Preoperative assessment for thoracic patients

Case

- 69-year-old ♂: **left upper lobectomy (adenocarcinoma)**

- PMH:
  - Obese BMI 31
  - Type 2 DM
  - Hypertension
  - Smoker: 55 pack-year

- Preoperative assessment:
  - ECG: sinus rhythm, right ventricular strain pattern
  - Labs: normal findings
  - PFT: obstructive ventilatory defect with FEV1 45% of predicted
  - Limited exercise tolerance: blames it on his “bad knees”. Never been evaluated by a cardiologist

→ Enough **ventilatory reserve postoperative**? Additional testing before surgery?

Goals of preoperative assessment

- Preoperative assessment is focused on **risk stratification**
- **Identify** patients at high risk for developing perioperative morbidity and mortality

→ Institute appropriate **management protocols** to reduce the patients surgical and anesthetic perioperative morbidity or mortality

Preoperative assessment = Teamwork

- Unlike orthopedics….

Preoperative assessment = Teamwork

- Anesthesiologist is **not** the “gate-keeper”
  - Thoracic surgeon who ultimately decides resectability
  - Anesthesiologist may function as an important safety check

- **No “elective” operations** – for any procedure, the risks of delaying the operation must be weighed heavily

Today we will be discussing…

Preoperative physiologic pulmonary evaluation for lung resection

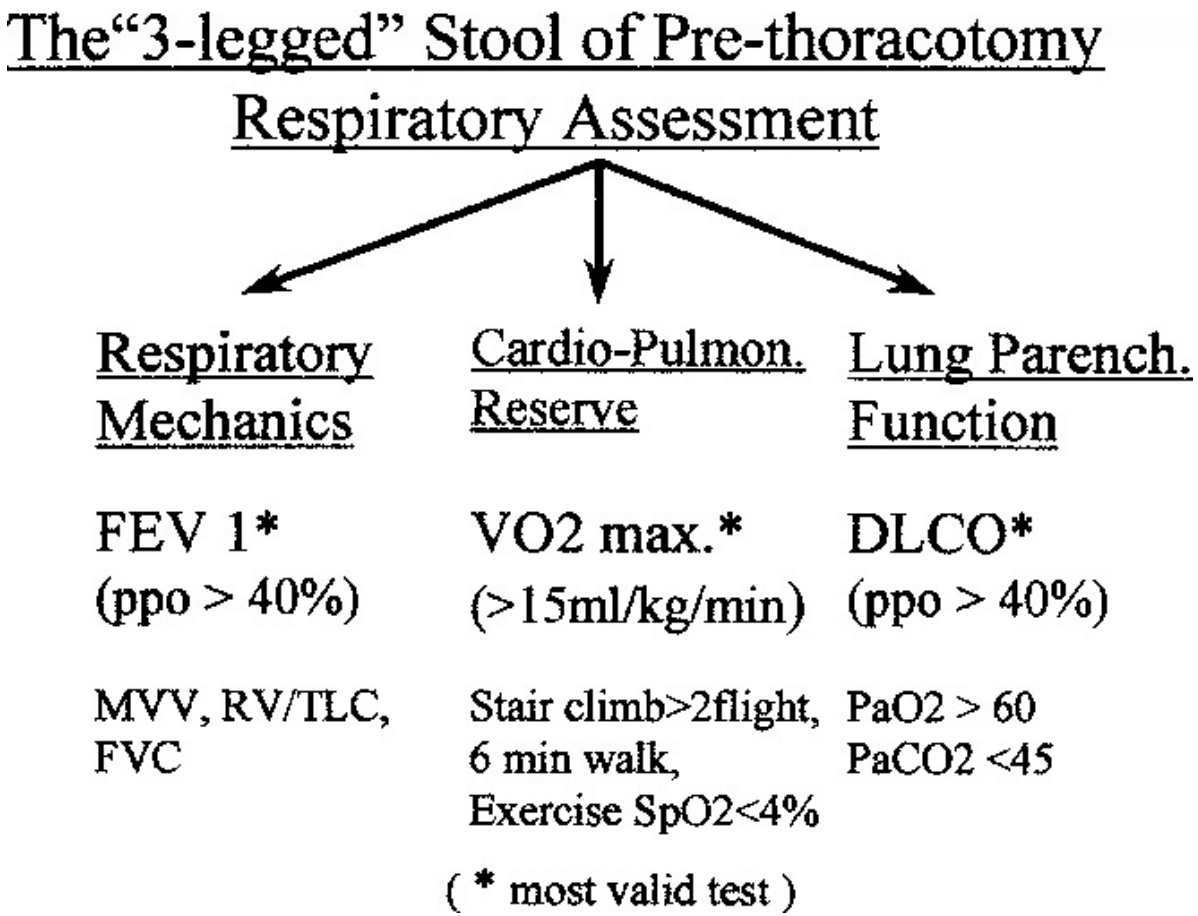
1. Cardiovascular risk
2. Pulmonary function tests
3. Exercise testing
4. Determining the real “risk”

Preoperative physiologic pulmonary evaluation for lung resection

- **Goal?**
  - Determine overall respiratory performance after lung resection

- **How?**
  1. Respiratory mechanics
  2. Gas exchange
  3. Cardio-respiratory interaction

“3-legged stool”

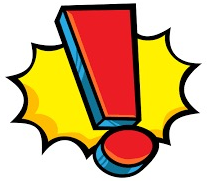


Times have changed…

- **Minimally invasive techniques**
  - Video-assisted thoracic surgery (VATS), Robot-Assisted Thoracoscopic Surgery (RATS)
- **Anesthesia techniques have improved**
  - Lung protective ventilation,…

Lung tissue is still being removed

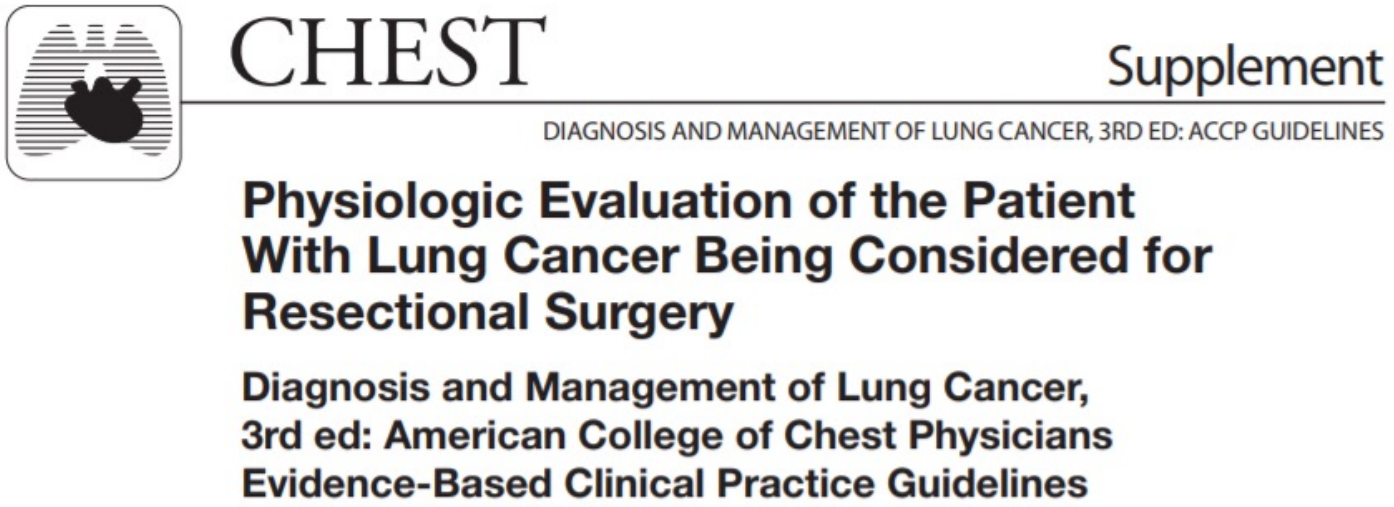
Conversion to open procedure



→ No distinction between minimally invasive or open techniques with regard to preoperative risk stratification

