PRE-OPERATIVE PULMONARY ASSESSMENT

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| The Lung Center |

Disclosures

- None

- 72 yo male with COPD,CAD, HFpEF
- Pre-op LV aneurysm/thrombus repair/removal. Thrombus "large and mobile".

- FEV1 1.15 -> 1.44 (41%): (25% increase)
- FVC 2.55 -> 3.07 (66%) (20% increase)
- Able to walk > 100 ft and climb a flight of stairs before stopping.
- RVSP 30 + RA

- 50 yo woman with BOS s/p BMT pre-op for resection and RND for SCCA buccal mucosa. Procedure anticipated to be 8 hours.

- FEV1 is 0. 45 liters (16%)
- FVC is 1.86 liters (61%)
- Echo without elevated PA pressure

Introduction

- **Postoperative pulmonary complications are equally prevalent and contribute similarly to morbidity and mortality compared with cardiac complications.**

- **Pulmonary complications are:**
  - **1. more likely than cardiac complications to predict long-term mortality**
  - **2. more costly than the other major postoperative complications including cardiac, thromboembolic and infectious**
  - **3. result in the longest length of stay**

- **Which definition is used determines the prevalence.**

Ann Intern Med 2006;144:581-595

Post-operative pulmonary complications

- **Atelectasis**
- **Infection**
- **Bronchospasm**
- **Respiratory failure/prolonged mechanical ventilation**
- **Exacerbation of chronic lung disease**

- **Definition:**
  - **Pulmonary abnormality that produces identifiable disease or dysfunction that is:**
    - **Clinically significant**
    - **Affects clinical course**

RISK STRATIFICATION
Non-lung resection surgery

- **Patient-related issues**
  - POOR COUGH
  - INCREASES ATELECTASIS
- **Surgery-related issues**
  - WORSE V/Q MATCHING

Upper abdominal surgery, for example, may be associated with reduced vital capacity 50-60%. May be decreased for a week.

RISK ASSESSMENT
Patient-related issues

- **COPD**
  - **One of the most frequently identified patient-related risk factor**
  - **No prohibitive level of pulmonary function (<u>for non-lung resection surgery</u>)**

- **Other chronic lung disease**

  - Insufficient data to quantify the risk of restrictive lung diseases
  - Abnormal findings on chest exam, however, have been shown in 2 small studies to be predictive of postoperative pulmonary complications

Preoperative Evaluation of Patients With Interstitial Lung Disease

Note: based on published data and expert opinion

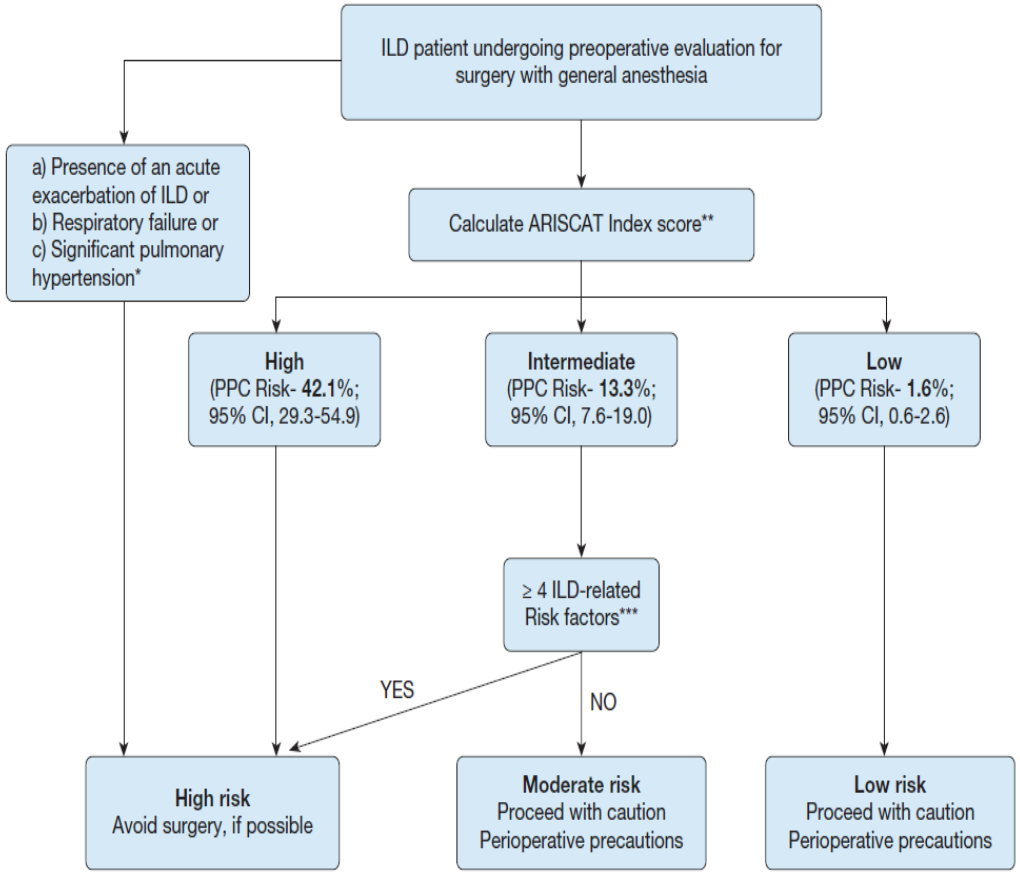
*Nina M. Patel, MD, FCCP; Tejaswini Kulkarni, MD, MPH; Daniel Dilling, MD, FCCP; and Mary Beth Scholand, MD, FCCP; the Interstitial and Diffuse Lung Disease Network Steering Committee**

