Effect of Steady State Exercise on Right and Left Ventricular Performance in Chronic Obstructive Pulmonary Disease*

Noninvasive Assessment by Radionuclide Angiography


Right and left ventricular response to exercise in patients with chronic obstructive pulmonary disease (COPD) remains to be defined fully. Consequently, exercise cardiac performance was evaluated in 24 patients with COPD and the results compared to data obtained in 20 normal control subjects.

In patients with COPD, forced expiratory volume in one-second (FEV1) averaged (±SEM) 51±5 percent predicted. Right ventricular (RV) and left ventricular (LV) ejection fractions (EF) were determined noninvasively by first-pass radionuclide angiography at rest and during exercise using a computerized multocrystal scintillation camera and intravenous injections of 99m technetium.1,2 The normal cardiac response to exercise in controls was an absolute increase of ≥ 5 percent in RV EFE and LVEF.3,4 In patients with COPD, cardiac performance was measured during relatively steady state upright bicycle exercise at approximately 50 percent maximal workload (range, 25 to 75 watts).

In patients with COPD, RV EFE was abnormal at rest (<45 percent) in 8/24 patients. Mean RV EFE at rest and exercise was not different (rest, 48±1 percent; exercise 45±2 percent, P-NS). In contrast, LVEF rose from 62±3 percent to 68±3 percent (P<.05). An abnormal RV response to exercise occurred in 20/24 patients, including 12 with normal resting LVEF and all eight with an abnormal resting LVEF. Furthermore, LVEF fell by at least 5 percent with exercise in seven of these 20 patients.

Mean arterial oxygen saturation did not change significantly with exercise. FEV1 was significantly lower in patients with an abnormal RV response to exercise than in those with normal response (49±5 vs 68±5 percent predicted, P<.05); a similar but not significant difference was demonstrated for resting arterial oxygen tension (65±3 vs 76±5 mm Hg, P NS). Seven patients had an abnormal LV response to exercise, which was unrelated to severity of COPD and probably was due to latent coronary artery disease.

RV dysfunction in COPD may not be present in the resting state, but may become manifest only under physiologic stress such as mild upright exercise. Abnormal exercise RV reserve in COPD occurs most frequently in patients with high degrees of resting obstructive ventilatory impairment.

REFERENCES


Q. (Woolcock): Did you give your patients oxygen?
A. (Matthay): We are planning to do this. It is obviously very important.

Q. (Edelman): Are your data explained by changes in afterload?
A. (Matthay): At this point I cannot answer this question for certain, although afterload augmentation by one of several potential mechanisms likely played a significant role in the observed abnormal RV exercise responses in patients with COPD.

Q. (Permutt): I think it is a beautiful piece of work—good correlation with mechanical factors. Is lung hyperinflation increased during exercise?
A. (Matthay): Although we did not address this in our exercising patients, we think it likely that lung hyperinflation increases with exercise, causing an increase in RV afterload.

CHRONIC OBSTRUCTIVE LUNG DISEASE 303

*From Yale University School of Medicine, New Haven. Supported in part by NIH Grant No. HL-21690-02.

CHEST, 77: 2, FEBRUARY, 1980 SUPPLEMENT