

Preoperative Evaluation for Surgical Fitness in Early Stage Lung Cancer

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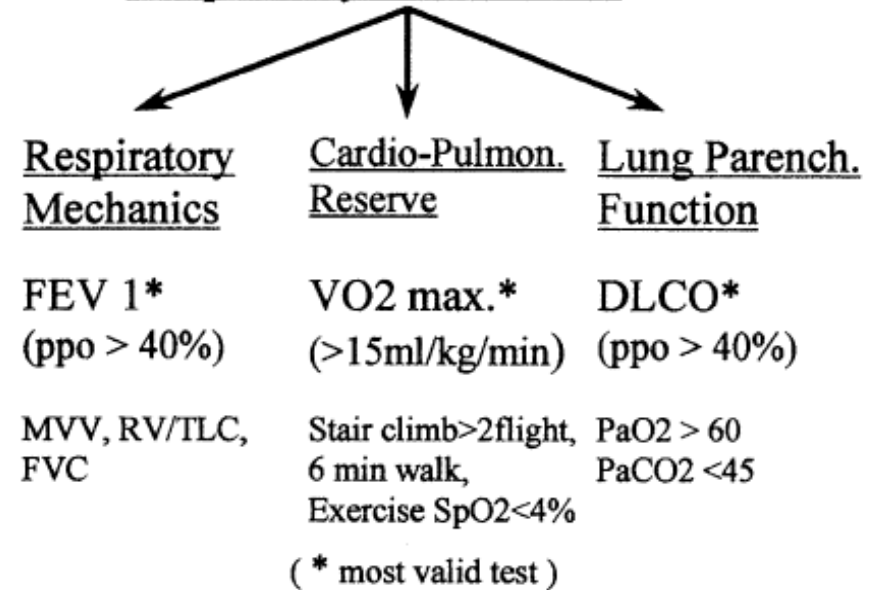


Mortality /Morbidity in Lung Cancer Surgery

- Major cause is Respiratory complications.
- Major respiratory complications occur in 15-20% accounting for 3-4% of mortality.
- Cardiac complications occur in 10-15%.

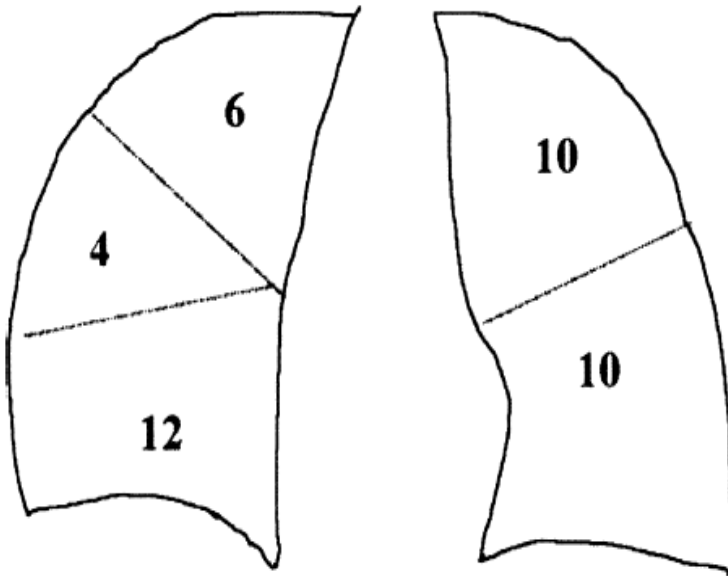
- Efforts to identify single test of respiratory function that has sufficient sensitivity and specificity to predict outcome for all pulmonary resection patients.
- It is now clear that no single test will ever accomplish this.
- Useful to assess each patient's respiratory function in three related but largely independent areas such as:
 - ✓ respiratory mechanics,
 - ✓ pulmonary parenchymal function,
 - ✓ cardio-respiratory interaction