CHEST 2019; 156(5):826-833

ARISCAT Index

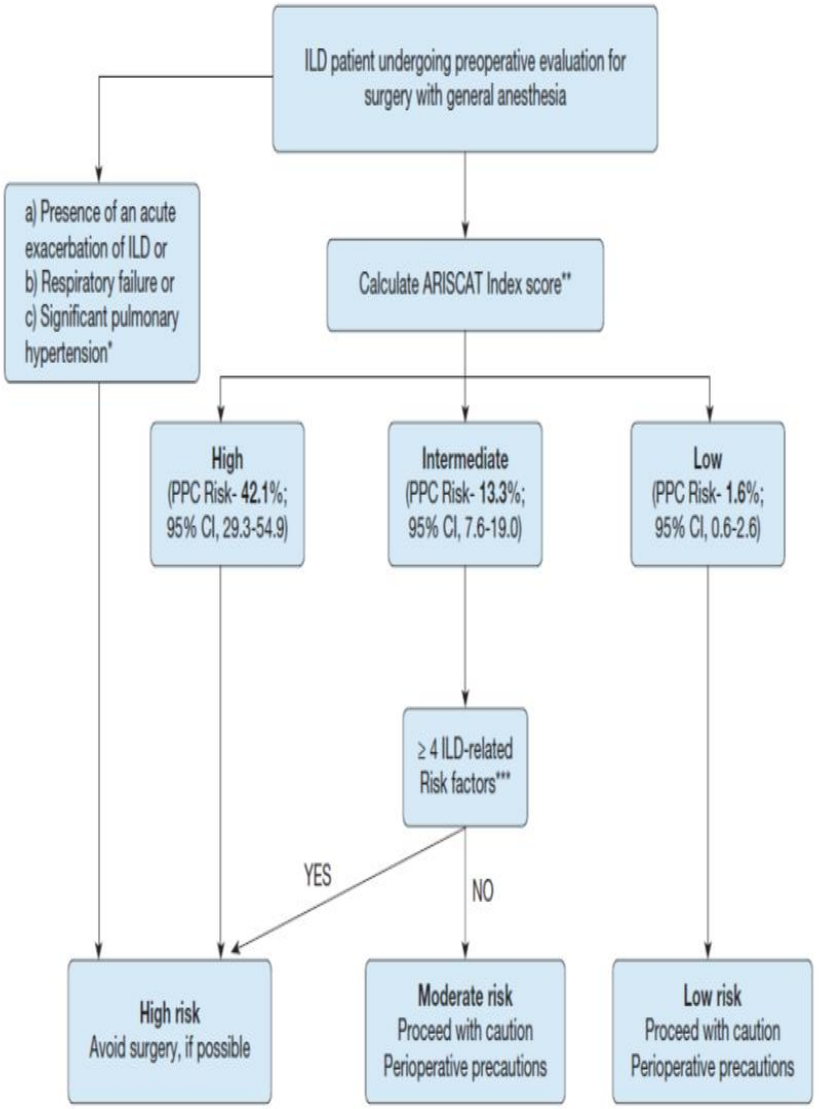
Independent Predictor of PPC Risk	Risk Score
Age, y	
≤ 50	0
51-80	3
> 80	16
Preoperative Spo_2 %	
≥ 96	0
91-95	8
≤ 90	24
Respiratory infection in the last month	17
Preoperative anemia (< 10 g/dL)	11
Surgical incision site	
Peripheral	0
Upper abdominal	15
Intrathoracic	24
Duration of surgery, h	
≤ 2	0
> 2 to 3	16
> 3	23
Emergency procedure	8

PPC Risk (Based on Cumulative Score)	ARISCAT Score
Low risk: 1.6% PPC risk	0-25
Intermediate risk: 13.3% PPC risk	26-44
High risk: 42.1% PPC risk	45-123



Patient- and Procedure-Related Risk Factors for ILD-Related PPCs

Factor	Reference(s)
Patient-related factors	
Male sex	3, 15
D_{LCO} < 60% predicted	14, 16, 17
Preoperative home oxygen requirement	18, 19
Presence of acute exacerbation of ILD	13, 20
Pulmonary hypertension[a]	18
Charlson Comorbidity Index score ≥ 2	3
Immunosuppressed status	13, 15
OSA[b]	…
Procedure-related factors	
General anesthesia	25, 26
Emergency surgery	1, 3
Longer duration of anesthesia/ longer operative time (> 2 h)	1, 14, 15
Pulmonary/thoracic surgery	1
Open rather than thorascopic surgery	3
Pneumonectomy or lobectomy (vs wedge resection)[c]	14, 15



RISK ASSESSMENT
Patient-related issues

- **Age**
  - **50 is an independent risk for complications.**
  - **50-59: OR 1.5**
  - **60-69: OR 2.28**
  - **70-79: OR 3.9**
  - **> or = 80: OR 5.63**

- **Metabolic**:
  - **Albumin < 3 g/dL**
  - **Blood urea nitrogen > 30 mg/dL**

RISK ASSESSMENT
Patient-related issues

- **Smoking**
  - **Increased risk if actively smoking at the time of surgery**
  - **No increased risk if stopped > 6 months**
  - **Smoking cessation of at least four weeks prior to surgery begins to lower the measureable risk but the true benefits may begin earlier.**
  - **There may be a relationship between risk and the amount of smoking.**