Guidelines

- American College of Chest Physicians (ACCP) 2013



CHEST Supplement

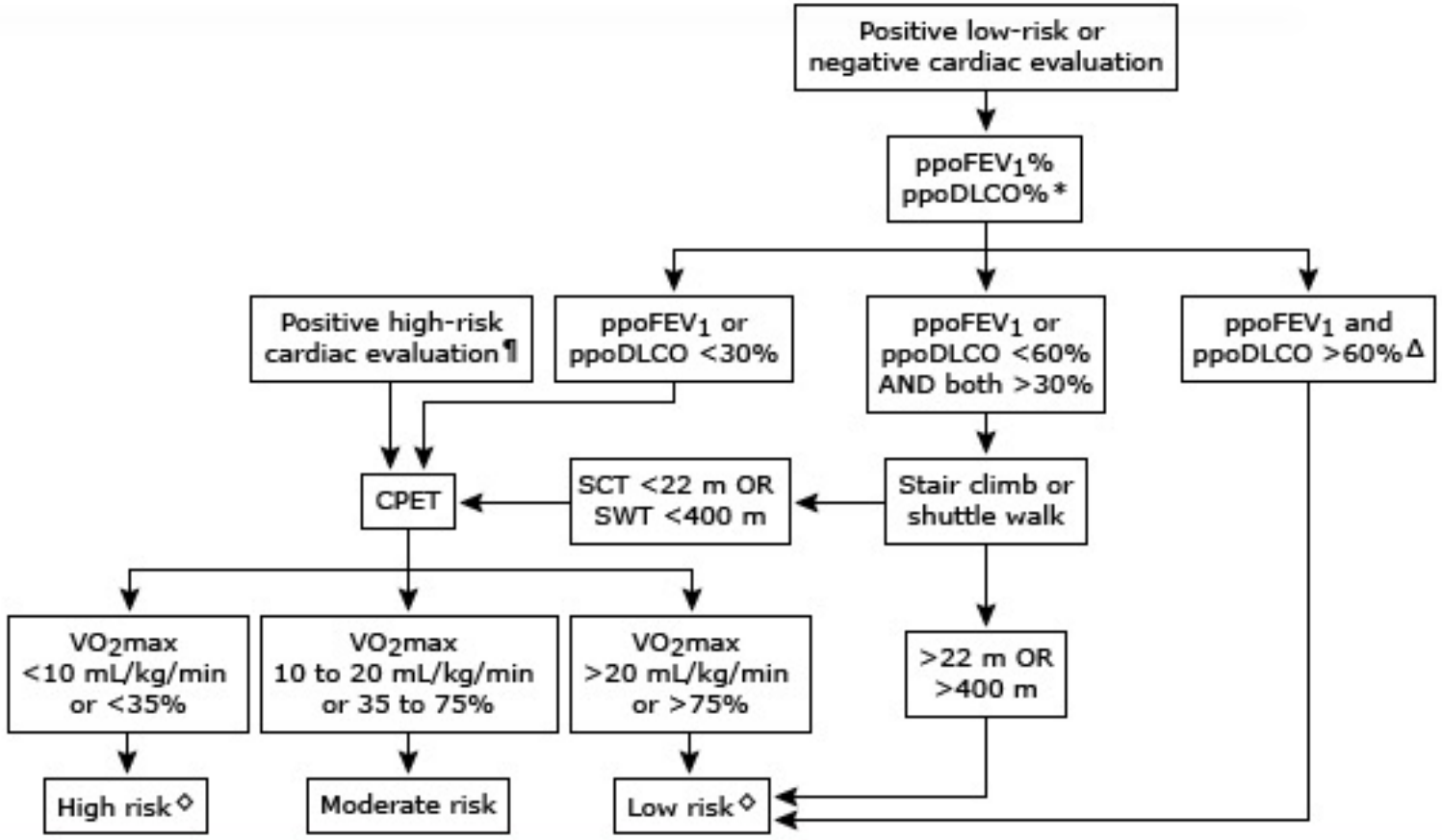
DIAGNOSIS AND MANAGEMENT OF LUNG CANCER, 3RD ED: ACCP GUIDELINES

Physiologic Evaluation of the Patient With Lung Cancer Being Considered for Resectional Surgery

Diagnosis and Management of Lung Cancer, 3rd ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines

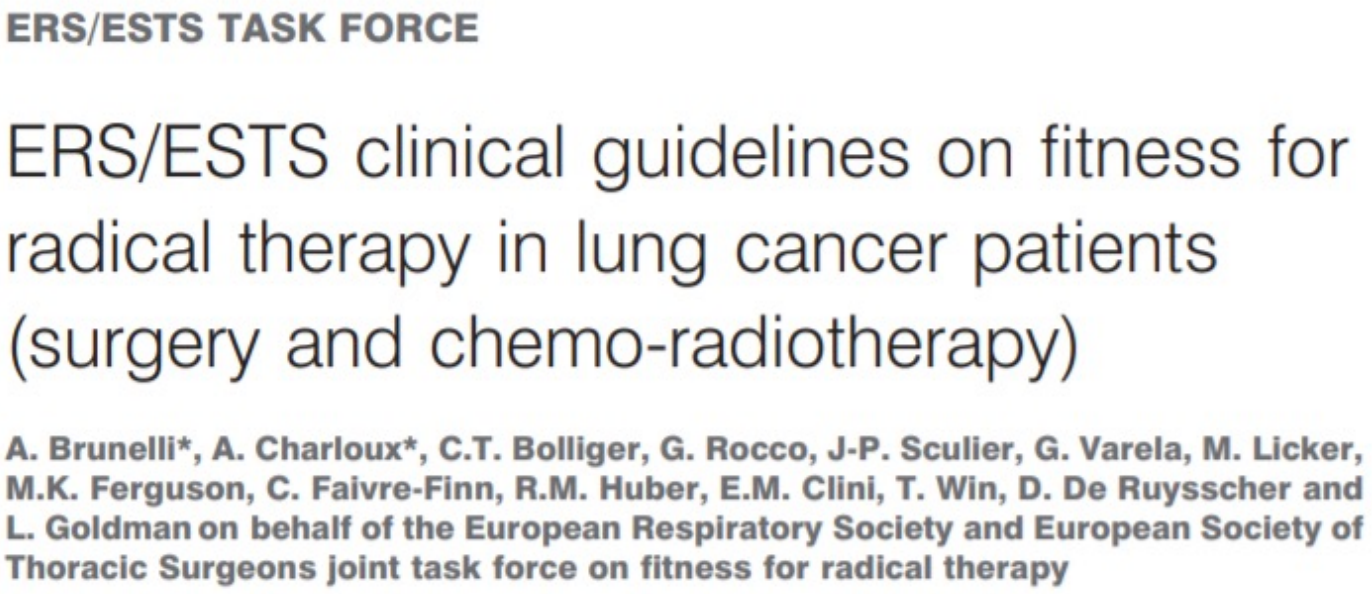
Guidelines

- ACCP



Guidelines

- European respiratory Society/European Society of thoracic surgeons (ERS/ESTS) 2009