The “3-legged” Stool of Pre-thoracotomy
Respiratory Assessment



Respiratory Mechanics

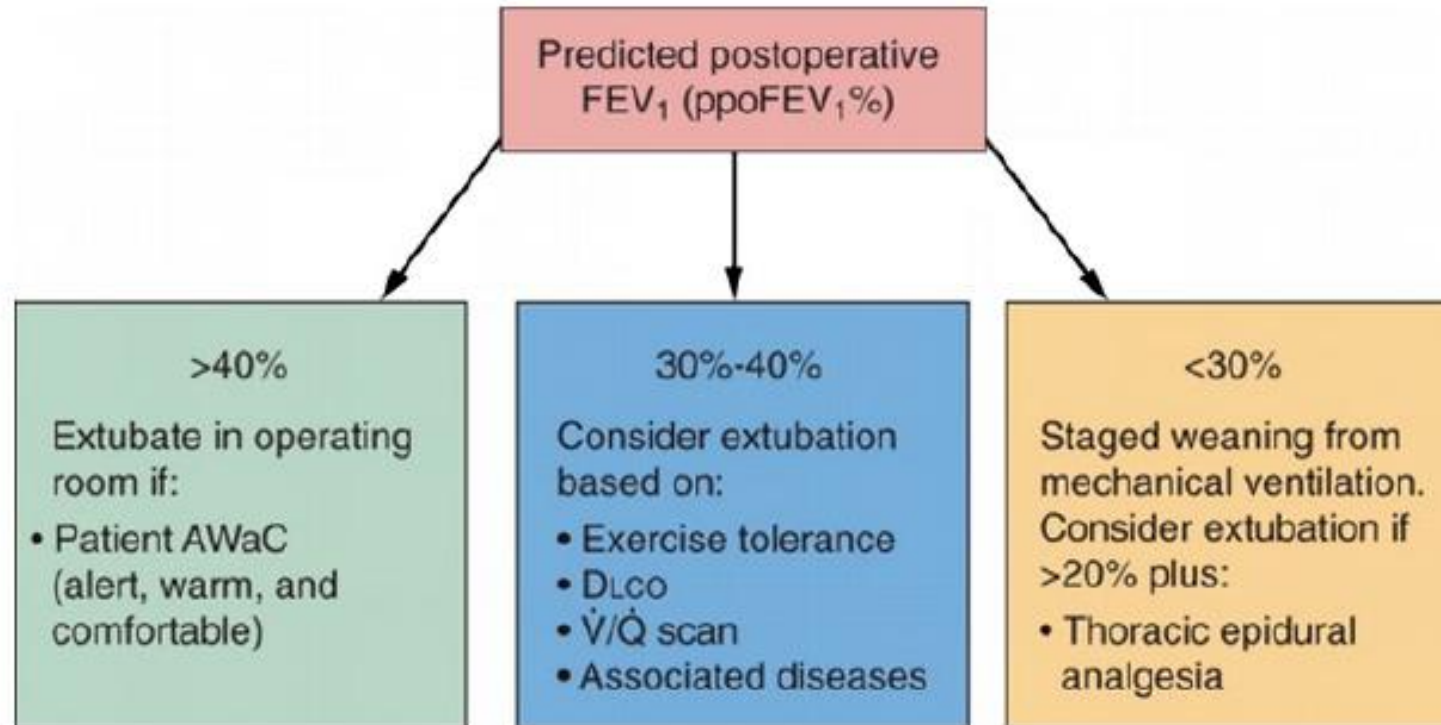
- Many tests of respiratory mechanics and volumes show correlation with post-thoracotomy outcome: FEV1, FVC, maximal voluntary ventilation (MVV), and residual volume/total lung capacity ratio (RV/TLC).
- Rather than absolute values, better correlation with % of predicted corrected for age, sex and height.
- Most valid single test for post-thoracotomy respiratory complications is the predicted postoperative FEV1 (ppoFEV1%)



- The number of subsegments of each lobe are used to calculate the predicted postoperative (ppo) pulmonary function.
- There are 6, 4, and 12 subsegments in the right upper, middle, and lower lobes.
- There are 10 subsegments in both the left upper and lower lobes, for a total of 42 subsegments.

$ppoFEV1\% = \text{preoperative FEV1\%} \times (1 - \% \text{ functional lung tissue removed}/100)$

For eg: Following removal of a functioning right lower lobe, a patient would be expected to lose 12/42 (29%) of their respiratory reserve. If the patient has a preoperative FEV1 (or DLCO) 70% of predicted, the patient would be expected to have a $ppoFEV1 = 70\% \times (1 - 29/100) = 50\%$.