RISK ASSESSMENT
Patient-related issues

- **Functional dependence/ASA class: has been shown to correlate with post-op pulmonary complication. ASA class > 2 associated with 4.87 fold increased risk.**

  - **Class I:** Normally healthy patient
  - **Class II:** Patient with mild systemic disease
  - **Class III:** Patient with systemic disease that is not incapacitating
  - **Class IV:** Patient with an incapacitating systemic disease that is a constant threat to life
  - **Class V:** Moribund patient not expected to survive for 24 hours or without an operation

RISK ASSESSMENT
Patient-related issues

- **Pulmonary hypertension**: associated with higher risk postoperatively (CHF, resp failure, dysrhythmia, renal insufficiency, sepsis) regardless of etiology and even in patients with mild-moderate disease.

  Risk predictors: h/o PE, NYHA class > or = 2, anesthesia > 3hr

- **Congestive heart failure**: risk for post-op pulmonary complications is as high or higher then those with COPD (the Goldman risk index predicts postop pulmonary complications).

RISK ASSESSMENT

Patient-related issues

- **Obesity**
  - **No added risk even with morbid obesity**

HOWEVER

- **Obstructive sleep apnea IS a risk for complications including hypoxemia and unplanned reintubation and possibly pneumonia and respiratory failure.**

RISK ASSESSMENT: (NON-LUNG RESECTION)

- **Significance controversial:**
  - **Asthma**
    - **Well-controlled vs. poorly controlled**
  - **Upper respiratory infections**

RISK ASSESSMENT:
(NON-LUNG RESECTION)

Table 3. **Summary Strength of the Evidence for the Association of Patient, Procedure, and Laboratory Factors with Postoperative Pulmonary Complications***

Factor	Strength of Recommendation†	Odds Ratio‡
Potential patient-related risk factor		
Advanced age	A	2.09–3.04
ASA class ≥ II	A	2.55–4.87
CHF	A	2.93
Functionally dependent	A	1.65–2.51
COPD	A	1.79
Weight loss	B	1.62
Impaired sensorium	B	1.39
Cigarette use	B	1.26
Alcohol use	B	1.21
Abnormal findings on chest examination	B	NA
Diabetes	C	
Obesity	D	
Asthma	D	
Obstructive sleep apnea	I	
Corticosteroid use	I	
HIV infection	I	
Arrhythmia	I	
Poor exercise capacity	I	
Potential procedure-related risk factor		
Aortic aneurysm repair	A	6.90
Thoracic surgery	A	4.24
Abdominal surgery	A	3.01
Upper abdominal surgery	A	2.91
Neurosurgery	A	2.53
Prolonged surgery	A	2.26
Head and neck surgery	A	2.21
Emergency surgery	A	2.21
Vascular surgery	A	2.10
General anesthesia	A	1.83
Perioperative transfusion	B	1.47
Hip surgery	D	
Gynecologic or urologic surgery	D	
Esophageal surgery	I	
Laboratory tests		
Albumin level < 35 g/L	A	2.53
Chest radiography	B	4.81
BUN level > 7.5 mmol/L (>21 mg/dL)	B	NA
Spirometry	I	

Smetana, G. W. et. al.
Ann Intern Med 2006;144:581-595

RISK ASSESSMENT:
Surgery-related issues

- **Site**
  - **Complications inversely related to distance from incision to diaphragm.**
- **Duration**
  - **< 2 hr/8% vs > 4 hr/40%**
- **Anesthesia**
  - **GA > regional/spinal**

RISK ASSESSMENT
NON-LUNG RESECTION

- **History**
- **Physical exam Labs: albumin, BUN**
- **Pulmonary function testing?**
- **Arterial blood gas?**
- **Chest x-ray?**

ACP guidelines

- "Preoperative spirometry and chest radiography should not be used routinely for predicting risk for postoperative pulmonary complications"

- Since publication of the guidelines in 2006, physicians have become more selective in their use of preop PFT's but still are less inclined to adhere to guidelines for chest xray.
    - 20% of preop chest xrays are abnormal but less then 3% influence perioperative management.

JAMA Internal Med 2015;175:1359-61.

RISK ASSESSMENT

- **ABG:** Not routinely necessary.

  pCO2 not an independent predictor of postop pulmonary complications.

Pulmonary Function Test

May have a role in determining cause of dyspnea, suspected COPD, etc. prior to surgery in order to better assess risk and also optimize patients pre-op.