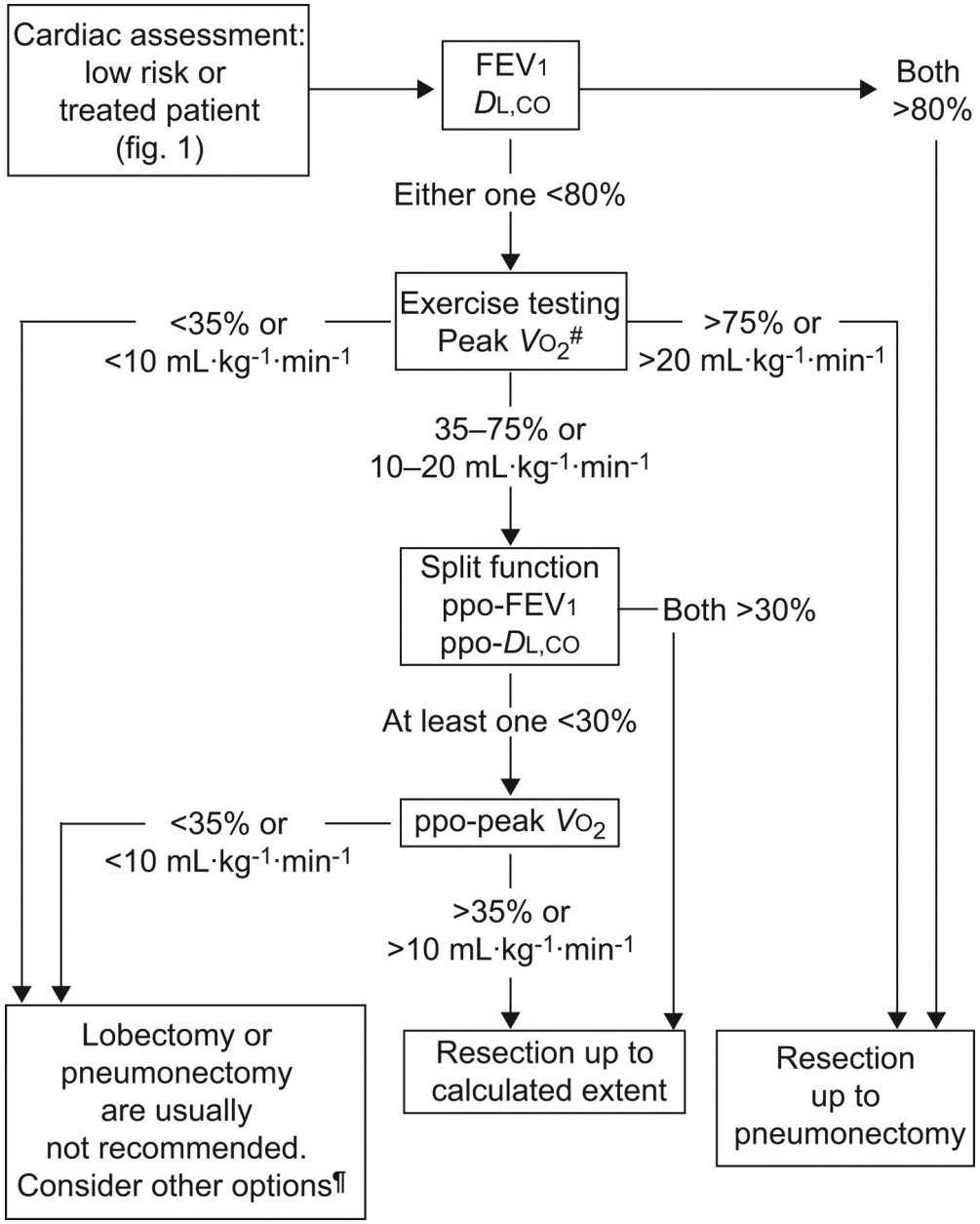
ERS/ESTS TASK FORCE

ERS/ESTS clinical guidelines on fitness for radical therapy in lung cancer patients (surgery and chemo-radiotherapy)

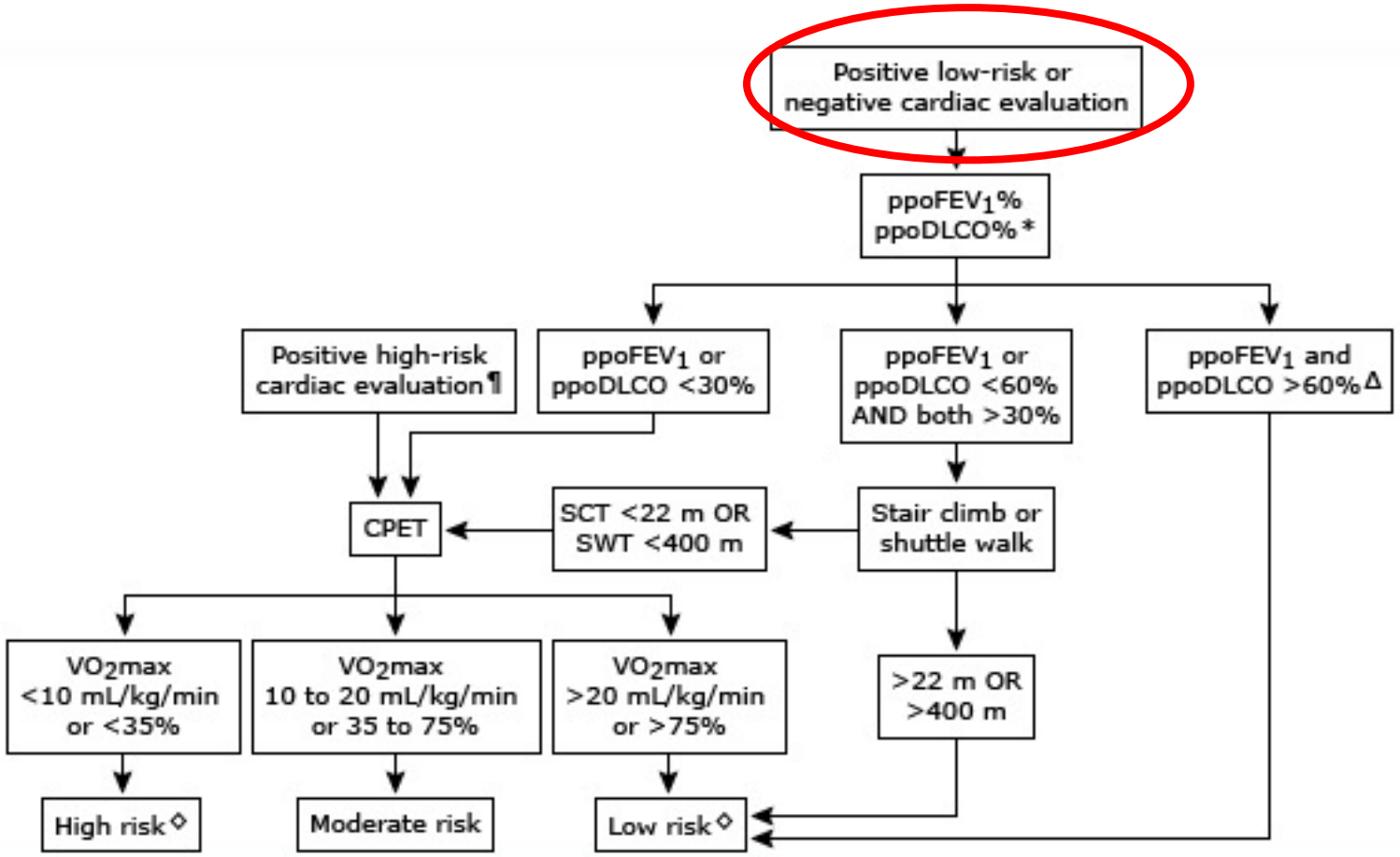
A. Brunelli*, A. Charloux*, C.T. Bolliger, G. Rocco, J-P. Sculier, G. Varela, M. Licker, M.K. Ferguson, C. Faivre-Finn, R.M. Huber, E.M. Clini, T. Win, D. De Ruysscher and L. Goldman on behalf of the European Respiratory Society and European Society of Thoracic Surgeons joint task force on fitness for radical therapy