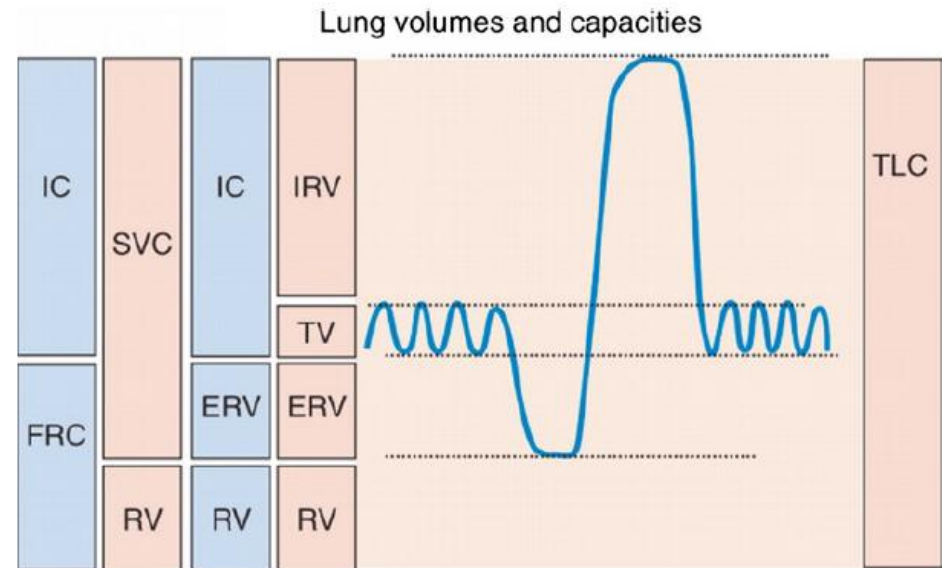


As a guideline : an absolute lower limit of acceptability for resection as a ppoFEV1 <20%.

Patients at increased risk of respiratory complications (ppoFEV1 <40%) should have complete pulmonary function testing including:

- assessment of lung volumes,
- airway resistance.

Complete pulmonary function testing will provide data on lung volumes and capacities to differentiate obstructive from restrictive diseases.

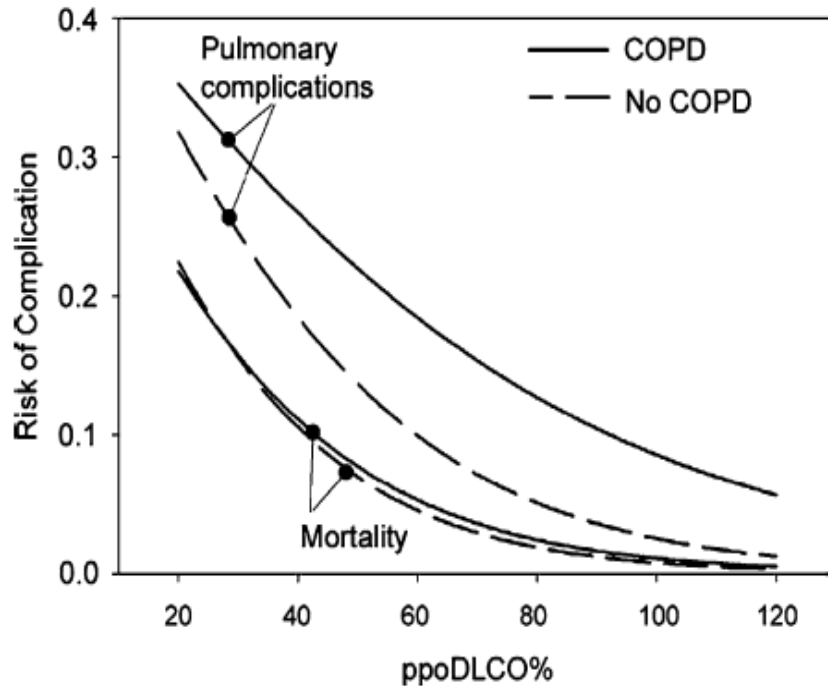


Lung parenchymal function

- Ability of lung to exchange O₂ and CO₂ between pulmonary vascular bed & alveoli.
- Most useful test is DLCO (Diffusing Capacity for Carbon Monoxide)
- Not only reflects diffusion, but actually corelates with the total functioning surface area of alveolar capillary interface.

DLCO

- Useful predictor of post-thoracotomy pulmonary complications, morbidity and death.
- ppoDLCO < 40% predicted correlates with both increased respiratory and cardiac complications and is independent of the FEV1.
- ppoDLCO < 30% implies very high risk for perioperative mortality
- Based on calculation of no of functioning subsegments of lung removed:
 - $ppoDLCO = \text{preDLCO} \times (19 - \text{segs to be removed}) / 19$
 - If any segments obstructed use :
 - $ppoDLCO = \text{preDLCO} \times (19 - a) - b / 19 - a$
 - a = no of obstructed segments
 - b = no of unobstructed segments to be resected
 - Segments as follows:
 - RUL 3, RML 2, RLL 5, LUL 3, Ling 2, LLL 4
 - Always express as % of predicted



- Both morbidity and mortality increase sharply when the ppo DLCO falls below a threshold value of 40%
- Importantly : Lung diffusion for carbon monoxide assessed after neoadjuvant chemotherapy is probably the most sensitive risk indicator of respiratory complications after surgery.