RISK MODIFICATION
PRE-OP

- **Smoking cessation at least 4 weeks (8+ would be better) preop**

- **Optimize the treatment of COPD and asthma.**

- **Minimize wheezing:**
  - **Beta-agonists**
  - **Systemic corticosteroids if persistent wheezes despite usual outpatient meds.**

RISK MODIFICATION
PRE-OP

- **Use of perioperative systemic corticosteroids**:
  - **For asthmatics with wheezing, productive cough, chest tightness, SOB on usual treatment.**
  - **Peak flow or FEV1 < 80% of their best despite their usual treatment.**

RISK MODIFICATION
PRE-OP

- **Use of perioperative antibiotics:**
  - **If clinically apparent infection**
  - **? If bronchiectasis or immunodeficiency**

RISK ASSESSMENT INDICES

- Cardiopulmonary risk index
- **Lawrence risk index**
- Brooks-Brunn risk index
- **Multifactorial risk index (Arozullah)**
- **ARISCAT preoperative risk index**

ARISCAT risk index

Post-op pulmonary complications

- Age
  - < or = 50 (0 pts)
  - 51-80 (3 pts)
  - > 80 (16 pts)
- Preoperative oxygen saturation
  - > or = 96% (0 pts)
  - 91-95% (8 pts)
  - < or = 90% (24 pts)
- Other clinical risk factors
  - Resp infection in the last month (17 pts)
  - Preop anemia with Hgb < or = 10 g/dl (11 pts)
  - Emergency surgery (8 pts)
- Surgical incision
  - Upper abd (15 pts)
  - Intrathoracic (24 pt)
- Duration of surgery
  - < or = 2 hr (0 pts)
  - 2-3 hr (16 pt)
  - > 3 hr (23 pt)

• 0-25 pt:	Low risk (1.6%)
• 26-44 pt:	Intermediate (13.3 %)
• 45-123 pt:	High risk (42%)

Multifactorial risk index: Predicting postop pneumonia after major noncardiac surgery

Preoperative Risk Factor	Point Value
Type of surgery	
Abdominal aortic aneurysm repair	15
Thoracic	14
Upper abdominal	10
Neck	8
Neurosurgery	8
Vascular	3
Age	
≥80 y	17
70–79 y	13
60–69 y	9
50–59 y	4
Functional status	
Totally dependent	10
Partially dependent	6
Weight loss > 10% in past 6 months	7
History of chronic obstructive pulmonary disease	5
General anesthesia	4
Impaired sensorium	4
History of cerebrovascular accident	4
Blood urea nitrogen level	
<2.86 mmol/L (<8 mg/dL)	4
7.85–10.7 mmol/L (22–30 mg/dL)	2
≥10.7 mmol/L (≥30 mg/dL)	3
Transfusion > 4 units	3
Emergency surgery	3
Steroid use for chronic condition	3
Current smoker within 1 year	3
Alcohol intake > 2 drinks/d in past 2 weeks	2

< or = 15 points: risk = < 0.3%

> or = 55 points: risk = 16%

Arozullah et al. Ann Intern Med 2001;135:847-857

Multifactorial risk index: Predicting postop respiratory failure after major noncardiac surgery

RESPIRATORY FAILURE RISK INDEX

Preoperative Predictor	Point Value
Type of surgery	
Abdominal aortic aneurysm	27
Thoracic	21
Neurosurgery, upper abdominal, or peripheral vascular	14
Neck	11
Emergency surgery	11
Albumin (<30 g/L)	9
Blood urea nitrogen (>30 mg/dL)	8
Partially or fully dependent functional status	7
History of chronic obstructive pulmonary disease	6
Age (years)	
≥70	6
60–69	4

RESPIRATORY FAILURE RISK INDEX SCORES FOR PHASE I AND PHASE II PATIENTS

Class	Point Total	n (%);*	Predicted Probability of PRF	Phase I (% RF)	Phase II (% RF)
1	≤10	39,567 (48%)	0.5%	0.5%	0.5%
2	11–19	18,809 (23%)	2.2%	2.1%	1.8%
3	20–27	13,865 (17%)	5.0%	5.3%	4.2%
4	28–40	7,976 (10%)	11.6%	11.9%	10.1%
5	>40	1,502 (2%)	30.5%	30.9%	26.6%

PRF, postoperative respiratory failure.
* Number of phase I subjects in each risk class.

Arozullah, et al.
Ann Surg. **2000; 232(2): 242–253.**

Canet risk index

Table 1. Definitions of Postoperative Pulmonary Complications

Complication	Definition
Respiratory infection	When a patient received antibiotics for a suspected respiratory infection and met at least one of the following criteria[4,9,10]: new or changed sputum, new or changed lung opacities, fever, leukocyte count >12,000/μ
Respiratory failure	When postoperative Pa_{O_2} <60 mmHg on room air, a ratio of Pa_{O_2} to inspired oxygen fraction <300 or arterial oxyhemoglobin saturation measured with pulse oximetry <90% and requiring oxygen therapy
Pleural effusion	Chest x-ray demonstrating blunting of the costophrenic angle, loss of the sharp silhouette of the ipsilateral hemidiaphragm in upright position, evidence of displacement of adjacent anatomical structures, or (in supine position) a hazy opacity in one hemithorax with preserved vascular shadows[11]
Atelectasis	Lung opacification with a shift of the mediastinum, hilum, or hemidiaphragm toward the affected area, and compensatory overinflation in the adjacent nonatelectatic lung[12,13]
Pneumothorax	Air in the pleural space with no vascular bed surrounding the visceral pleura[14]
Bronchospasm	Newly detected expiratory wheezing treated with bronchodilators
Aspiration pneumonitis	Acute lung injury after the inhalation of regurgitated gastric contents[15]

Table 6. Independent Predictors of Risk for PPCs Identified in the Logistic Regression Model