Guidelines

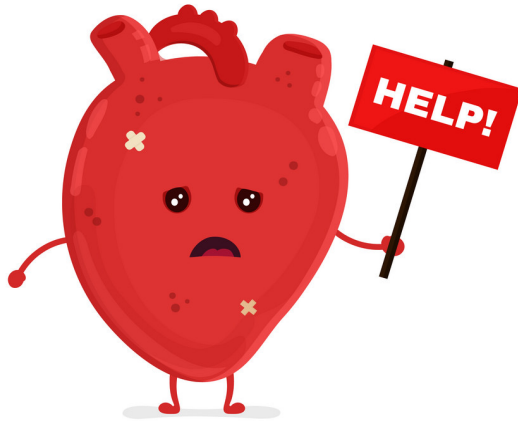
ERS/ESTS



Cardiovascular risk



Cardiovascular risk



- All patients scheduled to undergo noncardiac surgery should have an initial assessment of the risk of a cardiovascular perioperative cardiac event.

- Different models available
  - Revised cardiac risk index (RCRI)
  - American College of Surgeons surgical risk calculator (ACS-SRC)
  - Myocardial infarction or cardiac arrest (MICA) calculator

Cardiovascular risk

- RCRI

Clinical variable	Points
High-risk surgery	1
H/o Ischemic heart disease	1
H/o Congestive heart failure	1
H/o cerebrovascular disease	1
Insulin treatment for diabetes mellitus	1
Pre-operative serum creatinine level >2.0 mg/dl (180 mcgmol/L)	1

Interpretation of risk score

Risk class	Points	Risks of complications (%)
I. Very low	0	0.4 %
II. Low	1	0.9 %
III. Moderate	2	7.0 %
IV. High	3+	11.0 %

Cardiovascular risk

- ThRCRI

Validating the Thoracic Revised Cardiac Risk Index Following Lung Resection

Daniel C. Thomas, MD, MPH, Justin D. Blasberg, MD, Brian N. Arnold, MD, Joshua E. Rosen, BASc, Michelle C. Salazar, MD, Frank C. Detterbeck, MD, Daniel J. Boffa, MD, and Anthony W. Kim, MD, MS

Table 2. Preoperative Risk Factors Contributing to the ThRCRI in Patients Undergoing Lung Resection (N = 4,625)

ThRCRI Risk Factor	Weighted Score	%	n
Renal comorbidity[a]	1	1.7	76
Ischemic heart disease	1.5	8.8	403
Cerebrovascular disease	1.5	7.0	323
Pneumonectomy	1.5	6.4	298

[a] Preoperative serum creatinine >2 mg/dL.

Table 3. Distribution of Patients Within ThRCRI Risk Classes and Rate of Major Cardiac Complications (N = 4,625)

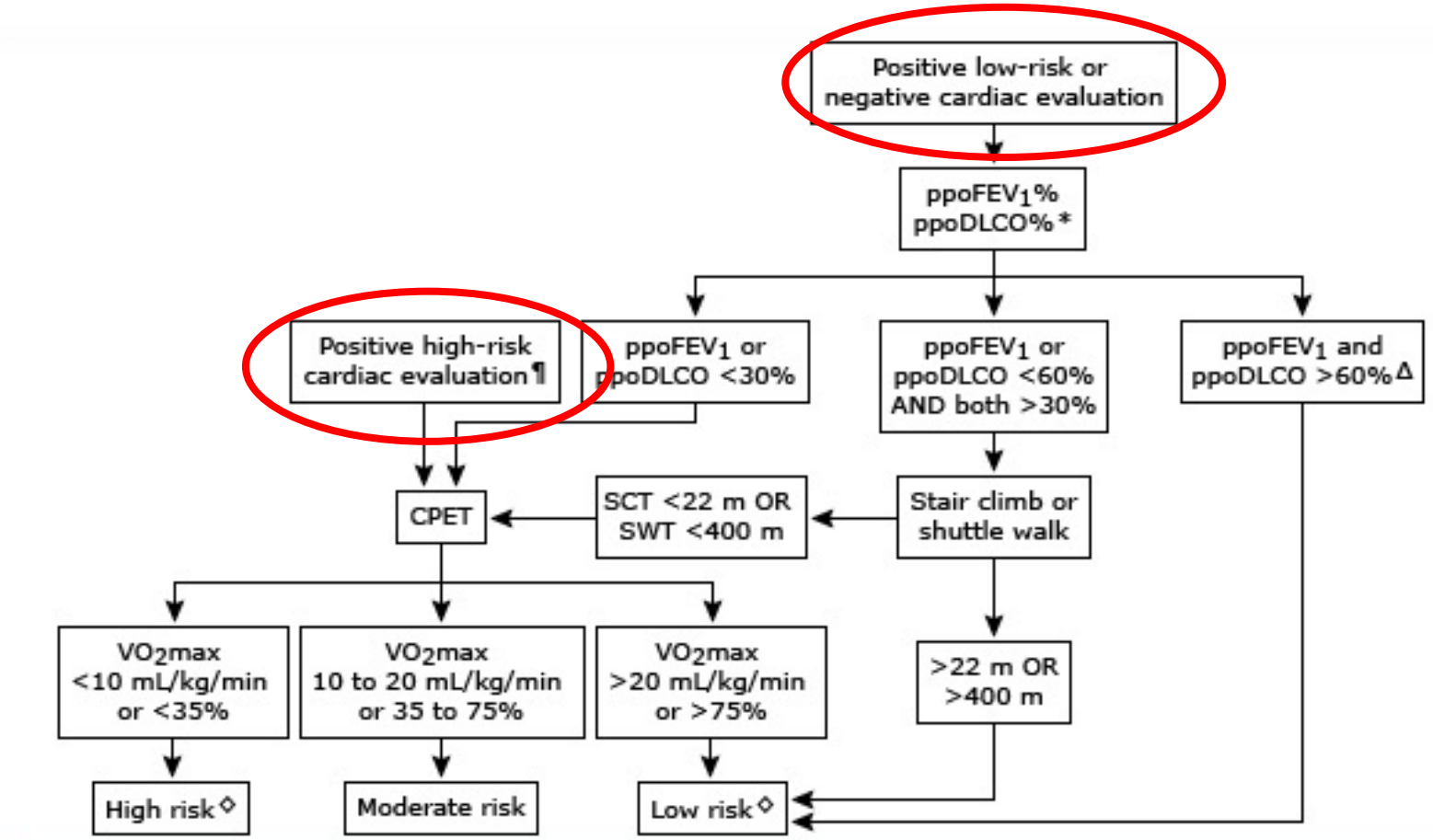
ThRCRI Score	ThRCRI Risk Class	%	n	Cardiac Complication Rate (n)[a]
0	A	78	3,637	1.4% (49)
1.0–1.5	B	19	882	2.7% (24)
2.0–2.5	C	0.5	22	9.1% (2)
>2.5	D	1.8	84	3.6% (3)

