
Physiology of Lung Resection
No Rules, Just . . . Rx

Attempting to clarify what makes a lung cancer patient a high risk for resectional surgery has been a fruitful area of investigation and debate for over 40 years. Recently, the prediction of postoperative maximum oxygen consumption (VO₂max) by Bolligier and associates,1 confirming the previous work of Corris and colleagues,2 has narrowed the focus considerably. The report of Nezu and coworkers in this issue of CHEST (see page 1511) nicely confirms the effects of standard lobectomy and pneumonectomy on the cardiopulmonary function of relatively healthy lung cancer patients. Of particular interest is the small 13.3% reduction in VO₂max secondary to lobectomy and the larger 28.1% decrement due to pneumonectomy. These results again suggest a significant contribution of lung function to exercise VO₂max. However, these workers also found a 17% decrease in stroke volume, a 22% reduction in cardiac output, and a 65% increase in pulmonary vascular resistance in a small, 10-patient subgroup that was studied hemodynamically. This leaves some unanswered questions as to just what the links in the chain of events are that lead to the reduction in VO₂max secondary to lung resection.

So where are we in predicting just who should and shouldn’t have lung resection for their cancer? In an attempt to answer this question, I entered into my handy-dandy computer statistics program the individual patient data points from 10 studies dating from 19841,3-11 that used quantitative lung scanning and/or exercise testing in preoperative evaluation. I then posed the question: “Please compare the predicted postoperative (ppo) FEV₁ and the exercise VO₂ data in the identification of those patients who failed to survive standard lung resection.” Figure 1 constitutes the answer I obtained... a mess! Granted, this was not a pristine meta-analysis or even a “quasi-semi” facsimile of a meta-analysis. Nevertheless, it doesn’t take a rocket scientist to see that there is no clear distinction between the results of these tests of survivors compared with nonsurvivors.

What do I suggest? More studies? Of course. In the meantime, with extremely sophisticated surgical and physiologic testing techniques generally available, each practitioner must assess their institution’s capabilities and forge ahead. For example, quantitative radionuclide scanning (or segment counting) is generally available to predict/estimate postoperative function. Cycle or treadmill ergometric assessment of exercise VO₂ (or assessment using level walking vs stair climbing distance tests) is possible. Some institutions have staff expert in video-assisted thoracoscopic surgery. Some can offer sophisticated pulmonary rehabilitation followed by lung volume reduction surgery and cancer resection combined.12 Others may have superb external beam radiotherapy13 or state-of-the-art chemotherapy protocols. In short, my opinion is that the old rules of inoperability (eg, MVV <50% predicted, FEV₁ <2.0 L, PaCO₂ >45 mm Hg, DCO <50% predicted, FEV₁<ppo <0.8 L, FEV₁<ppo <40% predicted, etc) etc) may no longer be valid. In other words, do what you and your center do best... but treat the patient.

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REFERENCES
1 Bolligier CT, Wyser C, Roser H, et al. Lung scanning and exercise testing for the prediction of postoperative perfor-

Figure 1. Plot of data from ten selected studies1,3-11 using lung scan prediction of ppo FEV₁ vs exercise VO₂.


for revision. The major advances in this scheme have been the inclusion of linear or “irregular” opacities to describe the interstitial fibrosis (IF) of asbestosis, increasing attention to pleural fibrosis (characterized as “thickening” and seen predominantly in asbestos-exposed persons), and refinement of the quantitative scale for profusion (number) of opacities from 4 points to 12.

A number of investigations in the last decade using the varied disciplines of high resolution computerized tomography (HRCT), pulmonary physiology, and analysis of mortality have provided new perspectives on the correlation of the ILO readings (most importantly, the profusion score for irregular opacities, hereafter called “score”) with other measures of the impact of asbestos-related pleuropulmonary fibrosis on the lung and on the patient. The study by Okas and colleagues in this issue of CHEST (see page 1517) provides an opportunity to evaluate this information.

Since 1990, successive revisions have altered the standardized scheme for interpreting chest films for pneumoconioses. Several basic investigations correlated workplace dust exposure, lung dust burden, and/or tissue response with the profusion score then in use, generally the 4-point score. The assumption was that “the more fibrosis present, the more retained dust” in the lung. These investigations were directed at coal workers’ pneumoconiosis (reviewed by Fernie and Buckley4 and Valleyathan and colleagues5) and to a lesser extent, at silicosis6-8 and asbestosis.9,10 Indeed, asbestosis is different from the nodular pneumoconioses in its less consistent relationship of dust burden to histologic severity, and in the greater impact of its “irregular” IF on lung function. That radiographic abnormality carries with it a far greater effect on lung function in asbestosis than in the nodular pneumoconioses was recognized early in the history of asbestosis.9,10

In coal workers’ pneumoconiosis and silicosis, the amount of dust and the severity of histologic fibrosis parallel each other.11,12 In addition, investigations have demonstrated consistent correlations between mineral content on the one hand,12 and the number and character of dust foci and fibrotic lesions on the other,13 with radiographic score. Eighty-five percent of the lungs in radiographic category 1 (scores 0/0, 1/1, and 1/2) showed only sparse dust foci unassociated with fibrosis.13

Prevalence of radiographic asbestosis (defined as scores ≥1/0) is proportionate to cumulative exposure to asbestos, the slope of the relationship varying from industry to industry.14 In general, the severity of histologic IF is related to the fiber burden in the lung.15-18 Kipen and colleagues,10 in a 1987 study of heavily exposed insulators with lung cancer, noted

Sherlock Holmes, Albrecht Dürer, and Socrates

The International Labour Office Radiographic Classification of Pneumoconioses Reassessed for Asbestosis

It has been stated that “The interpretation of films for pneumoconiosis requires profound knowledge and perspicacity and that the ideal interpreter is a happy blend of Sherlock Holmes, Albrecht Dürer and Socrates.”1 This trio’s knowledge and perspicacity would certainly be applicable to the standard tool for interpreting chest films for pneumoconioses, the International Labour Office (ILO) Classification of Pneumoconioses, last revised in 19802 and overdue

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