Exercise testing as a predictor of surgical risk after pneumonectomy for bronchogenic carcinoma

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Summary The aim of the present investigation was to evaluate the predictive value of a symptom-limited exercise test in predicting postoperative morbidity and mortality in patients submitted to pneumonectomy.

The study was conducted in 150 patients (mean age, 57.1). Forty-four patients (29.3%) had postoperative complications. Four patients (2.7%) died within one month of the pneumonectomy. Patients with complications had significantly lower VO2 max.

The incidence of complications in relation to the amount of oxygen consumption showed that with the progressive decrease of oxygen consumption there was a progressive increase in frequency of complications. In particular patients with VO2 max <50% of predicted should be considered at high risk of morbidity and mortality from cardiopulmonary causes.

This predictive capacity of VO2 max was more evident in patients with a preoperative FEV1 less than 70% of predicted. The present data support the suggestion that exercise testing could be a useful adjunct in the evaluation of postoperative risk for pneumonectomy, especially in patients with obstructive pulmonary disease.

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KEYWORDS Bronchogenic carcinoma; Exercise test; Postsurgical complications

Introduction Many studies have evaluated criteria for predicting postoperative mortality and cardiopulmonary complications after lung resection: they include spirometry, determination of lung diffusing capacity for CO, arterial blood gas measurement and radionuclide lung scanning.1 There has been debate about the clinical significance of exercise testing in preoperative evaluation of patients candidate to lung resection, and conflicting results have been reported in the literature concerning the usefulness of symptom-limited exercise testing. Moreover, different exercise parameters and different recommendations were given in different studies.1

The aim of the present investigation was to study the value of a symptom-limited exercise test in predicting postoperative morbidity and mortality in patients with non-metastatic bronchogenic carcinoma scheduled for pneumonectomy.

Patients and methods We studied 150 patients who underwent elective pneumonectomy for bronchogenic carcinoma from 1992 to 2000. There were 141 males and 9 females. The mean age was 57.1 years (range 33–79). Seven patients (4.6%) were more than 70 years old, and 95% were smokers (mean pack year, 28).

Thirty patients (20%) had cardiovascular disease: hypertension (67%), arrhythmia (17%), ischemic heart disease (20%). Thirty-six patients (17.5%) had a previously diagnosed respiratory disease

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were not significantly associated with the development of pulmonary complications.

Patients without complications showed a significantly higher $\text{VO}_{2\text{max}}$ (ml kg$^{-1}$ min$^{-1}$ % pred.) $(75.6\% \pm 1.3$ vs. $71\% \pm 1.8$, $P<0.05$) than observed in patients with complications. This predictive capacity of $\text{VO}_{2\text{max}}$ (ml kg$^{-1}$ min$^{-1}$ % pred.) was more evident when we compared non-complicated with complicated patients but with a preoperative FEV$_1$ less than 70% of predicted (non-complicated $73.5\% \pm 2.1$ vs. complicated $59\% \pm 4.9$, $P<0.005$).

Finally, the incidence of complications in relation to the amount of oxygen consumption was evaluated. As shown in Table 1, with the progressive decrease of oxygen consumption there was a progressive increase in frequency of complications. Three of the 4 patients who died had a $\text{VO}_{2\text{max}}$ (ml kg$^{-1}$ min$^{-1}$) $<50\%$ of predicted.

Discussion

Most complications and deaths after pneumonectomy are cardiopulmonary. The possibility to better identify patients at risk of complications is therefore very useful. Many variables have been used to assess the risk of postoperative complications: spirometry and radionuclide scans (which are considered to accurately estimate postoperative pulmonary function) lack adequate sensitivity or specificity for cardiopulmonary postoperative complications. In fact, in our study, it was confirmed that spirometric results and predicted postpneumonectomy variables, in particular ppoFEV$_1$, are not useful for the prediction of postoperative complications.

There has been debate about the clinical significance of exercise testing in preoperative evaluation, and conflicting results have been

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<th>$\text{VO}_{2\text{max}}$ (ml kg$^{-1}$ min$^{-1}$ % pred)</th>
<th>All:150 c/no. (%)</th>
<th>FEV$_1$ &gt;70:114 c/no. (%)</th>
<th>FEV$_1$ &lt;70:36 c/no. (%)</th>
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reported in the literature about the applicability of a symptom-limited exercise. According to some authors, the exercise test is a good predictor of postoperative complication, but according to others it is not.1,3–6

The present study confirmed that VO2max (l min⁻¹ or ml kg⁻¹ min⁻¹), expressed as a percentage of the predicted, discriminated between patients suffering from complications and those who did not, particularly when a chronic obstructive pulmonary disease (FEV₁ less than 70% of predicted) occurred. We found that a VO2max (l min⁻¹ or ml kg⁻¹ min⁻¹) < 50% of predicted is associated with a very high risk of complications after pneumonectomy. In the present study, VO2max measured in ml kg⁻¹ min⁻¹ and expressed as percentage of predicted seems to be a better single indicator of complications after lung resection than VO2max measured in l min⁻¹ and expressed as percentage of predicted.

Unfortunately, it was not possible to identify a clear cutoff limit that separated all the dying patients from the survivors. In fact, three of the four patients who died had a VO2max (ml kg⁻¹ min⁻¹) less than 50% of predicted (sensitivity 75%), and 137 of the 146 patients still alive were above this limit (93.8% specificity). Similarly, 3 of the 4 patients who died had a VO2max (l min⁻¹) less the 50% of predicted (75% sensitivity), and 116 of 146 were above this limit (79.5% specificity). This result is in agreement with studies previously reported in the literature.6

In conclusion, cardiopulmonary exercise testing which evaluates the integrated performance of the respiratory and the cardiovascular system can be useful to evaluate the risk of postoperative complications since exercise induces or amplifies abnormalities not readily evident at rest. We therefore recommend routine exercise testing for the evaluation of patients candidate to pneumonectomy, particularly when FEV₁ is less than 70% of predicted, since the information obtained by the test gives the clinician additional useful data on which to base a clinical decision.

References