Cardiovascular risk

- High risk?
  - ThRCRI ≥ 2
  - Any cardiac condition requiring medication
  - Newly suspected cardiac condition
  - Inability to climb 2 flights of stairs

→ Cardiac consultation with noninvasive cardiac testing (cardiopulmonary excercise testing)

Cardiovascular risk



Pulmonary function tests

- Preoperative forced expiratory volume in one second **(FEV1)**

→ Correlates with degree of respiratory impairment in patients with obstructive lung disease

→ Indirect measure of pulmonary reserve

- Diffusing capacity for carbon monoxide **(DLCO)**

→ Most important predictor of mortality and postoperative complications in patients undergoing resection

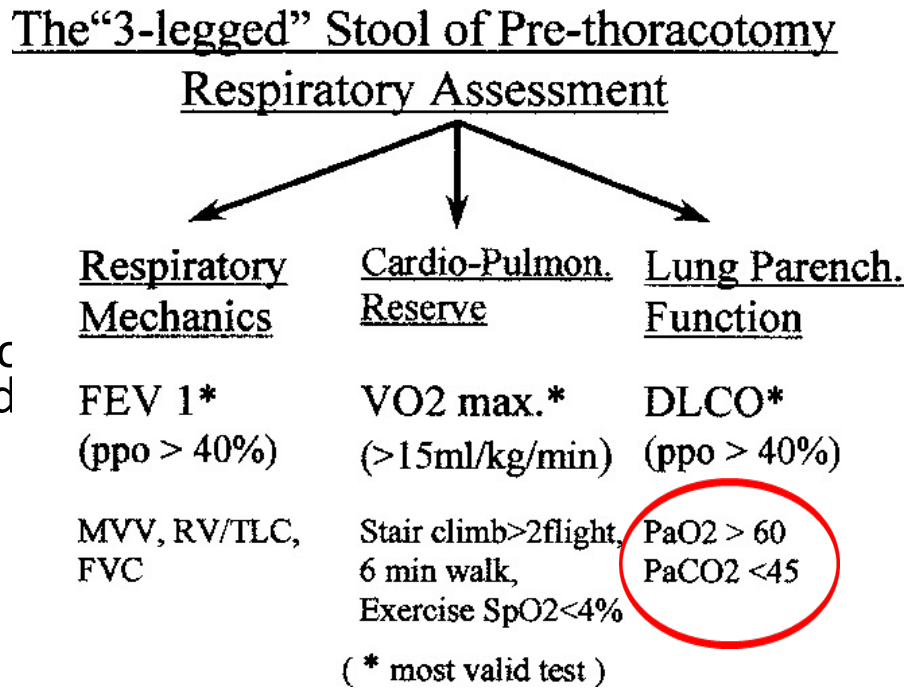
➢ Should be measured in **ALL** patients in whom resectional surgery is being considered

Pulmonary function tests

- **Others**

→ Other indicators of gas exchange and other PFT parameters, although often performed, are not typically predictive of mortality or postoperative lung function and do not assist in determining optimal amounts of lung that can be resected.

Pulmonary function tests



- **Others**

→ Other indicators of gas exchange and other PFT parameters, altho typically predictive of mortality or postoperative lung function and d optimal amounts of lung that can be resected.

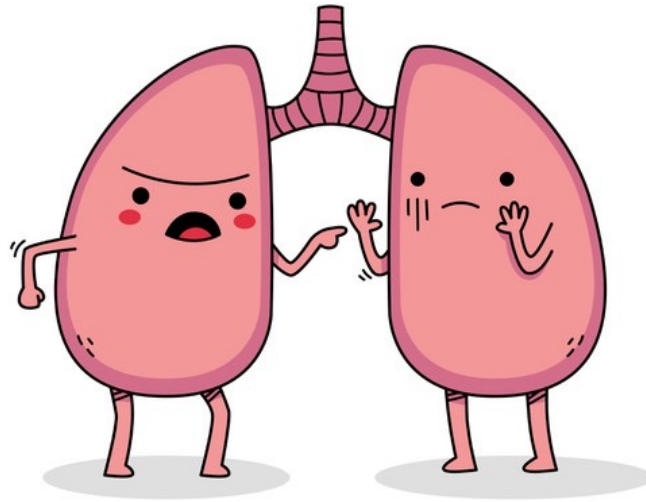
→Arterial blood gases

Historically:

- **PaO2 < 60 mmHg**: contraindication
  - PaO2 may improve after lung resection when ventilation-perfusion matching has improved
- **PaCO2 > 45 mmHg** : contraindication
  - complications do not necessarily increase

→ Because of these limitations, **DLCO** is now considered the most useful test for evaluating gas exchange in the alveoli.