Quantitative Perfusion Scan

- Assessment of preop contribution of lung/lobe to be resected.
- Calculation of predicted postop pulmonary function depending on percent of functional lung to be resected.
- **More useful if region to be resected is contributing minimally to the lung function**
- Especially in pneumonectomy and if ppoFEV1 < 40%

Cardiopulmonary interaction

- Most important to assess cardiopulmonary reserves and aerobic capacity.
- Capable of uncovering severe pathophysiologic abnormalities in the oxygen transport system.
- Basic like Stair climbing, Shuttle walk test, 6MWT, Exercise oxygen desaturation.
- Formal Cardiopulmonary Exercise Testing (CPET) with measurement of $VO_2\text{max}$

6 min walk test

- Good predictor of surgical risk in lung cancer surgery.
- Good correlation with VO₂max.
- Simple, minimal equipment.
- Better reflects activities of daily living than other walk tests

6 Min walk test

- Walk as far as you can during 6 mins.
- Self paced.
- Healthy range 400 to 700 m
- 6 MWT distance < 2000 feet(600m) approx. correlates with VO₂max <15ml/kg/m.
- Holden et al : 6MWD > 1000 feet was predictive of survival with NPV 100% and PPV 85%.
- Walk < 500 feet (150 mtrs) very high risk.
- Useful indicator of functional capacity

Stair Climbing

- In a prospective series of 640 lobectomy and pneumonectomy candidates, attainment of a lower altitude (less than 12 meters) on a symptom-limited stair climbing test was associated with increased cardiopulmonary complications, mortality, and cost, compared with climbing to a higher altitude (22 meters).
- The American College of Chest Physicians (ACCP) uses a cutoff of 22 m on the stair climbing test.
- Patients whose exercise ability falls below the designated cutoff are at increased risk for perioperative mortality and cardiopulmonary complications, and are recommended for formal cardiopulmonary exercise testing with measurement of maximal oxygen consumption (VO₂ max).

