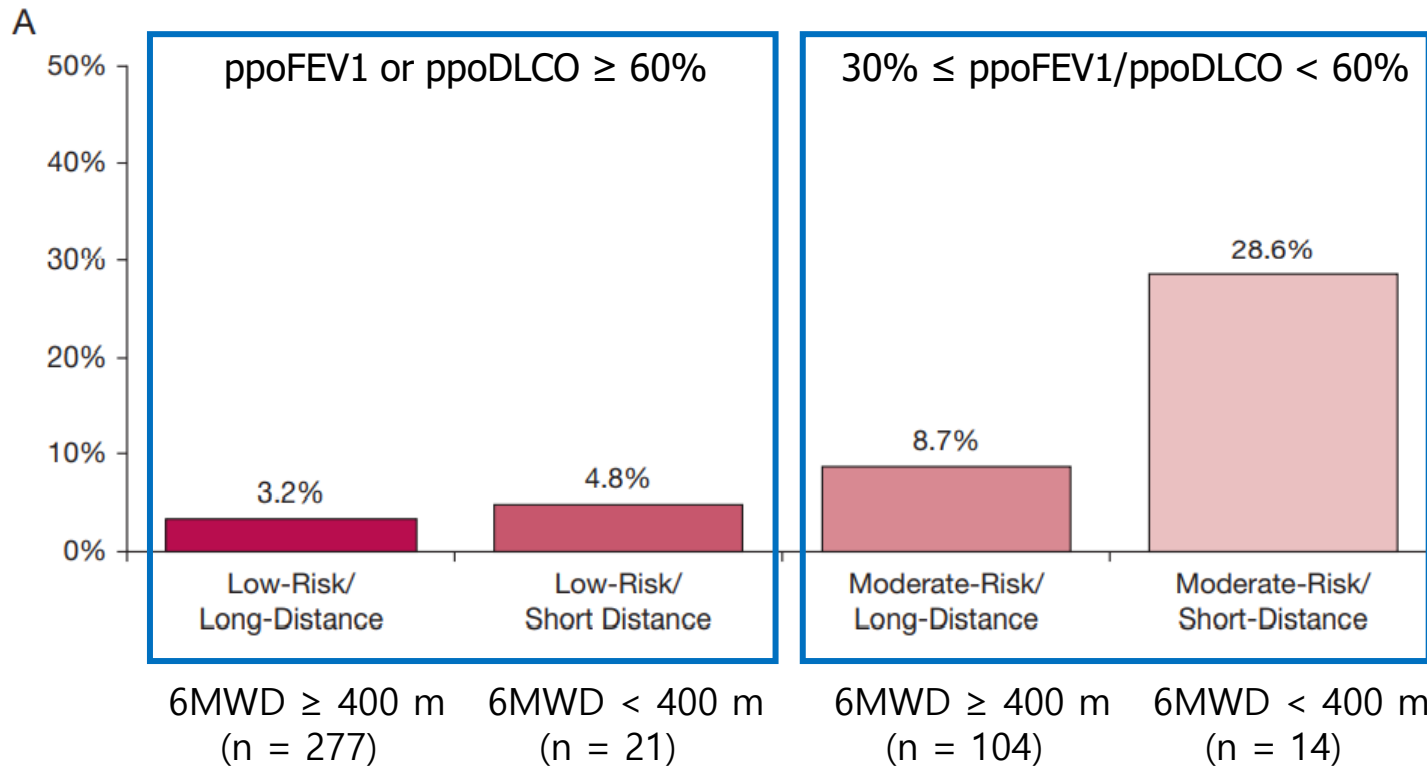
ACCP Guideline 2013

- Actual Risks affected by parameters defined here and:
- Patient Factors: Comorbidities, age
 - Structural Aspects: center (volume, specialization)
 - Process factors: Management of complications
 - Surgical access: Thoracotomy vs. minimally invasive



Prognostic Value of 6MWT to Predict Postoperative Cardiopulmonary Complications in NSCLC

- 416 patients who underwent lobectomy for NSCLC (Mar 2016 to Oct 2018), **South Korea**
- low-risk group (ppoFEV1 and ppoDLCO $\geq 60\%$) or moderate-risk group ($30\% \leq$ ppoFEV1 or ppoDLCO $< 60\%$)
- each group was then further classified into short-distance (< 400 m) or long-distance (≥ 400 m) groups according to **6MWT**
- Incidence of postoperative cardiopulmonary complications occurring within the first 30 postoperative day



Overall incidence of PPCs
= **5.5%** (23/416)

Summary

- 폐절제를 시행한 환자에서 PPC (Postoperative pulmonary complication)은 다양한 합병증을 포함한다.
 - Hemothorax, Chylothorax, Persistent Air Leak, Bronchopleural Fistula, Postpneumonectomy Empyema
 - Atelectasis, Pneumonia, Postoperative Acute lung injury(PALI)
- 폐절제를 시행한 환자에서 PPC incidence는 13~24.8%.
 - Postoperative pneumonia(POP)는 3.6~15.43%
 - Postoperative Acute lung injury(PALI) 는 0.8-2.79%
- 폐절제를 시행할 환자에서 preoperative evaluation에서 폐기능 검사는 중요하다.

Thank you for your attention

You can find me at:

dongwonpark@hanyang.ac.kr
portrayme@gmail.com