Pulmonary function tests



- Preoperative FEV1 and DLCO **≥80%**

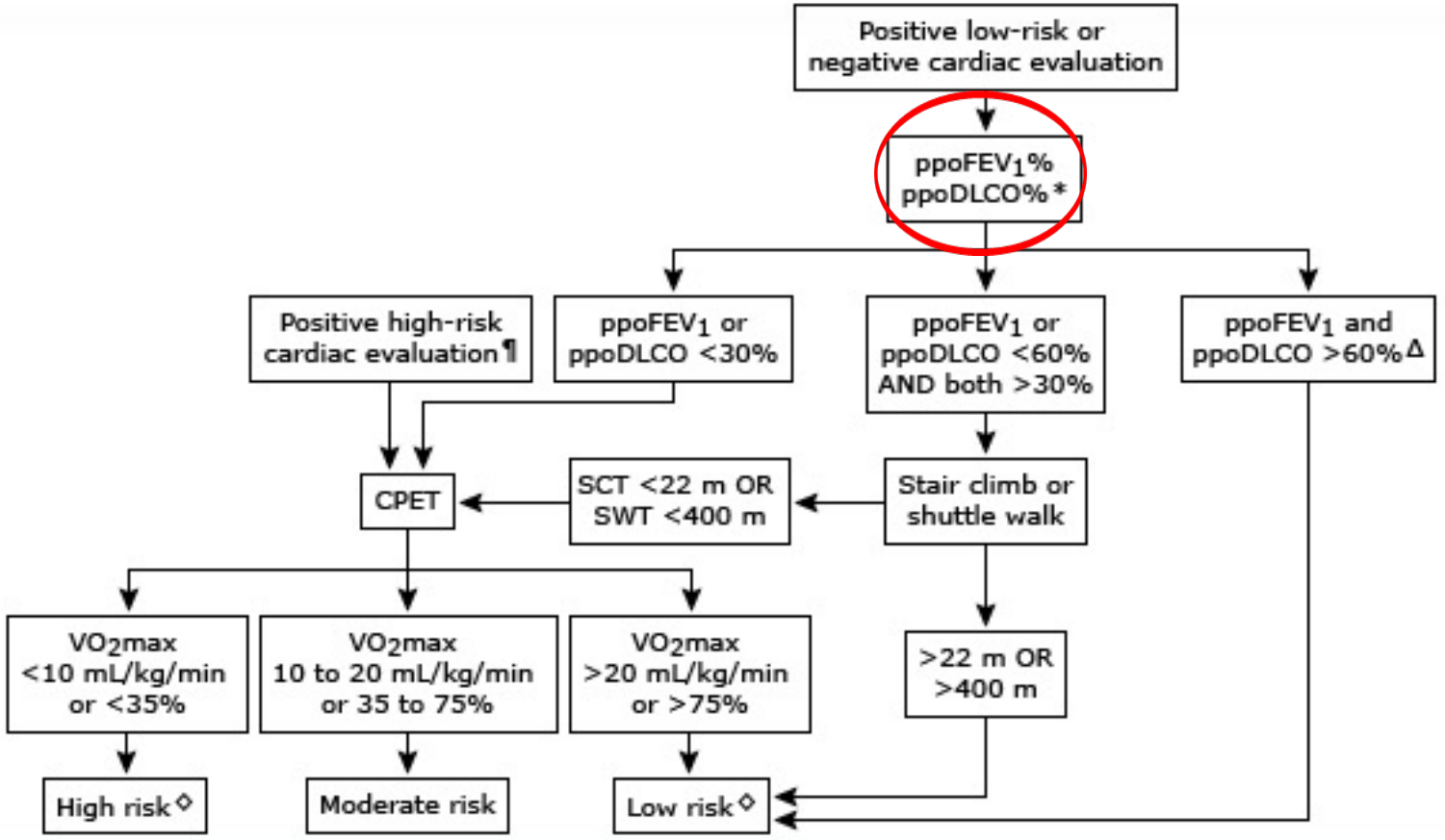
→No further testing

→Low risk: Can generally tolerate lobectomy or pneumonectomy without resulting in clinically significant residual lung dysfunction

- Preoperative FEV1 OR/AND DLCO **<80%**

→ Calculation of predicted postoperative (PPO) lung function

Pulmonary function tests



Pulmonary function tests: PPO

- **Predicted postoperative (PPO) pulmonary function**
  - PPO FEV_1 and PPO DLCO
    - Preoperative values
    - The amount of lung tissue to be resected
    - Contribution to overall lung function
  - How do you calculate this?

Pulmonary function tests: PPO

- The contribution of the region of lung that is to be resected to overall lung function
  - Quantitative lung scintigraphy (Perfusion scan) → Pneumonectomy
  - Lung segment counting (Chest computed tomography) → Lobectomy
    - Scintigraphy plays a limited role in the assessment of patients undergoing lobectomy because of the difficulty in interpreting the contribution of individual lobes to the overall perfusion

Pneumonectomy:

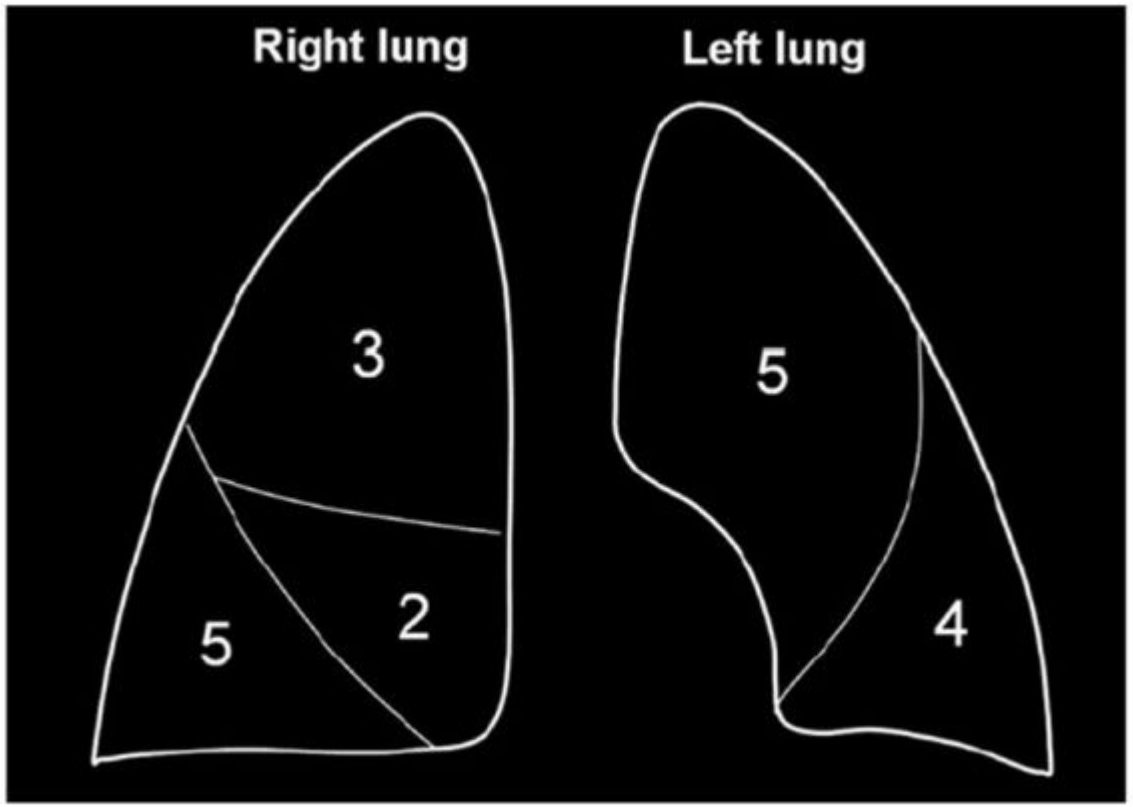
PPO FEV1 = preoperative FEV1 x (1 – fraction of total perfusion in the resected lung measured on radionuclide perfusion)

Lobectomy:

PPO FEV1 = preoperative FEV1 x (1 – a/b) where “a” is the number of segments to be resected and “b” is the total number of unobstructed segments)

Pulmonary function tests: PPO

- The contribut ected to overall lung function
  - Quantitative ectomy
  - Lung segme obectomy



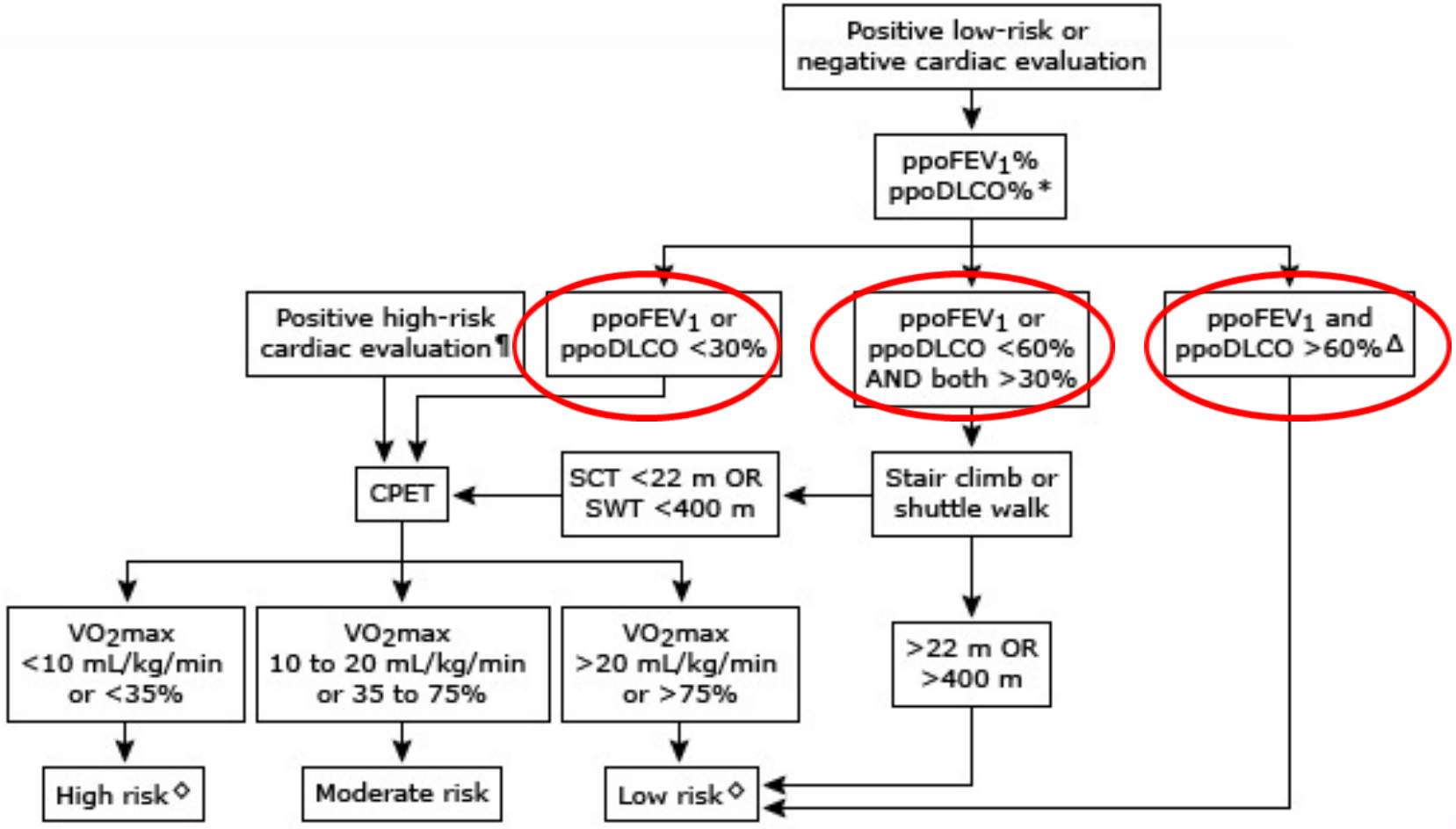
Pneumonector

PPO FEV1 = preop the resected lung measured on radi

Lobectomy:

PPO FEV1 = preop r of segments to be resected and "b" is the total number of unobstructed segments)

Pulmonary function tests: PPO



Exercise testing

- Low technology exercise testing
  - Incremental shuttle walk test > 400 meters
  - Stair climbing > 22 meters
    - Lack of standardization (duration, speed, numbers of steps per flight,..)

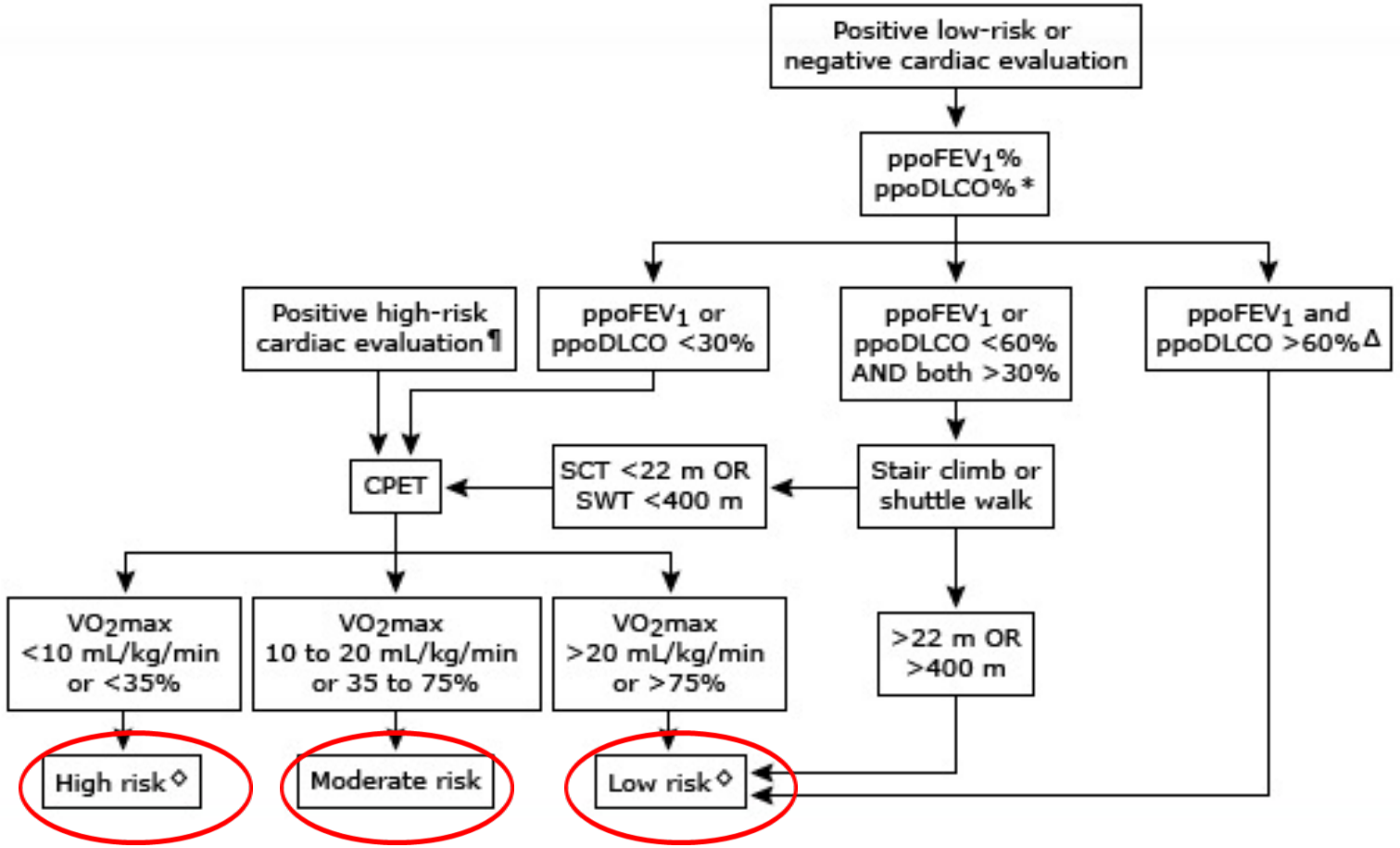
- **FAIL low technology exercise test or PPO < 30% ?**