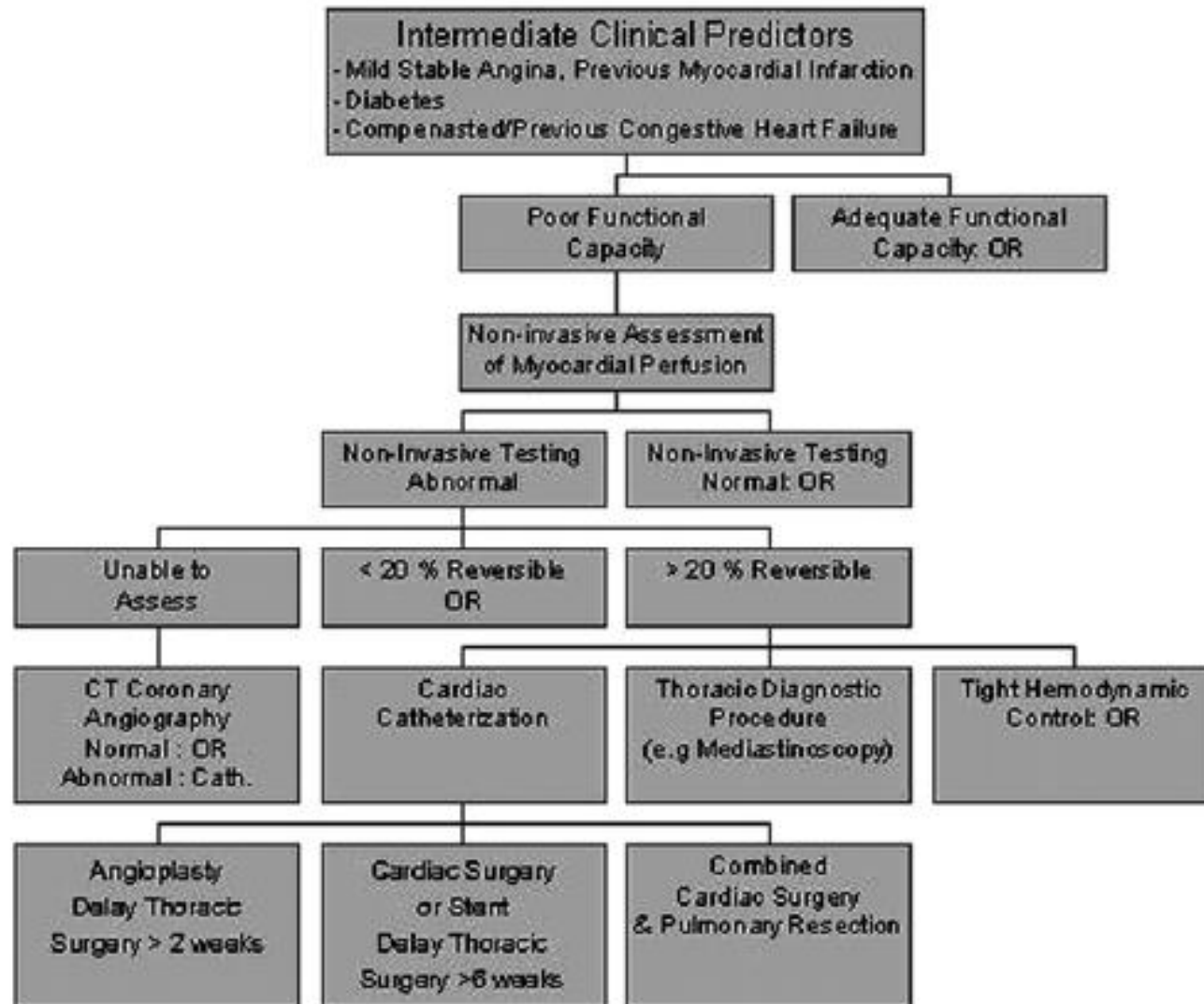
Incremental shuttle walk test

- The incremental shuttle walk test (ISWT) is a 12 level test in which the subject walks at a progressively increasing speed for 12 minutes over a course, in which each 10 meter trip between cones is a "shuttle."
- An ISWT distance greater than **400 meters** has been associated with a maximum oxygen uptake (**VO₂max**) **≥15 mL/kg per minute**.
- The European Respiratory Society (ERS) guidelines note that the ISWT distance underestimates exercise capacity at the lower range and suggests a **cutoff of 40 shuttles (400 m)**
- Patients whose ISWT distance falls below this cutoff are at increased risk for perioperative mortality and cardiopulmonary complications, and it is suggested that they undergo formal cardiopulmonary exercise testing with measurement of VO₂ max.