	Multivariate Analysis OR (95% CI) n = 1,624*	β Coefficient	Risk Score†
Age, yr			
≤50	1		
51–80	1.4 (0.6–3.3)	0.331	3
>80	5.1 (1.9–13.3)	1.619	16
Preoperative Spo_2, %			
≥96	1		
91–95	2.2 (1.2–4.2)	0.802	8
≤90	10.7 (4.1–28.1)	2.375	24
Respiratory infection in the last month	5.5 (2.6–11.5)	1.698	17
Preoperative anemia (≤10 g/dl)	3.0 (1.4–6.5)	1.105	11
Surgical incision			
Peripheral	1		
Upper abdominal	4.4 (2.3–8.5)	1.480	15
Intrathoracic	11.4 (4.9–26.0)	2.431	24
Duration of surgery, h			
≤2	1		
>2 to 3	4.9 (2.4–10.1)	1.593	16
>3	9.7 (4.7–19.9)	2.268	23
Emergency procedure	2.2 (1.0–4.5)	0.768	8

* Because of a missing value for some variables, three patients were excluded. Logistic regression model constructed with the development subsample, c-index = 0.90; Hosmer-Lemeshow chi-square test = 7.862; $P = 0.447$. † The simplified risk score was the sum of each β logistic regression coefficient multiplied by 10, after rounding off its value.

CI = confidence interval; OR = odds ratio; PPC = postoperative pulmonary complications; Spo_2 = oxyhemoglobin saturation by pulse oximetry breathing air in supine position.

Anesthesiology 2010;113:1338

Table 7. PPC Risk Score: Distribution of Patients and Rates by Intervals

	Risk Score Intervals*		
	Low Risk <26 Points	Intermediate Risk 26–44 Points	High Risk ≥45 Points
Development subsample, No. (%) of patients†	1,238 (76.2)	288 (17.7)	98 (6.0)
Validation subsample, No. (%) of patients	645 (77.1)	135 (16.1)	57 (6.8)
PPC rate, development subsample, % (95% CI)	0.7 (0.2–1.2)	6.3 (3.5–9.1)	44.9 (35.1–54.7)
PPC rate, validation subsample, % (95% CI)	1.6 (0.6–2.6)	13.3 (7.6–19.0)	42.1 (29.3–54.9)

Anesthesiology 2010;113:1338

- 50 yo woman with BOS s/p BMT for resection and RND for SCCA buccal mucosa. Procedure anticipated to be 8 hours.

- FEV1 is 0. 45 liters (16%)
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- FEV1 1.15 -> 1.44 (41%): (25% increase)
- FVC 2.55 -> 3.07 (66%) (20% increase)
- Able to walk > 100 ft and climb a flight of stairs before stopping.
- RVSP 30 + RA

Arozullah: 33 pt=10% RF

EVALUATION FOR LUNG RESECTION

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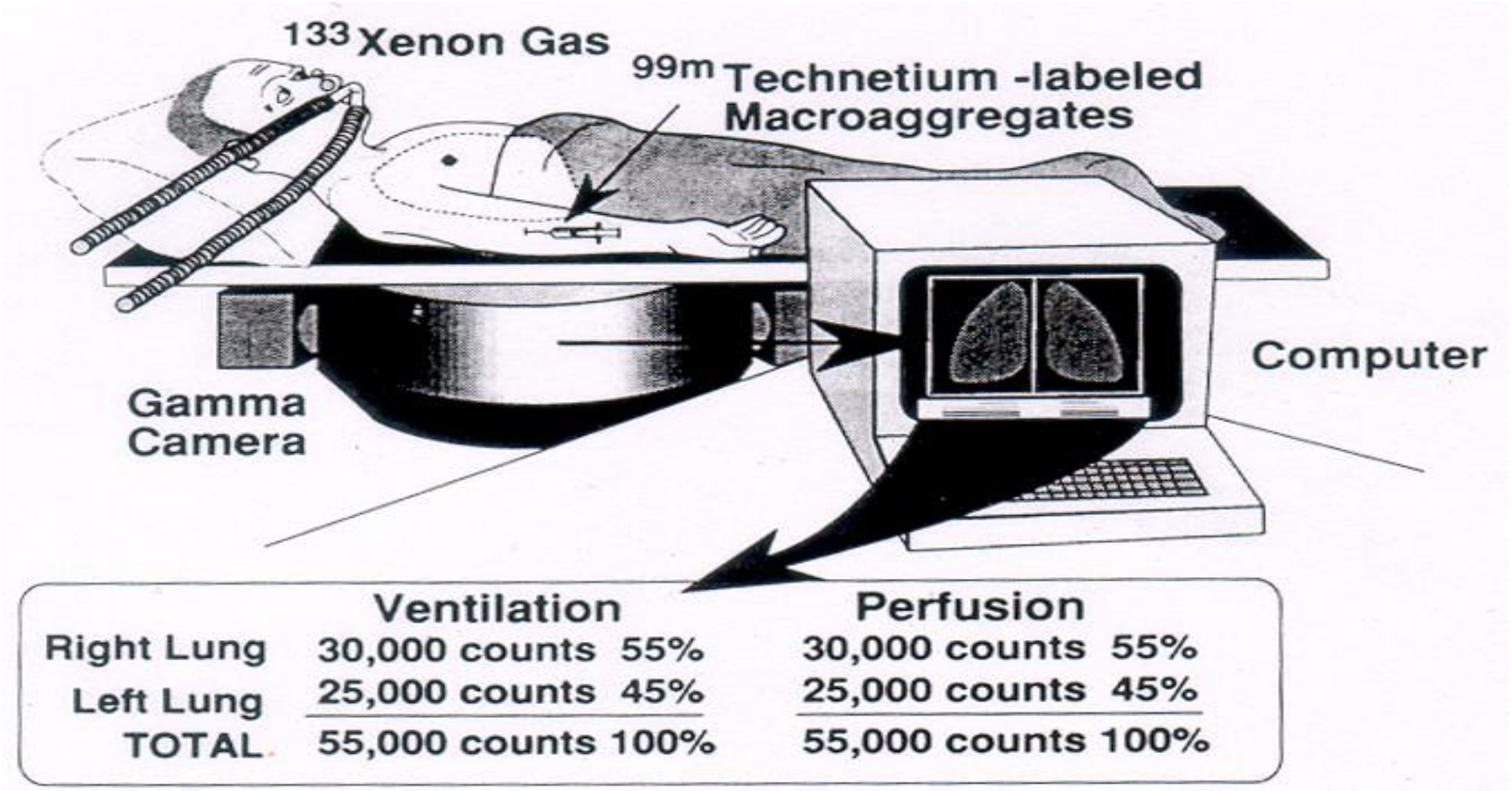
- **All patients undergoing lung resection need pulmonary function studies (FEV1 and DLCO)!**
  - **FEV1 < 60% strongest predictor of postop complication**