→ Cardiopulmonary exercise testing (CPET)

Exercise testing: CPET

- Examines the function of the **integrated cardiopulmonary system**
- Maximal oxygen consumption (**VO2max**)
  = Gold standard for evaluation of exercise tolerance
  = Limit of cardiorespiratory response to excercise
- **Interpretation:**
  - VO2max <10mL/kg/min: high risk of complications and mortality
    - Shuttle walk test under 250m VO2max < 10ml/kg/min
    - climb two flights of stairs without stopping VO2max > 12ml/kg/min
  - VO2max >20 mL/kg/minute: low risk of complications and mortality

Risk?


Positive low-risk or negative cardiac evaluation
ppoFEV1% ppoDLCO%*
Positive high-risk cardiac evaluation¶
ppoFEV1 or ppoDLCO <30%
ppoFEV1 or ppoDLCO <60% AND both >30%
ppoFEV1 and ppoDLCO >60%Δ
CPET
SCT <22 m OR SWT <400 m
Stair climb or shuttle walk
VO2max <10 mL/kg/min or <35%
VO2max 10 to 20 mL/kg/min or 35 to 75%
VO2max >20 mL/kg/min or >75%
>22 m OR >400 m
High risk◇
Moderate risk
Low risk◇

Risk

- **Low risk** — Risk of mortality <1%

Major anatomic resections can be safely performed in this group without incurring a significant risk of residual lung dysfunction.

- **Moderate risk** — Risk of mortality 2-9%

Recommendations for surgery are heavily influenced by the values of predicted postoperative testing, exercise tolerance, and extent of resection. Risks and benefits of the operation should be thoroughly discussed with the patient.

- **High risk** — Risk of mortality >10%

Considerable risk of severe cardiopulmonary morbidity and residual functional loss is expected. Patients should be counseled about alternative surgical (eg, minor resections or minimally invasive surgery) or nonsurgical options.

To operate or not to operate?

Does this mean that if you are in the high risk group, you should **always** consider cancelling surgery?

To operate or not to operate?

Does this mean that if you are in the high risk group, you should **always** consider cancelling surgery?

→**NO**

To operate or not to operate?

- Actual risk affected by **more parameters** than incorporated in the guidelines:
  - Patient factors: Comorbidities, age
  - Structural aspects: Center (volume, specialization)
  - Process factors: Management of complications
  - Surgical access: Thoracotomy vs minimal invasive

- Given the poor prognosis of cancer without surgery and patients' willingness to accept higher levels of risk, every effort should be made to optimize the medical condition of a patient so that surgery can be considered


That's all Folks!

References

- Clinical consensus on preoperative pulmonary function assessment in patients undergoing pulmonary resection (first edition) Gening Jiang, Lei Zhang, Yuming Zhu, Chang Chen, Xiao Zhou, Jinming Liu, Peng Zhang, Hao Wang, Boxiong Xie, Haifeng Wang, Lei Jiang, Jiang Fan, Deping Zhao, Qiankun Chen, Liang Duan, Wenxin He, Yiming Zhou, Hongcheng Liu, Xiaogang Zhao, Xiong Qin, Yang Yang, Ye Ning, Dong Xie, Jie Dai, Department of Thoracic Surgery, Shanghai Pulmonary Hospital, Tongji University, Shanghai 200433, China
- Preoperative pulmonary evaluation for lung resection. J Anaesthesiol Clin Pharmacol. 2018 Jul-Sep; 34(3): 296–300.
- https://www.uptodate.com/contents/preoperative-physiologic-pulmonary-evaluation-for-lung-resection?sectionName=Preoperative%20pulmonary%20function&search=thoracic%20anesthesia&topicRef=94261&anchor=H2&source=see_link#H2
- https://www.uptodate.com/contents/anesthesia-for-open-pulmonary-resection?search=thoracic%20anesthesia&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1#H642462381
- https://www.uptodate.com/contents/evaluation-of-preoperative-pulmonary-risk?search=thoracic%20anesthesia&topicRef=6973&source=see_link#H2
- 1. Brunelli A, Charloux A, Bolliger CT, Rocco G, Sculier JP, Varela G, et al. ERS/ESTS clinical guidelines on fitness for radical therapy in lung cancer patients (surgery and chemo-radiotherapy) *Eur Respir J.* 2009;34:17–41.
- Brunelli A, Kim AW, Berger KI, Addrizzo-Harris DJ. Physiologic evaluation of the patient with lung cancer being considered for resectional surgery: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest 2013;143:e166S.
- Lim E, Baldwin D, Beckles M, Duffy J, Entwisle J, Faivre-Finn C, et al. Guidelines on the radical management of patients with lung cancer. *Thorax.* 2010;65(Suppl 3):iii1–27.
- Charloux A, Brunelli A, Bolliger CT, Rocco G, Sculier JP, Varela G, et al. Lung function evaluation before surgery in lung cancer patients: How are recent advances put into practice? A survey among members of the European Society of Thoracic Surgeons (ESTS) and of the Thoracic Oncology Section of the European Respiratory Society (ERS) *Interact Cardiovasc Thorac Surg.* 2009;9:925–31.
- Ferguson MK, Little L, Rizzo L, Popovich KJ, Glonek GF, Leff A, et al. Diffusing capacity predicts morbidity and mortality after pulmonary resection. *J Thorac Cardiovasc Surg.* 1988;96:894–900.
- Agnew N. Preoperative cardiopulmonary exercise testing. *Continuing Educ Anaesth Crit Care Pain.* 2010;10:33–7
- Snowden CP, Prentis JM, Anderson HL, Roberts DR, Randles D, Renton M, et al. Submaximal cardiopulmonary exercise testing predicts complications and hospital length of stay in patients undergoing major elective surgery. *Ann Surg.* 2010;251:535–41
- Wang J, Olak J, Ultmann RE, Ferguson MK. Assessment of pulmonary complications after lung resection. *Ann Thorac Surg.* 1999;67:1444–7