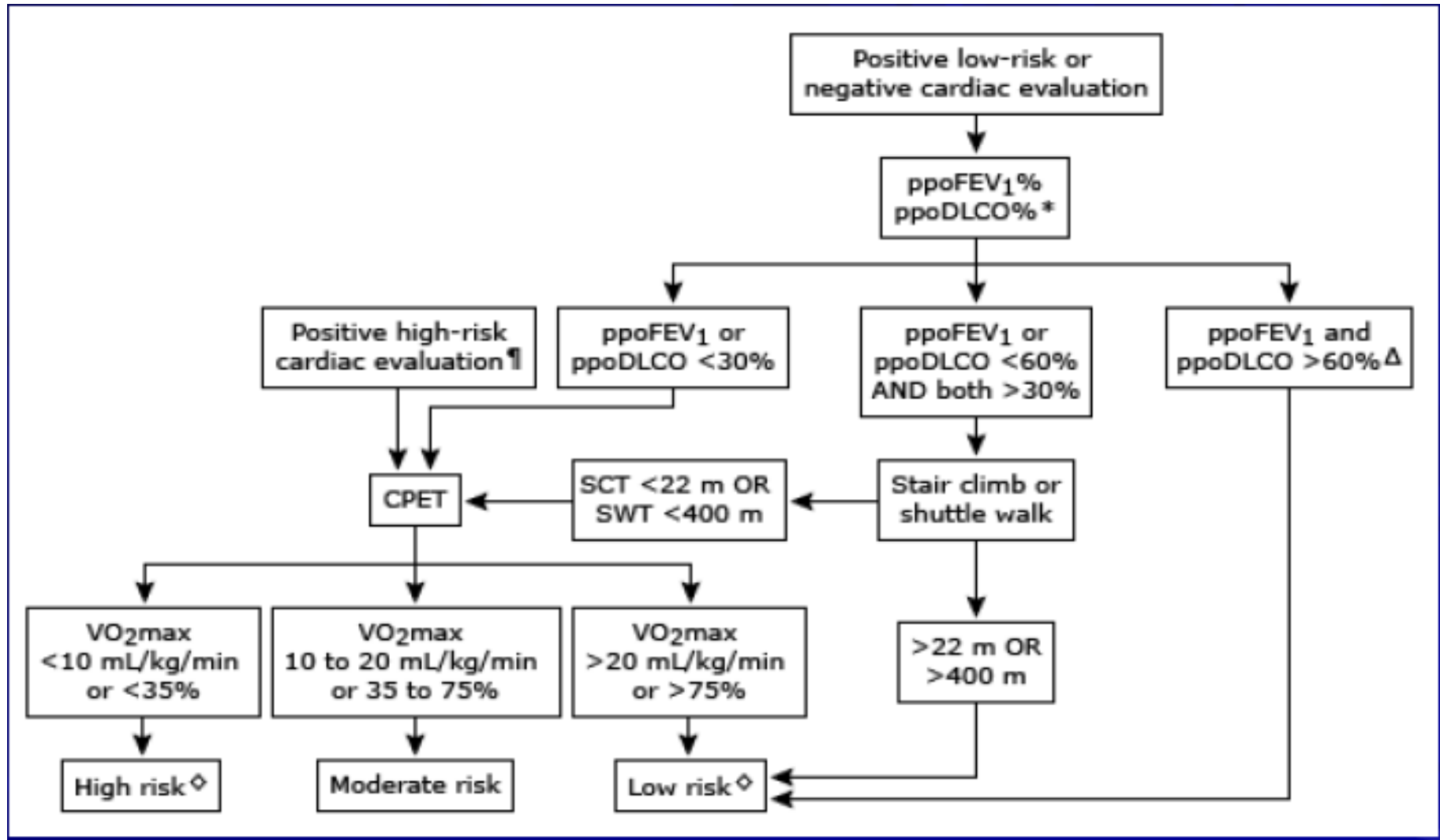
- Cardiopulmonary exercise testing (CPET) is useful when the results of PPO FEV1, PPO DLCO, and/or low technology exercise testing do not clearly define the patient's risk as either high or low.
- Patients who can achieve a **VO2 max >20 mL/kg** per minute are likely to have an acceptable rate of postoperative complications, whereas those with a value **<10 mL/kg per min (or less than 35 percent predicted)** are probably best managed by nonsurgical modalities.
- For those with VO2 max values in between 10 and 20 mL/kg per minute, the PPO VO2 max is calculated.
- **If the PPO VO2 max is <10 mL/kg per min or <35 percent, surgical candidacy is poor and non-resectional options should be sought.**
- **On the other hand, if the PPO VO2 max is ≥10 mL/kg per min or ≥35 percent, resection is not absolutely contraindicated, but the patient must understand the higher risk if either the PPO FEV1 or DLCO is <30 percent predicted.**



Cardiac Risk Assessment for Pulmonary Resection



Algorithm for pulmonary preoperative assessment of patients requiring lung resection



Take home messages

- Given the poor prognosis for patients with lung cancer that is not treated surgically, every effort should be made to identify those patients who will tolerate resection.
- Given the high prevalence of chronic obstructive pulmonary disease (COPD) among patients with lung cancer, screening spirometry and diffusing capacity for carbon monoxide (DLCO) should be obtained in all patients prior to lung resection.
- Preoperative values of forced expiratory volume in one second (**FEV1**) **>2 L (or >80 percent predicted)** and **DLCO >80 percent** predicted suggest that the patient should be able to tolerate surgery including pneumonectomy.

- For patients with preoperative **FEV1 <2 L (or <80 percent predicted) or DLCO <80 percent predicted**, the predicted **postoperative (PPO) FEV1 and DLCO** should be calculated.
- ✓ Both PPO FEV1 and PPO DLCO >60 percent predicted : **low risk** and acceptable for surgical resection.
- ✓ Either PPO FEV1 or PPO DLCO <60 percent predicted, but both >30 percent predicted: **a low technology exercise test** (either stair climb or a shuttle walk test) should be performed.
- ✓ If the patient fails to meet cutoffs for the stair climb or shuttle walk test or if either the PPO FEV1 or PPO DLCO is <30 percent: **a formal cardiopulmonary exercise test** is indicated with measurement of maximal oxygen consumption (VO₂ max).

Thank You

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