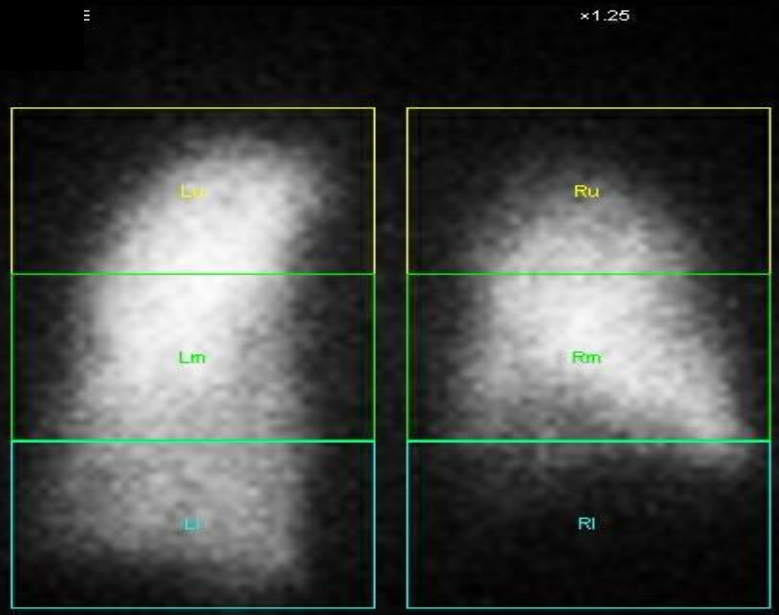
EVALUATION FOR LUNG RESECTION

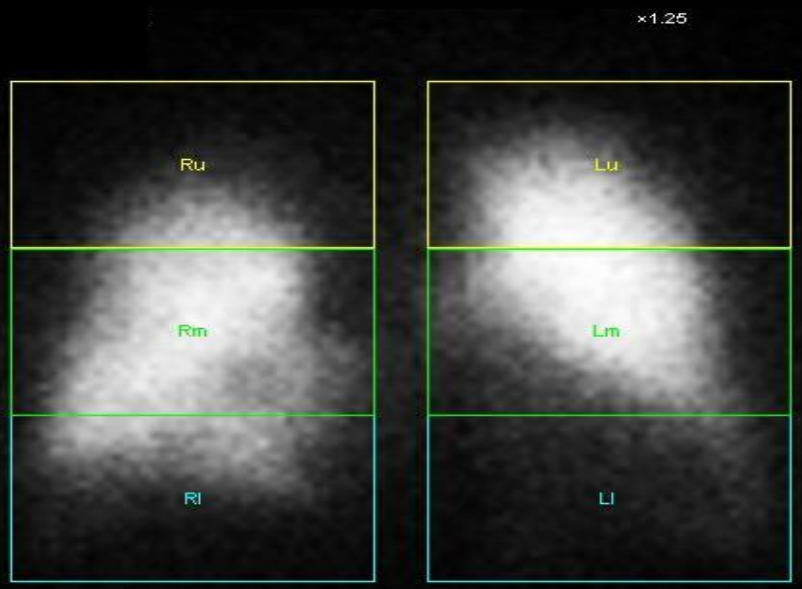
- **BTS guidelines:**
  - **FEV_1 > 2 liters (or >80% predicted) adequate for pneumonectomy**
  - **FEV_1 > 1.5 liters adequate for lobectomy**
- **ACCP: focus on predicted postoperative values.**

PREDICTING POSTOPERATIVE PULMONARY FUNCTION



Quantitative ventilation-perfusion scan





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VQ QUANT
ANT - POST
POST Perf Quant.

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	Posterior Kct				Geometric Mean Kct				Anterior Kct			
	Left		Right		Left Lung		Right Lung		Right		Left	
	%	Kct	%	Kct	%	Kct	%	Kct	%	Kct	%	Kct
Upper Zone:	18.7	62.86	11.1	37.26	18.2	60.07	9.8	32.42	8.4	28.21	17.0	57.40
Middle Zone:	25.9	86.94	25.2	84.82	27.4	90.44	27.9	92.10	29.6	100.01	27.9	94.08
Lower Zone:	14.3	47.90	4.8	16.27	9.1	30.17	7.6	25.23	11.6	39.11	5.6	19.00
Total Lung:	58.8	197.70	41.2	138.35	54.7	180.68	45.3	149.75	49.5	167.34	50.5	170.48

PRE-OP QUANTITATIVE VENTILATION/PERFUSION SCAN

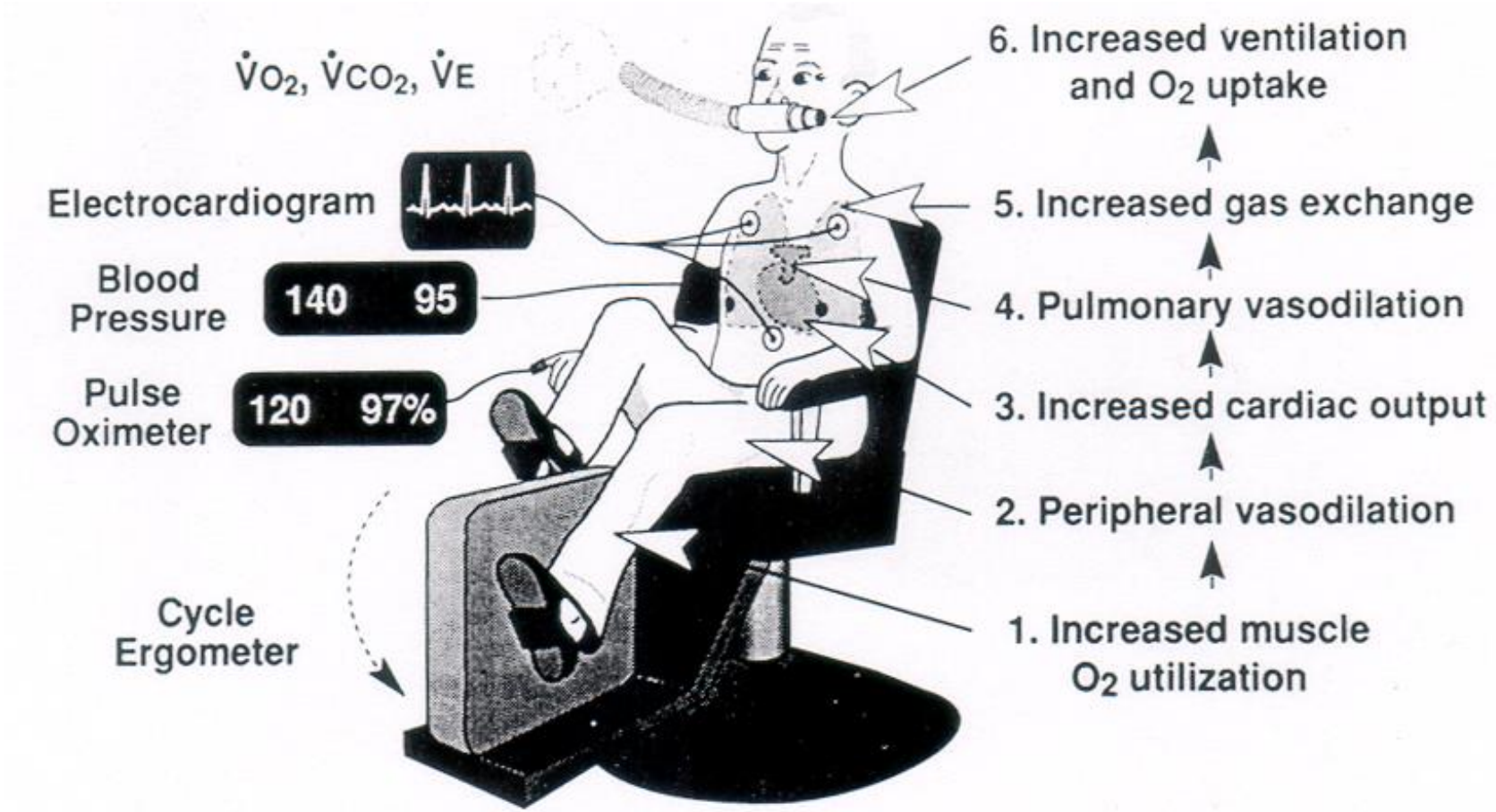
- **Predicted post-op FEV1=**

  pre-op FEV1 x (1 – fraction of total perfusion in the resected lung).

ACCP:

- **If either PPO FEV1 or PPO DLCO is < 60% but both are > 30%, recommend exercise testing (stair climbing for example).**
- **If either PPO FEV1 or PPO DLCO is < 30%, recommend a cardiopulmonary exercise test.**

CARDIOPULMONARY EXERCISE TESTING



PRE-OP EXERCISE TESTING IN LUNG RESECTION SURGERY

- **VO2max > 20 ml/kg/min suitable for surgery with "acceptable" morbidity and mortality.**

- **VO2 < 10 ml/kg/min appear to be at high risk of perioperative complication and death**

Those between 10-20 ml/kg/min are at higher risk; all other factors including the predicted post-op values taken into account and the higher risk discussed with patient.

POST-OP RISK MODIFICATION

- **Secretion clearance/lung expansion strategies are the only therapies proven to reduce post operative pulmonary complications. Implicit and necessary to this strategy is good pain control.**
  - **Deep breathing = incentive spirometry**
  - **Intermittent positive pressure breathing (IPPB) vs continuous positive airway pressure (CPAP)**

Strength of the Evidence for Specific Interventions To Reduce the Risk for Postoperative Pulmonary Complications

Table 4. **Strength of the Evidence for Specific Interventions To Reduce the Risk for Postoperative Pulmonary Complications**

Risk Reduction Strategy	Strength of Evidence*	Type of Complication Studied
Postoperative lung expansion modalities	A	Atelectasis, pneumonia, bronchitis, severe hypoxemia
Selective postoperative nasogastric decompression	B	Atelectasis, pneumonia, aspiration
Short-acting neuromuscular blockade	B	Atelectasis, pneumonia
Laparoscopic (vs. open) operation	C	Spirometry, atelectasis, pneumonia, overall respiratory complications
Smoking cessation	I	Postoperative ventilator support
Intraoperative neuraxial blockade	I	Pneumonia, postoperative hypoxia, respiratory failure
Postoperative epidural analgesia	I	Atelectasis, pneumonia, respiratory failure
Immunonutrition	I	Overall infectious complications, pneumonia, respiratory failure
Routine total parenteral or enteral nutrition†	D	Atelectasis, pneumonia, empyema, respiratory failure
Right-heart catheterization	D	Pneumonia

* Definitions for categories of strength of evidence, modified from the U.S. Preventive Services Task Force categories (11). A = good evidence that the strategy reduces postoperative pulmonary complications and benefit outweighs harm; B = at least fair evidence that the strategy reduces postoperative pulmonary complications and benefit outweighs harm; C = at least fair evidence that the strategy may reduce postoperative pulmonary complications, but the balance between benefit and harm is too close to justify a general recommendation; D = at least fair evidence that the strategy does not reduce postoperative pulmonary complications or harm outweighs benefit; I = evidence of effectiveness of the strategy to reduce postoperative pulmonary complications is conflicting, of poor quality, lacking, or insufficient or the balance between benefit and harm cannot be determined.

† Evidence remains uncertain (strength of evidence I) on total parenteral or enteral nutrition for severely malnourished patients or when a protracted time of inadequate nutritional intake is anticipated.

Lawrence, V. A. et. al. Ann Intern Med 2006;144:596-608

POST-OP RISK MODIFICATION

- **Pain control:**
  - **Epidural vs systemic opioids**

- **NG tubes not for routine use; only as necessary case-by-case**

SUMMARY:PRE-OP

- **Smoking cessation**
- **Appropriate/optimal treatment for COPD, asthma.**
- **Steroids if not optimally managed airway disease, especially if actively wheezing**
- **If respiratory infection, begin antibiotics, delay elective surgery**

SUMMARY: INTRA-OP

- **Short duration better then long**
- **Laparoscopic better then open**
- **Regional better then general anesthesia**

- **PA catheters don’t help**

SUMMARY: POST-OP

- **Lung expansion maneuvers the only proven strategy:**
  - **Early mobilization or incentive spirometry**

Question #1

- **A 75 yr old man is referred for a pre-operative evaluation in preparation for surgery to repair a 6.4 cm aortic aneurysm. He is a former smoker in the remote past and is known to have COPD/chronic bronchitis with an FEV_1 of 42% predicted. He has daily sputum production with a cough. He uses tiotropium and an inhaled corticosteroid daily.**

- **On exam you find him to be comfortable at rest with an O_2 saturation 94%. His breath sounds are clear but symmetrically diminished bilaterally.**

- **What should you tell his surgeon?**

Question #1

- **A. He is a high risk patient for post-operative pulmonary complications and should be give peri-operative systemic corticosteroids.**
- **B. He is a high risk patient but his surgery is low risk so he should do fine.**
- **C. He is a high risk patient and should have aggressive post-operative lung expansion treatments to prevent complications.**
- **D. He is too high a risk and should not have surgery.**
- **E. Not enough information; need an arterial blood gas to adequately judge his risk.**

Question #1

- **A. He is a high risk patient for post-operative pulmonary complications and should be give peri-operative systemic corticosteroids.**
- **B. He is a high risk patient but his surgery is low risk so he should do fine.**
- **C. He is a high risk patient and should have aggressive post-operative lung expansion treatments to prevent complications.**
- **D. He is too high a risk and should not have surgery.**
- **E. Not enough information; need an arterial blood gas to adequately judge his risk.**

Question #2

- **You are asked to evaluate a 57 yo woman with lung cancer who is undergoing concurrent chemotherapy and radiation therapy prior to resection of the tumor. It is anticipated she will need a left upper lobe resection. Her pre-op FEV_1 is 1.4 liters (55% predicted) and her diffusion capacity is 50% predicted.**

- **She undergoes a quantitative ventilation / perfusion scan which reveals that 40% of ventilation and perfusion goes to the left lung but only 15% of ventilation and 10% of perfusion goes to the left upper lobe.**

- **Which statement is true about this patient?**

Question #2

- **A. Her post-op predicted FEV_1 and diffusion capacity will be too low to justify the risk of the surgery.**
- **B. She should have repeat pulmonary function testing after she stops smoking.**
- **C. She should be scheduled for an exercise test to help determine if surgery is advisable.**
- **D. She is a high risk patient being considered for high risk surgery; palliative care should be offered instead.**
- **E. Surgery should only be offered if it can be done by video-assisted thoracoscopy.**

References

- Ann Intern Med 2006;144:581-595
- BMJ 2000;321:1493
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